Solutions of Triangle Location Construction Problems
Part II - Connelly's corpus

Generated automatically by ArgoTriCS
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Contents

Problem 561

Generated automatically by ArgoTriCS
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1 Problem

Problem 561: Given a point A, a point B and a point E_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
3. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
4. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
5. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
6. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
7. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
8. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
9. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; line c and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines h_c and b are not the same; points H_b and A are not the same; points H and H_b must be different; points H_c and H are not the same; points A and H_c must be different; points B and H are not the same; points A and B are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D3,D6,D7,D9,GD01,GD02,GL03,L3,L46,L47,L48]

Solving time: 11.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point B 20 40
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_t A
cmark_b B
cmark_r E_{a}
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G13260} which is a foot of the point E_{a} on the line c
foot P_{\_G13260} E_{a} c
cmark_r P_{\_G13260}
color 200 200 200
drawline E_{a} P_{\_G13260}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    13260}
sim H_{c} P_{\_G13260} A
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G13498} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G13498} E_{a} h_{b}
cmark_r P_{\_G13498}
color 200 200 200
drawline E_{a} P_{\_G13498}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    13498}
sim H_{b} P_{\_G13498} H
cmark_l H_{b}


% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0
```

```
% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; line c and circle k(E_{a},A) intersect; points A and E_{a} are not the same
% Determination conditions: lines h_{c} and b are not the same; points H_{b} and A are not the same
    ; points H and H_{b} must be different; points H_{c} and H are not the same; points A and H_{c}
     must be different; points B and H are not the same; points A and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_cH_bA} \neq S_{HH_bA}$ i.e., lines H_cH and H_bA are not parallel (construction based assumption)

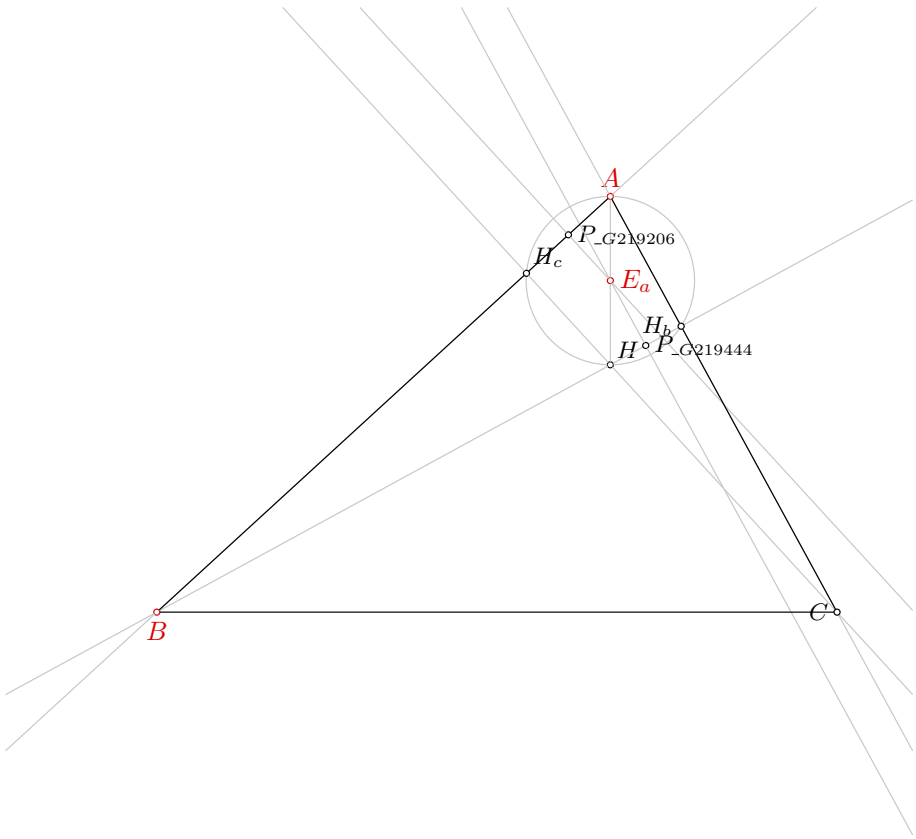

Figure 1: Illustration of the problem 0561

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a} BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving B=B

NDG conditions are:
$S_{H_cH_bA} \neq S_{HH_bA}$ i.e., lines H_cH and H_bA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a} BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.3 Proving E_a=$\_E_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving E_a=$\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 21 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving $E_a = \_E_a$

Proving failed

Problem 562

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 562: Given a point A, a point B and a point E_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point B, construct a point M_c (rule W01); ;
2. Using the point B and the point E_b, construct a point H (rule W01); ;
3. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
4. Using the point B and the point E_b, construct a line h_b (rule W02); % DET: points B and E_b are not the same;
5. Using the point A and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points A and M_c are not the same;
6. Using the circle $k(M_c, A)$, the line h_a, the point M_c and the point A, construct a point H_a (rule W05); % NDG: line h_a and circle $k(M_c, A)$ intersect % DET: points A and H_a must be different;
7. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
8. Using the circle $k(M_c, A)$, the line h_b, the point M_c and the point B, construct a point H_b (rule W05); % NDG: line h_b and circle $k(M_c, A)$ intersect % DET: points B and H_b must be different;
9. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
10. Using the line a and the line b, construct a point C (rule W03); % NDG: lines a and b are not parallel % DET: lines a and b are not the same.

Non-degenerate conditions: lines a and b are not parallel; line h_b and circle $k(M_c, A)$ intersect; line h_a and circle $k(M_c, A)$ intersect; points A and M_c are not the same.

Determination conditions: lines a and b are not the same; points H_b and A are not the same; points B and H_b must be different; points H_a and B are not the same; points A and H_a must be different; points B and E_b are not the same; points A and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D20,D29,D3,D5,D6,D8,D9,GD01,GD02,GL03,GL09,L40,L41,L42]

Solving time: 10.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point B 20 40
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_t A
cmark_b B
cmark_r E_{b}
color 0 0 0
fontsize 8


% Constructing a point M_{c} such that AM_{c}/AB=0.5
towards M_{c} A B 0.5
cmark_lt M_{c}
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% DET: points B and E_{b} are not the same
% Constructing a line h_{b} which passes through point B and point E_{b}
line h_{b} B E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points A and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point A
circle k(M_{c},A) M_{c} A

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: line h_{a} and circle k(M_{c},A) intersect% DET: points A and H_{a} must be different
% Constructing a point P_{\_G33470} which is a foot of the point M_{c} on the line h_{a}
foot P_{\_G33470} M_{c} h_{a}
cmark_r P_{\_G33470}
color 200 200 200
drawline M_{c} P_{\_G33470}
color 0 0 0

% Constructing a point H_{a} which is an image of the point A in the symmetry to point/line P_{\_G
    33470}
sim H_{a} P_{\_G33470} A
cmark_r H_{a}


% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: line h_{b} and circle k(M_{c},A) intersect% DET: points B and H_{b} must be different
% Constructing a point P_{\_G33708} which is a foot of the point M_{c} on the line h_{b}
foot P_{\_G33708} M_{c} h_{b}
cmark_r P_{\_G33708}
color 200 200 200
drawline M_{c} P_{\_G33708}
color 0 0 0

% Constructing a point H_{b} which is an image of the point B in the symmetry to point/line P_{\_G
    33708}
sim H_{b} P_{\_G33708} B
cmark_l H_{b}
```

```
% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: lines a and b are not parallel% DET: lines a and b are not the same
% Constructing a point C which belongs to line a and line b
intersec C a b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and b are not parallel; line h_{b} and circle k(M_{c},A)
    intersect; line h_{a} and circle k(M_{c},A) intersect; points A and M_{c} are not the same
% Determination conditions: lines a and b are not the same; points H_{b} and A are not the same;
    points B and H_{b} must be different; points H_{a} and B are not the same; points A and H_{a}
    must be different; points B and E_{b} are not the same; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

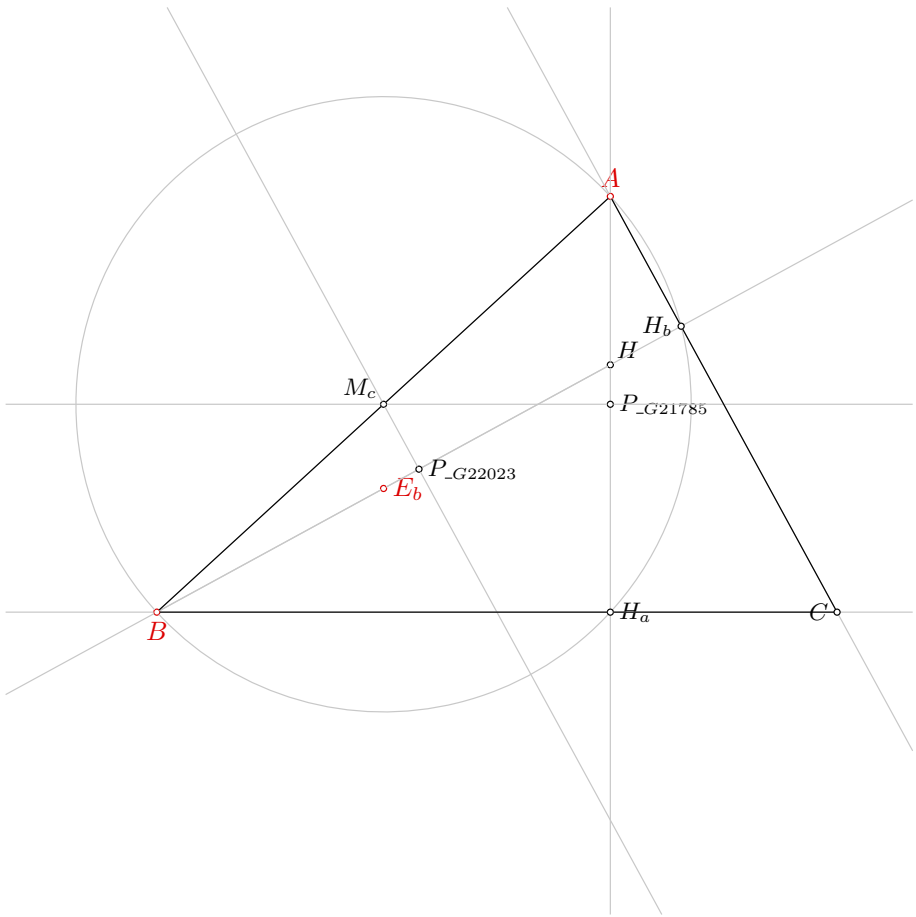

Figure 1: Illustration of the problem 0562

4.1.3 Proving E_b=$\_E_b$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_aH_bA} \neq S_{BH_bA}$ i.e., lines H_aB and H_bA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving B=B

NDG conditions are:

$S_{H_aH_bA} \neq S_{BH_bA}$ i.e., lines H_aB and H_bA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.3 Proving E_b=$\_E_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving E_b=$\_E_b$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving $E_b{=}\_E_b$

Proving failed

Problem 563

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 563: Given a point A, a point B and a point E_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point B, construct a point M_c (rule W01); ;
2. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
3. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
4. Using the point E_c and the line c, construct a line h_c (rule W10b); ;
5. Using the line h_c and the line c, construct a point H_c (rule W03); % NDG: lines h_c and c are not parallel % DET: lines h_c and c are not the same;
6. Using the point A and the point H_c, construct a line $m(AH_c)$ (rule W14); % DET: points A and H_c are not the same;
7. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;
8. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;
9. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
10. Using the circle $k(N, M_a)$ and the line $m(AH_c)$, construct a point M_b and a point E_a (rule W04); % NDG: line $m(AH_c)$ and circle $k(N, M_a)$ intersect;

11. Using the point M_b and the point A, construct a point C (rule W01); .

Non-degenerate conditions: line $m(AH_c)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel; lines h_c and c are not parallel.

Determination conditions: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points A and H_c are not the same; lines h_c and c are not the same; points E_c and M_c are not the same; points A and B are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14]

Lemmas used: [D10,D20,D22,D30,D32,D7,GD01,GD02,GL01,GL03,GL04,GL09,L17,L18,L19,L20,L22,L24,L3,I

Solving time: 2.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point B 20 40
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_t A
cmark_b B
cmark_r E_{c}
color 0 0 0
fontsize 8


% Constructing a point M_{c} such that AM_{c}/AB=0.5
towards M_{c} A B 0.5
cmark_lt M_{c}
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
```

```
color 0 0 0



% Constructing a line h_{c} which is perpendicular to line c and which passes through point E_{c}
perp h_{c} E_{c} c

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines h_{c} and c are not parallel% DET: lines h_{c} and c are not the same
% Constructing a point H_{c} which belongs to line h_{c} and line c
intersec H_{c} h_{c} c
cmark_rt H_{c}


% DET: points A and H_{c} are not the same
% Constructing bisector m(AH_{c}) of the segment AH_{c}
med m(AH_{c}) A H_{c}

color 200 200 200
drawline m(AH_{c})
color 0 0 0

color 200 200 200
drawsegment A H_{c}
color 0 0 0


% DET: points E_{c} and M_{c} are not the same
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0


% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(AH_{c}) and circle k(N,M_{a}) intersect
% Constructing points M_{b} and E_{a} which are in intersection of k(N,M_{a}) and m(AH_{c})
intersec2 M_{b} E_{a} k(N,M_{a}) m(AH_{c})
cmark_lt M_{b}
cmark_r E_{a}



% Constructing a point C such that M_{b}C/M_{b}A=-1
towards C M_{b} A -1
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(AH_{c}) and circle k(N,M_{a}) intersect; points E_{c} and N are
     not the same; lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel; lines h_{c} and c are
    not parallel
% Determination conditions: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and M_{c} are not the same; points A and H_{c} are not the same; lines h_{c} and c are not the
    same; points E_{c} and M_{c} are not the same; points A and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving B=B

Status: Theorem has been proved.

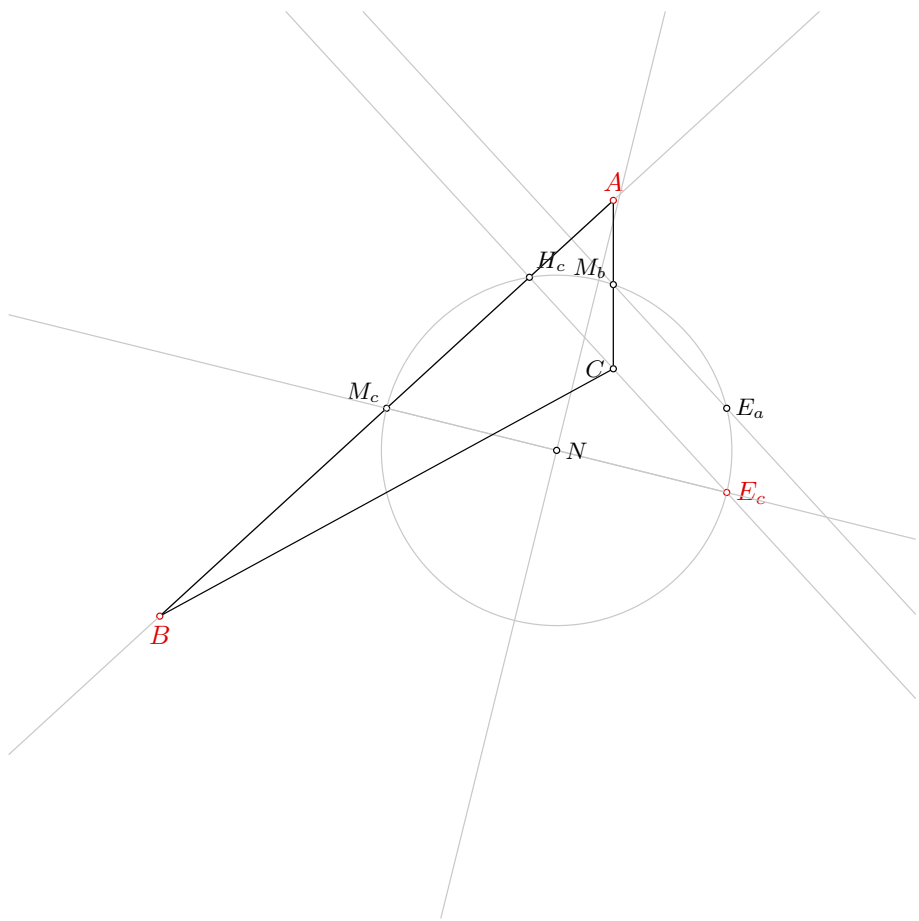

Figure 1: Illustration of the problem 0563

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.025 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_c=_E_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 36 terms.

Time Complexity: Time spent by the prover is 0.657 seconds.

NDG conditions Points E_c and M_c are not identical

Line through points A and H_c is not perpendicular to line through points H_c and B

Points A and B are not identical

Points B, C and M_c are not collinear

Line through points C and B is not perpendicular to line through points B and A

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{E_cAB} \neq 0$ i.e., points E_c, A and B are not collinear (foot is not the point itself; construction based assumption)

$S_{E_cAB} \neq S_{F^0_{h_c}AB}$ i.e., lines $E_cF^0_{h_c}$ and AB are not parallel (construction based assumption)

$S_{M^3_{m(E_cM_c)}E_cM_c} \neq S_{T^4_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^3_{m(E_cM_c)}T^4_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving B=B

NDG conditions are:

$S_{E_cAB} \neq 0$ i.e., points E_c, A and B are not collinear (foot is not the point itself; construction based assumption)

$S_{E_cAB} \neq S_{F^0_{h_c}AB}$ i.e., lines $E_cF^0_{h_c}$ and AB are not parallel (construction based assumption)

$S_{M^3_{m(E_cM_c)}E_cM_c} \neq S_{T^4_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^3_{m(E_cM_c)}T^4_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving $E_c{=}\_E_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 58 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving $E_c{=}\_E_c$

Proving failed

Problem 564

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 564: Given a point A, a point B and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point B, construct a point M_c (rule W01); ;
2. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
3. Using the point N and the point M_c, construct a line $m(H_aH_b)$ (rule W02); % DET: points N and M_c are not the same;
4. Using the point A and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points A and M_c are not the same;
5. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
6. Using the circle $k(N, M_a)$, the line c, the point N and the point M_c, construct a point H_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points M_c and H_c must be different;
7. Using the circle $k(N, M_a)$, the line $m(H_aH_b)$, the point N and the point M_c, construct a point E_c (rule W05a); % NDG: line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect % DET: points M_c and E_c must be different;
8. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
9. Using the circle $k(M_c, A)$ and the circle $k(N, M_a)$, construct a point H_b and a point H_a (rule W07); % NDG: circles $k(M_c, A)$ and $k(N, M_a)$ intersect % DET: circles $k(M_c, A)$ and $k(N, M_a)$ are not the same;

10. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;

11. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; circles $k(M_c, A)$ and $k(N, M_a)$ intersect; line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect; line c and circle $k(N, M_a)$ intersect; points M_c and N are not the same; points A and M_c are not the same.

Determination conditions: lines h_c and b are not the same; points A and H_b are not the same; circles $k(M_c, A)$ and $k(N, M_a)$ are not the same; points E_c and H_c are not the same; points M_c and E_c must be different; points M_c and H_c must be different; points N and M_c are not the same; points A and B are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D10,D20,D30,D32,D6,D7,GD01,GD02,GL01,GL09,L18,L19,L20,L21,L24,L3,L41,L42,L53,L54]

Solving time: 4.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point B 20 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_b B
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point M_{c} such that AM_{c}/AB=0.5
towards M_{c} A B 0.5
cmark_lt M_{c}
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0
```

```
% DET: points N and M_{c} are not the same
% Constructing a line m(H_{a}H_{b}) which passes through point N and point M_{c}
line m(H_{a}H_{b}) N M_{c}

color 200 200 200
drawline m(H_{a}H_{b})
color 0 0 0



% NDG: points A and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point A
circle k(M_{c},A) M_{c} A

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line c and circle k(N,M_{a}) intersect% DET: points M_{c} and H_{c} must be different
% Constructing a point P_{\_G84691} which is a foot of the point N on the line c
foot P_{\_G84691} N c
cmark_r P_{\_G84691}
color 200 200 200
drawline N P_{\_G84691}
color 0 0 0

% Constructing a point H_{c} which is an image of the point M_{c} in the symmetry to point/line P
    _{\_G84691}
sim H_{c} P_{\_G84691} M_{c}
cmark_rt H_{c}


% NDG: line m(H_{a}H_{b}) and circle k(N,M_{a}) intersect% DET: points M_{c} and E_{c} must be
    different
% Constructing a point E_{c} which is an image of the point M_{c} in the symmetry to point/line N
sim E_{c} N M_{c}
cmark_r E_{c}


% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}
```

```
color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: circles k(M_{c},A) and k(N,M_{a}) intersect% DET: circles k(M_{c},A) and k(N,M_{a}) are not
    the same
% Constructing points H_{b} and H_{a} which are in intersection of k(M_{c},A) and k(N,M_{a})
intersec2 H_{b} H_{a} k(M_{c},A) k(N,M_{a})
cmark_l H_{b}
cmark_r H_{a}


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; circles k(M_{c},A) and k(N,M_{a})
    intersect; line m(H_{a}H_{b}) and circle k(N,M_{a}) intersect; line c and circle k(N,M_{a})
    intersect; points M_{c} and N are not the same; points A and M_{c} are not the same
% Determination conditions: lines h_{c} and b are not the same; points A and H_{b} are not the same
    ; circles k(M_{c},A) and k(N,M_{a}) are not the same; points E_{c} and H_{c} are not the same;
    points M_{c} and E_{c} must be different; points M_{c} and H_{c} must be different; points N
    and M_{c} are not the same; points A and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

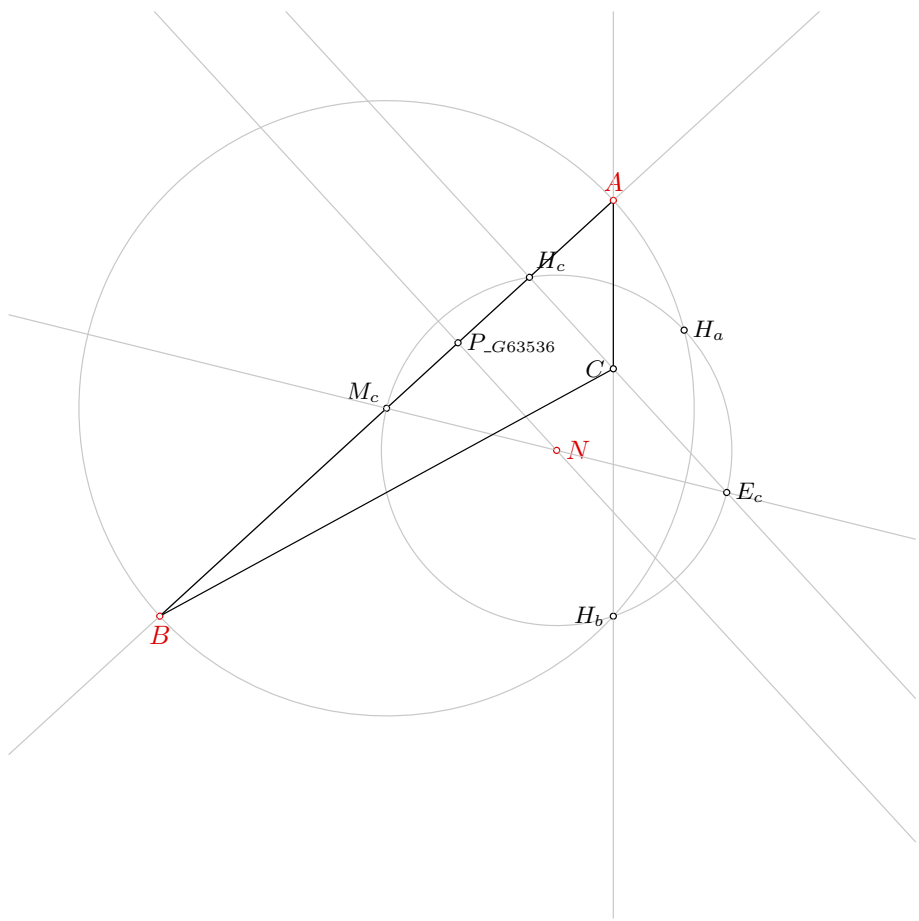

Figure 1: Illustration of the problem 0564

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{E_cAH_b} \neq S_{H_cAH_b}$ i.e., lines E_cH_c and AH_b are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving B=B

NDG conditions are:

$S_{E_cAH_b} \neq S_{H_cAH_b}$ i.e., lines E_cH_c and AH_b are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving $N{=}\_N$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 778 terms.

Time Complexity: Time spent by the prover is 2.110 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 565

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 565: Given a point A, a point C and a point E_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
3. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
4. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
5. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
6. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
7. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H and H_c must be different;
8. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
9. Using the line h_b and the line c, construct a point B (rule W03); % NDG: lines h_b and c are not parallel % DET: lines h_b and c are not the same.

Non-degenerate conditions: lines h_b and c are not parallel; line h_c and circle $k(E_a, A)$ intersect; line b and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines h_b and c are not the same; points H_c and A are not the same; points H and H_c must be different; points H_b and H are not the same; points A and H_b must be different; points C and H are not the same; points A and C are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D3,D6,D7,D9,GD01,GD02,GL03,L3,L46,L47,L48]

Solving time: 11.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point C 110 40
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_t A
cmark_l C
cmark_r E_{a}
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G104880} which is a foot of the point E_{a} on the line b
foot P_{\_G104880} E_{a} b
cmark_r P_{\_G104880}
color 200 200 200
drawline E_{a} P_{\_G104880}
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    104880}
sim H_{b} P_{\_G104880} A
cmark_l H_{b}


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G105118} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G105118} E_{a} h_{c}
cmark_r P_{\_G105118}
color 200 200 200
drawline E_{a} P_{\_G105118}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    105118}
sim H_{c} P_{\_G105118} H
cmark_rt H_{c}


% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0
```

```
% NDG: lines h_{b} and c are not parallel% DET: lines h_{b} and c are not the same
% Constructing a point B which belongs to line h_{b} and line c
intersec B h_{b} c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and c are not parallel; line h_{c} and circle k(E_{a},A)
    intersect; line b and circle k(E_{a},A) intersect; points A and E_{a} are not the same
% Determination conditions: lines h_{b} and c are not the same; points H_{c} and A are not the same
    ; points H and H_{c} must be different; points H_{b} and H are not the same; points A and H_{b}
     must be different; points C and H are not the same; points A and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.023 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_bH_cA} \neq S_{HH_cA}$ i.e., lines H_bH and H_cA are not parallel (construction based assumption)

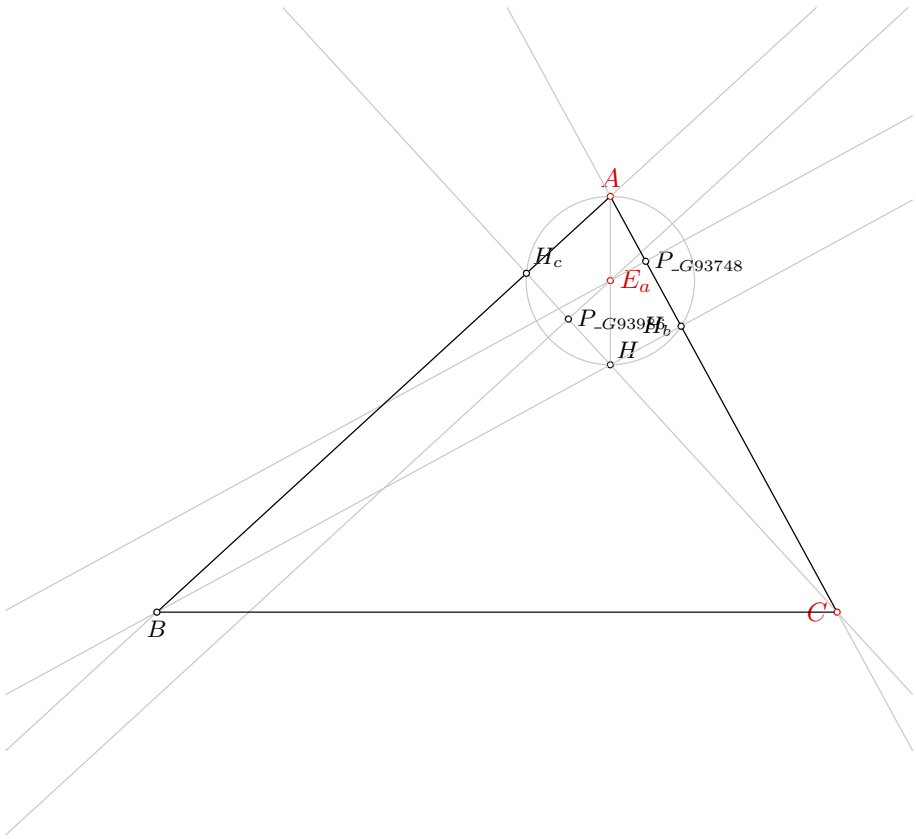

Figure 1: Illustration of the problem 0565

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a} BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving C=C

NDG conditions are:
$S_{H_bH_cA} \neq S_{HH_cA}$ i.e., lines H_bH and H_cA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a} BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.3 Proving E_a=$\_E_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving E_a=$\_E_a$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving $E_a = \_E_a$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 51 terms.

Time Complexity: Time spent by the prover is 0.260 seconds.There are no ndg conditions.

Problem 566

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 566: Given a point A, a point C and a point E_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point C, construct a point M_b (rule W01); ;
2. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
3. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
4. Using the point E_b and the line b, construct a line h_b (rule W10b); ;
5. Using the line h_b and the line b, construct a point H_b (rule W03); % NDG: lines h_b and b are not parallel % DET: lines h_b and b are not the same;
6. Using the point A and the point H_b, construct a line $m(AH_b)$ (rule W14); % DET: points A and H_b are not the same;
7. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;
8. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;
9. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
10. Using the circle $k(N, M_a)$ and the line $m(AH_b)$, construct a point M_c and a point E_a (rule W04); % NDG: line $m(AH_b)$ and circle $k(N, M_a)$ intersect;

11. Using the point M_c and the point A, construct a point B (rule W01); .

Non-degenerate conditions: line $m(AH_b)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel; lines h_b and b are not parallel.

Determination conditions: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points A and H_b are not the same; lines h_b and b are not the same; points E_b and M_b are not the same; points A and C are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14]

Lemmas used: [D20,D22,D29,D3,D32,D6,D9,GD01,GD02,GL01,GL03,GL04,GL09,L17,L18,L19,L21,L22,L23,L

Solving time: 2.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point C 110 40
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_t A
cmark_l C
cmark_r E_{b}
color 0 0 0
fontsize 8


% Constructing a point M_{b} such that AM_{b}/AC=0.5
towards M_{b} A C 0.5
cmark_lt M_{b}
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
```

```
color 0 0 0



% Constructing a line h_{b} which is perpendicular to line b and which passes through point E_{b}
perp h_{b} E_{b} b

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines h_{b} and b are not parallel% DET: lines h_{b} and b are not the same
% Constructing a point H_{b} which belongs to line h_{b} and line b
intersec H_{b} h_{b} b
cmark_l H_{b}


% DET: points A and H_{b} are not the same
% Constructing bisector m(AH_{b}) of the segment AH_{b}
med m(AH_{b}) A H_{b}

color 200 200 200
drawline m(AH_{b})
color 0 0 0

color 200 200 200
drawsegment A H_{b}
color 0 0 0


% DET: points E_{b} and M_{b} are not the same
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0


% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(AH_{b}) and circle k(N,M_{a}) intersect
% Constructing points M_{c} and E_{a} which are in intersection of k(N,M_{a}) and m(AH_{b})
intersec2 M_{c} E_{a} k(N,M_{a}) m(AH_{b})
cmark_lt M_{c}
cmark_r E_{a}



% Constructing a point B such that M_{c}B/M_{c}A=-1
towards B M_{c} A -1
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(AH_{b}) and circle k(N,M_{a}) intersect; points E_{b} and N are
     not the same; lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel; lines h_{b} and b are
    not parallel
% Determination conditions: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the same; points E_{b}
    and M_{b} are not the same; points A and H_{b} are not the same; lines h_{b} and b are not the
    same; points E_{b} and M_{b} are not the same; points A and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving C=C

Status: Theorem has been proved.

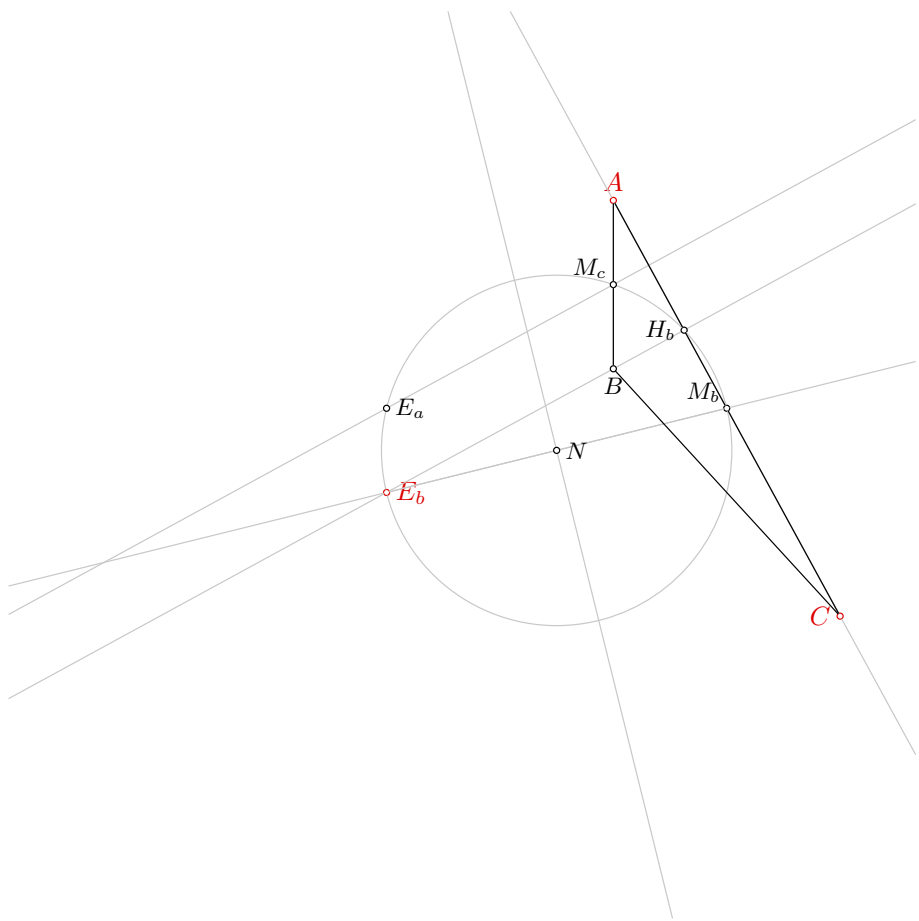

Figure 1: Illustration of the problem 0566

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_b=_E_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 36 terms.

Time Complexity: Time spent by the prover is 0.458 seconds.

NDG conditions Points M_b and E_b are not identical

Points M_b, H_b and E_b are not collinear

Points M_b, A and B are not collinear

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{E_bAC} \neq 0$ i.e., points E_b, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{E_bAC} \neq S_{F^0_{h_b}AC}$ i.e., lines $E_bF^0_{h_b}$ and AC are not parallel (construction based assumption)

$S_{M^3_{m(E_bM_b)}E_bM_b} \neq S_{T^4_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^3_{m(E_bM_b)}T^4_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving C=C

NDG conditions are:

$S_{E_bAC} \neq 0$ i.e., points E_b, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{E_bAC} \neq S_{F^0_{h_b}AC}$ i.e., lines $E_bF^0_{h_b}$ and AC are not parallel (construction based assumption)

$S_{M^3_{m(E_bM_b)}E_bM_b} \neq S_{T^4_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^3_{m(E_bM_b)}T^4_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.3 Proving $E_b{=}\_E_b$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 42 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving $E_b{=}\_E_b$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 314 terms.

Time Complexity: Time spent by the prover is 0.590 seconds.There are no ndg conditions.

Problem 567

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 567: Given a point A, a point C and a point E_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point C, construct a point M_b (rule W01); ;
2. Using the point C and the point E_c, construct a point H (rule W01); ;
3. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
4. Using the point C and the point E_c, construct a line h_c (rule W02); % DET: points C and E_c are not the same;
5. Using the point A and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points A and M_b are not the same;
6. Using the circle $k(M_b, C)$, the line h_a, the point M_b and the point A, construct a point H_a (rule W05); % NDG: line h_a and circle $k(M_b, C)$ intersect % DET: points A and H_a must be different;
7. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
8. Using the circle $k(M_b, C)$, the line h_c, the point M_b and the point C, construct a point H_c (rule W05); % NDG: line h_c and circle $k(M_b, C)$ intersect % DET: points C and H_c must be different;
9. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
10. Using the line a and the line c, construct a point B (rule W03); % NDG: lines a and c are not parallel % DET: lines a and c are not the same.

Non-degenerate conditions: lines a and c are not parallel; line h_c and circle $k(M_b, C)$ intersect; line h_a and circle $k(M_b, C)$ intersect; points A and M_b are not the same.

Determination conditions: lines a and c are not the same; points H_c and A are not the same; points C and H_c must be different; points H_a and C are not the same; points A and H_a must be different; points C and E_c are not the same; points A and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D22,D3,D30,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L43,L44,L45]

Solving time: 10.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point C 110 40
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_t A
cmark_l C
cmark_r E_{c}
color 0 0 0
fontsize 8


% Constructing a point M_{b} such that AM_{b}/AC=0.5
towards M_{b} A C 0.5
cmark_lt M_{b}
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% DET: points C and E_{c} are not the same
% Constructing a line h_{c} which passes through point C and point E_{c}
line h_{c} C E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points A and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point A
circle k(M_{b},C) M_{b} A

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: line h_{a} and circle k(M_{b},C) intersect% DET: points A and H_{a} must be different
% Constructing a point P_{\_G147834} which is a foot of the point M_{b} on the line h_{a}
foot P_{\_G147834} M_{b} h_{a}
cmark_r P_{\_G147834}
color 200 200 200
drawline M_{b} P_{\_G147834}
color 0 0 0

% Constructing a point H_{a} which is an image of the point A in the symmetry to point/line P_{\_G
    147834}
sim H_{a} P_{\_G147834} A
cmark_r H_{a}


% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: line h_{c} and circle k(M_{b},C) intersect% DET: points C and H_{c} must be different
% Constructing a point P_{\_G148072} which is a foot of the point M_{b} on the line h_{c}
foot P_{\_G148072} M_{b} h_{c}
cmark_r P_{\_G148072}
color 200 200 200
drawline M_{b} P_{\_G148072}
color 0 0 0

% Constructing a point H_{c} which is an image of the point C in the symmetry to point/line P_{\_G
    148072}
sim H_{c} P_{\_G148072} C
cmark_rt H_{c}
```

```
% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: lines a and c are not parallel% DET: lines a and c are not the same
% Constructing a point B which belongs to line a and line c
intersec B a c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and c are not parallel; line h_{c} and circle k(M_{b},C)
    intersect; line h_{a} and circle k(M_{b},C) intersect; points A and M_{b} are not the same
% Determination conditions: lines a and c are not the same; points H_{c} and A are not the same;
    points C and H_{c} must be different; points H_{a} and C are not the same; points A and H_{a}
    must be different; points C and E_{c} are not the same; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.019 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

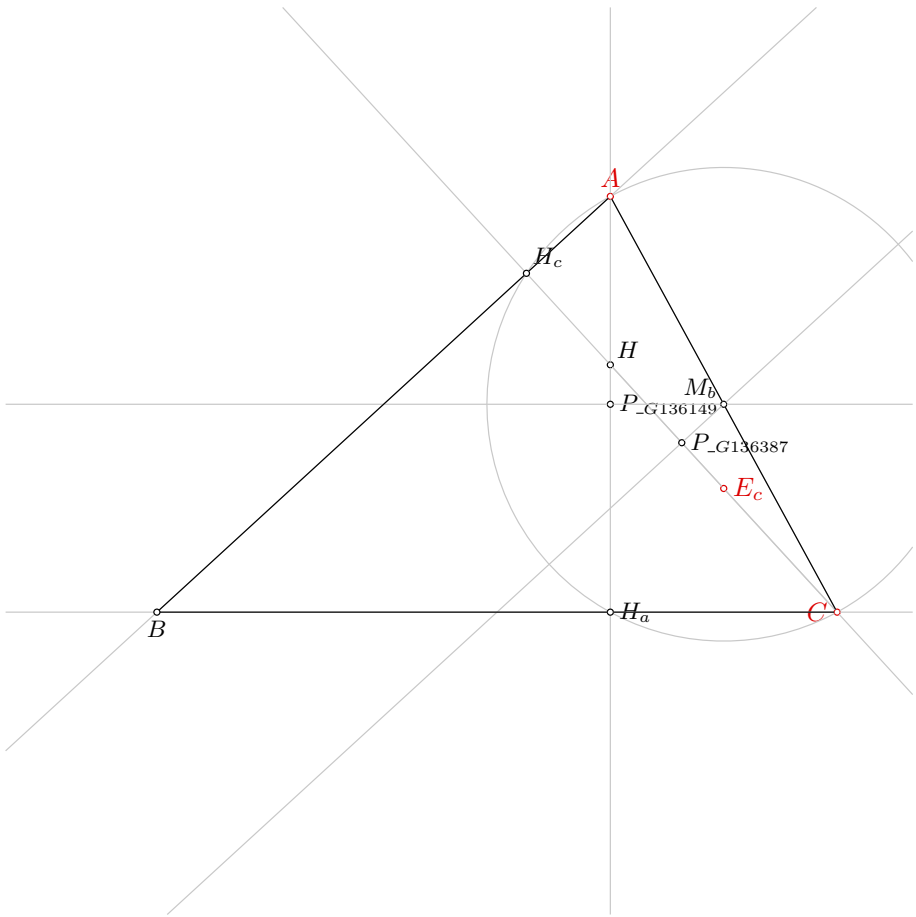

Figure 1: Illustration of the problem 0567

4.1.3 Proving E_c=_E_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 37 terms.

Time Complexity: Time spent by the prover is 4.501 seconds.

NDG conditions Points A and H are not identical

Points M_b and H are not identical

Points A, E_c and C are not collinear

Points A, E_c and C are not collinear

Line through points A and H_c is not parallel with line through points C and H_a

Points A and H_a are not identical

Points M_b, A and B are not collinear

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_aH_cA} \neq S_{CH_cA}$ i.e., lines H_aC and H_cA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving C=C

NDG conditions are:

$S_{H_aH_cA} \neq S_{CH_cA}$ i.e., lines H_aC and H_cA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving E_c=$\_E_c$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving E_c=$\_E_c$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 97 terms.

Time Complexity: Time spent by the prover is 0.440 seconds.There are no ndg conditions.

Problem 568

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 568: Given a point A, a point C and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point C, construct a point M_b (rule W01); ;
2. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
3. Using the point N and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points N and M_b are not the same;
4. Using the point A and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points A and M_b are not the same;
5. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
6. Using the circle $k(N, M_a)$, the line b, the point N and the point M_b, construct a point H_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points M_b and H_b must be different;
7. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point M_b, construct a point E_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_b and E_b must be different;
8. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
9. Using the circle $k(M_b, C)$ and the circle $k(N, M_a)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(M_b, C)$ and $k(N, M_a)$ intersect % DET: circles $k(M_b, C)$ and $k(N, M_a)$ are not the same;

10. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

11. Using the line h_b and the line h_a, construct a point H (rule W03); % NDG: lines h_b and h_a are not parallel % DET: lines h_b and h_a are not the same;

12. Using the point N and the point H, construct a point G (rule W01); ;

13. Using the point C and the point G, construct a point M_c (rule W01); ;

14. Using the point A and the point M_c, construct a point B (rule W01); .

Non-degenerate conditions: lines h_b and h_a are not parallel; circles $k(M_b, C)$ and $k(N, M_a)$ intersect; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; line b and circle $k(N, M_a)$ intersect; points M_b and N are not the same; points A and M_b are not the same.

Determination conditions: lines h_b and h_a are not the same; points A and H_a are not the same; circles $k(M_b, C)$ and $k(N, M_a)$ are not the same; points E_b and H_b are not the same; points M_b and E_b must be different; points M_b and H_b must be different; points N and M_b are not the same; points A and C are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D20,D22,D29,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L16,L17,L19,L20,L21

Solving time: 5.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point C 110 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_l C
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point M_{b} such that AM_{b}/AC=0.5
towards M_{b} A C 0.5
cmark_lt M_{b}
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C
```

```
color 200 200 200
drawline b
color 0 0 0


% DET: points N and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point N and point M_{b}
line m(H_{a}H_{c}) N M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0


% NDG: points A and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point A
circle k(M_{b},C) M_{b} A

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0


% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0


% NDG: line b and circle k(N,M_{a}) intersect% DET: points M_{b} and H_{b} must be different
% Constructing a point P_{\_G186007} which is a foot of the point N on the line b
foot P_{\_G186007} N b
cmark_r P_{\_G186007}
color 200 200 200
drawline N P_{\_G186007}
color 0 0 0

% Constructing a point H_{b} which is an image of the point M_{b} in the symmetry to point/line P
    _{\_G186007}
sim H_{b} P_{\_G186007} M_{b}
cmark_l H_{b}


% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{b} and E_{b} must be
    different
% Constructing a point E_{b} which is an image of the point M_{b} in the symmetry to point/line N
sim E_{b} N M_{b}
cmark_r E_{b}
```

```
% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: circles k(M_{b},C) and k(N,M_{a}) intersect% DET: circles k(M_{b},C) and k(N,M_{a}) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(M_{b},C) and k(N,M_{a})
intersec2 H_{a} H_{c} k(M_{b},C) k(N,M_{a})
cmark_r H_{a}
cmark_rt H_{c}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{b} and h_{a} are not parallel% DET: lines h_{b} and h_{a} are not the same
% Constructing a point H which belongs to line h_{b} and line h_{a}
intersec H h_{b} h_{a}
cmark_rt H



% Constructing a line L_{\_G186509} which passes through point N and point H
line L_{\_G186509} N H

color 200 200 200
drawline L_{\_G186509}
color 0 0 0


% Constructing a point P_{\_G186610} with coordinates (0,0)
point P_{\_G186610} 0 0
cmark_r P_{\_G186610}

% Constructing a point P_{\_G186534} such that NP_{\_G186534}/NP_{\_G186610}=-1
towards P_{\_G186534} N P_{\_G186610} -1
cmark_r P_{\_G186534}
color 200 200 200
drawsegment P_{\_G186610} P_{\_G186534}
color 0 0 0
```

```
% Constructing a point P_{\_G186579} such that NP_{\_G186579}/NP_{\_G186610}=3
towards P_{\_G186579} N P_{\_G186610} 3
cmark_r P_{\_G186579}
color 200 200 200
drawsegment N P_{\_G186579}
color 0 0 0

% Constructing a line L_{\_G186540} which passes through point H and point P_{\_G186579}
line L_{\_G186540} H P_{\_G186579}

color 200 200 200
drawline L_{\_G186540}
color 0 0 0


% Constructing a line L_{\_G186503} which contains the point P_{\_G186534} and is parallel to the
    line L_{\_G186540}
parallel L_{\_G186503} P_{\_G186534} L_{\_G186540}

color 200 200 200
drawline L_{\_G186503}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G186503} and line L_{\_G186509}
intersec G L_{\_G186503} L_{\_G186509}
cmark_t G



% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and h_{a} are not parallel; circles k(M_{b},C) and k(N,M_{
    a}) intersect; line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; line b and circle k(N,M_{a})
     intersect; points M_{b} and N are not the same; points A and M_{b} are not the same
```

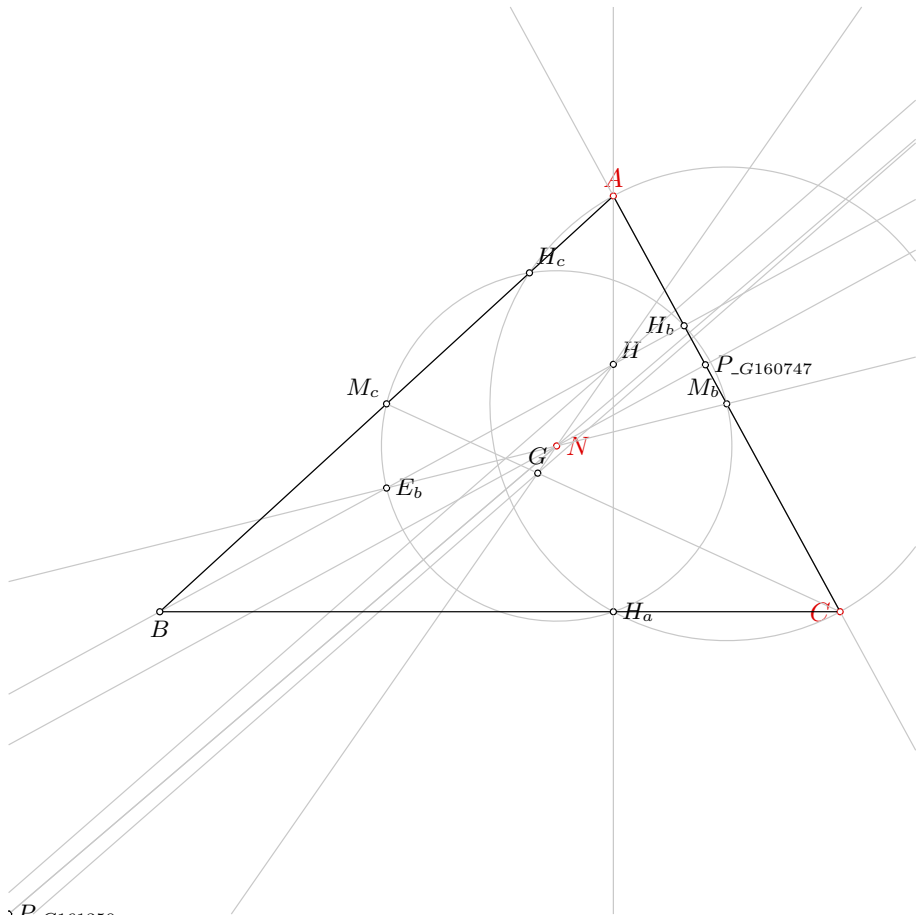

Figure 1: Illustration of the problem 0568

```
% Determination conditions: lines h_{b} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(M_{b},C) and k(N,M_{a}) are not the same; points E_{b} and H_{b} are not the
    same; points M_{b} and E_{b} must be different; points M_{b} and H_{b} must be different;
    points N and M_{b} are not the same; points A and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.03 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving $C{=}C$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving $N{=}\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving $A{=}A$

NDG conditions are:

$S_{E_bAH_a} \neq S_{H_bAH_a}$ i.e., lines E_bH_b and AH_a are not parallel (construction based assumption)

$S_{P\_G163279NH} \neq S_{P^0_{L\_G163248}NH}$ i.e., lines $P\_G163279P^0_{L\_G163248}$ and NH are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving $C{=}C$

NDG conditions are:

$S_{E_bAH_a} \neq S_{H_bAH_a}$ i.e., lines E_bH_b and AH_a are not parallel (construction based assumption)

$S_{P\_G167616NH} \neq S_{P^0_{L\_G167585}NH}$ i.e., lines $P\_G167616P^0_{L\_G167585}$ and NH are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.3 Proving $N{=}\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.3 Proving $N{=}\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 569

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 569: Given a point A, a point E_a and a point E_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point E_b and the point H, construct a point B (rule W01); ;
3. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
4. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
5. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
6. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
7. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
8. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
9. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
10. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; line c and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines h_c and b are not the same; points H_b and A are not the same; points H and H_b must be different; points H_c and H are not the same; points A and H_c must be different; points E_b and H are not the same; points A and B are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D29,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 12.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{a} 80 83.86
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{a}
cmark_r E_{b}
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0
```

```
% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G213158} which is a foot of the point E_{a} on the line c
foot P_{\_G213158} E_{a} c
cmark_r P_{\_G213158}
color 200 200 200
drawline E_{a} P_{\_G213158}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    213158}
sim H_{c} P_{\_G213158} A
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G213396} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G213396} E_{a} h_{b}
cmark_r P_{\_G213396}
color 200 200 200
drawline E_{a} P_{\_G213396}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    213396}
sim H_{b} P_{\_G213396} H
cmark_l H_{b}
```

```
% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; line c and circle k(E_{a},A) intersect; points A and E_{a} are not the same
% Determination conditions: lines h_{c} and b are not the same; points H_{b} and A are not the same
    ; points H and H_{b} must be different; points H_{c} and H are not the same; points A and H_{c}
     must be different; points E_{b} and H are not the same; points A and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.035 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

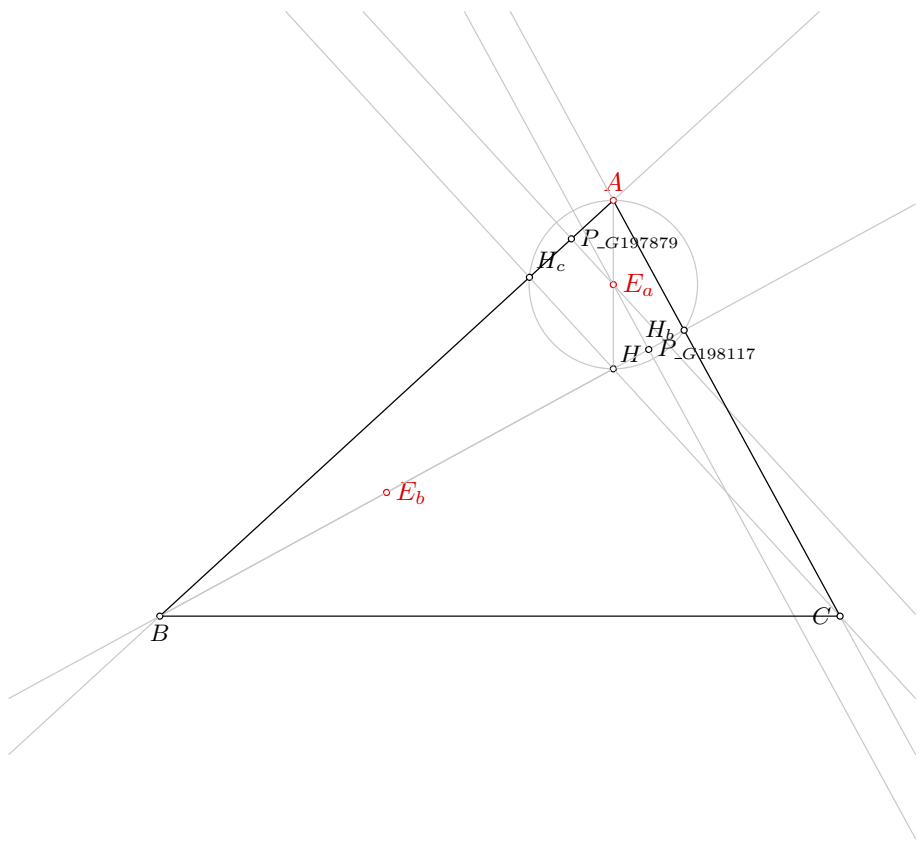

Figure 1: Illustration of the problem 0569

4.2 GCLC - Area method

4.2.1 Proving $A{=}A$

NDG conditions are:

$S_{H_cH_bA} \neq S_{HH_bA}$ i.e., lines H_cH and H_bA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_a{=}\_E_a$

Proving failed

4.2.3 Proving $E_b{=}\_E_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_a{=}\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 1326 terms.

Time Complexity: Time spent by the prover is 2.250 seconds.There are no ndg conditions.

4.3.3 Proving $E_b{=}\_E_b$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 804 terms.

Time Complexity: Time spent by the prover is 2.390 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving $E_b{=}\_E_b$

Proving failed

Problem 570

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 570: Given a point A, a point E_a and a point E_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point E_c and the point H, construct a point C (rule W01); ;
3. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
4. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
5. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
6. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
7. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
8. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H and H_c must be different;
9. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
10. Using the line h_b and the line c, construct a point B (rule W03); % NDG: lines h_b and c are not parallel % DET: lines h_b and c are not the same.

Non-degenerate conditions: lines h_b and c are not parallel; line h_c and circle $k(E_a, A)$ intersect; line b and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines h_b and c are not the same; points H_c and A are not the same; points H and H_c must be different; points H_b and H are not the same; points A and H_b must be different; points E_c and H are not the same; points A and C are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D3,D30,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 12.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{a} 80 83.86
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{a}
cmark_r E_{c}
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0
```

```
% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G238418} which is a foot of the point E_{a} on the line b
foot P_{\_G238418} E_{a} b
cmark_r P_{\_G238418}
color 200 200 200
drawline E_{a} P_{\_G238418}
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    238418}
sim H_{b} P_{\_G238418} A
cmark_l H_{b}


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G238656} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G238656} E_{a} h_{c}
cmark_r P_{\_G238656}
color 200 200 200
drawline E_{a} P_{\_G238656}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    238656}
sim H_{c} P_{\_G238656} H
cmark_rt H_{c}
```

```
% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{b} and c are not parallel% DET: lines h_{b} and c are not the same
% Constructing a point B which belongs to line h_{b} and line c
intersec B h_{b} c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and c are not parallel; line h_{c} and circle k(E_{a},A)
    intersect; line b and circle k(E_{a},A) intersect; points A and E_{a} are not the same
% Determination conditions: lines h_{b} and c are not the same; points H_{c} and A are not the same
    ; points H and H_{c} must be different; points H_{b} and H are not the same; points A and H_{b}
     must be different; points E_{c} and H are not the same; points A and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.034 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

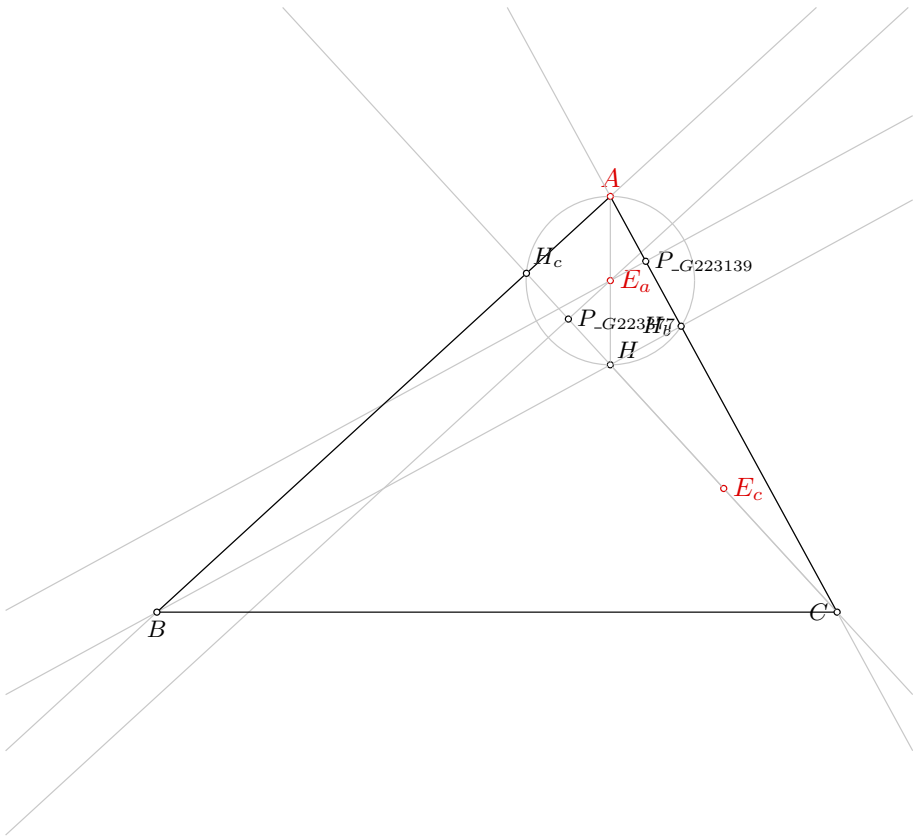

Figure 1: Illustration of the problem 0570

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_bH_cA} \neq S_{HH_cA}$ i.e., lines H_bH and H_cA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving E_c=$\_E_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving E_a=$\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 1794 terms.

Time Complexity: Time spent by the prover is 4.540 seconds.There are no ndg conditions.

4.3.3 Proving E_c=$\_E_c$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 1072 terms.

Time Complexity: Time spent by the prover is 5.730 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving E_a=$\_E_a$

Proving failed

4.4.3 Proving E_c=$\_E_c$

Proving failed

Problem 571

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 571: Given a point A, a point E_a and a point G, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point A and the point G, construct a point M_a (rule W01); ;
3. Using the point G and the point H, construct a point N (rule W01); ;
4. Using the point G and the point H, construct a point O (rule W01); ;
5. Using the point A and the point E_a, construct a line h_a (rule W02); % DET: points A and E_a are not the same;
6. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
7. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
9. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and E_a are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L16,L19,L22,L55,L58]

Solving time: 9.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{a} 80 83.86
point G 70 58.33

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{a}
cmark_t G
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0



% Constructing a point N such that GN/GH=0.25
towards N G H 0.25
cmark_r N
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
```

```
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points A and E_{a} are not the same
% Constructing a line h_{a} which passes through point A and point E_{a}
line h_{a} A E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G6700} which is a foot of the point N on the line h_{a}
foot P_{\_G6700} N h_{a}
cmark_r P_{\_G6700}
color 200 200 200
drawline N P_{\_G6700}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G6700}
sim H_{a} P_{\_G6700} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
```

```
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points E_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and E_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.023 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=$\_E_a$

Proving failed

4.1.3 Proving G=$\_G$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

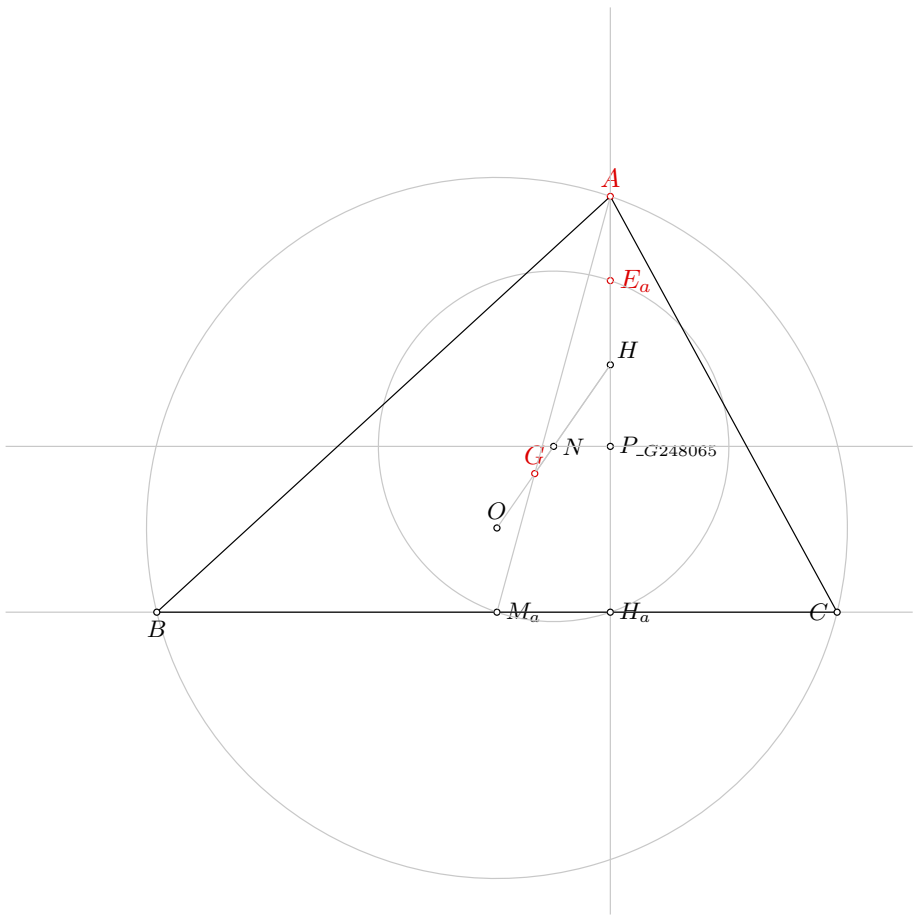

Figure 1: Illustration of the problem 0571

$S_{AB\_M_b} \neq S_{\_M_aB\_M_b}$ i.e., lines A_M_a and B_M_b are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving G=$\_G$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving E_a=$\_E_a$

Proving failed

4.3.3 Proving G=$\_G$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving E_a=$\_E_a$

Proving failed

4.4.3 Proving G=$\_G$

Proving failed

Problem 572

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 572: Given a point E_a, a point H and a point A, construct the triangle ABC.

2 Status

Problem is redundant.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H, construct a point A (rule W01); ;
2. Choose freely a point B (rule free);
3. Using the point B and the point H, construct a point E_b (rule W01); ;
4. Using the point B and the point A, construct a line c (rule W02); % DET: points B and A are not the same;
5. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
6. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
7. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
8. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
9. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H and H_a must be different;
10. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;

11. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; line h_a and circle $k(E_b, B)$ intersect; line c and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines h_c and a are not the same; points H_a and B are not the same; points H and H_a must be different; points H_c and H are not the same; points B and H_c must be different; points E_a and H are not the same; points B and A are not the same.

Rules used: [W01,W02,W03,W05,W06,free]

Lemmas used: [D10,D28,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 10.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H 80 72.73
point A 80 95

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H
cmark_t A
color 0 0 0
fontsize 8


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a free point B
point B 20 40

cmark_b B



% Constructing a point E_{b} such that BE_{b}/BH=0.5
towards E_{b} B H 0.5
cmark_r E_{b}
color 200 200 200
drawsegment B H
color 0 0 0
```

```
% DET: points B and A are not the same
% Constructing a line c which passes through point B and point A
line c B A

color 200 200 200
drawline c
color 0 0 0



% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G31089} which is a foot of the point E_{b} on the line c
foot P_{\_G31089} E_{b} c
cmark_r P_{\_G31089}
color 200 200 200
drawline E_{b} P_{\_G31089}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    31089}
sim H_{c} P_{\_G31089} B
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H and H_{a} must be different
```

```
% Constructing a point P_{\_G31327} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G31327} E_{b} h_{a}
cmark_r P_{\_G31327}
color 200 200 200
drawline E_{b} P_{\_G31327}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    31327}
sim H_{a} P_{\_G31327} H
cmark_r H_{a}


% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; line h_{a} and circle k(E_{b},B)
    intersect; line c and circle k(E_{b},B) intersect; points B and E_{b} are not the same
% Determination conditions: lines h_{c} and a are not the same; points H_{a} and B are not the same
    ; points H and H_{a} must be different; points H_{c} and H are not the same; points B and H_{c}
     must be different; points E_{a} and H are not the same; points B and A are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

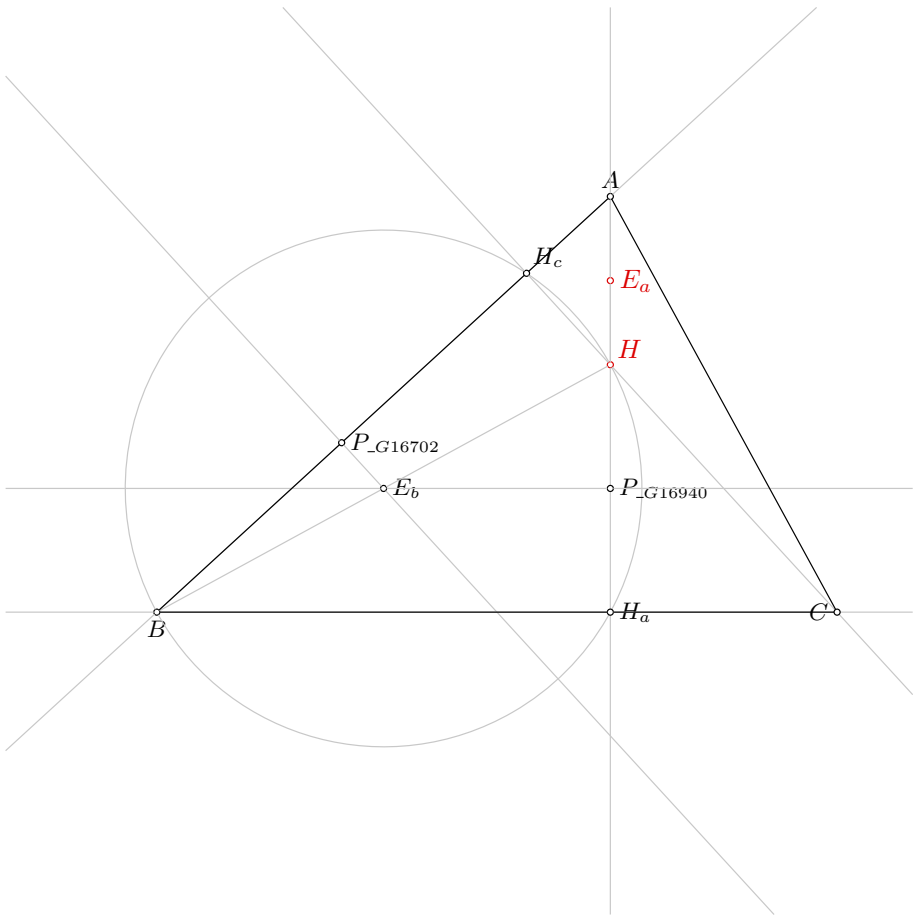

Figure 1: Illustration of the problem 0572

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2 terms.

Time Complexity: Time spent by the prover is 0.023 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving A=A

NDG conditions are:

$S_{H_cH_aB} \neq S_{HH_aB}$ i.e., lines H_cH and H_aB are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 805 terms.

Time Complexity: Time spent by the prover is 1.410 seconds.There are no ndg conditions.

4.3.2 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 152 terms.

Time Complexity: Time spent by the prover is 0.160 seconds.There are no ndg conditions.

4.3.3 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 573

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 573: Given a point E_a, a point H_a and a point A, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Choose freely a point A on the line h_a (rule WOnline1) ;
3. Using the point A and the point E_a, construct a point H (rule W01); ;
4. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
5. Using the point H_a and the line h_a, construct a line a (rule W10a); ;
6. Choose freely a point B on the line a (rule WOnline2);
7. Using the point B and the point A, construct a line c (rule W02); % DET: points B and A are not the same;
8. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
9. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
10. Using the line a and the line h_c, construct a point C (rule W03); % NDG: lines a and h_c are not parallel % DET: lines a and h_c are not the same.

Non-degenerate conditions: lines a and h_c are not parallel; line c and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines a and h_c are not the same; points H and H_c are not the same; points A and H_c must be different; points B and A are not the same; points E_a and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,WOnline1,WOnline2]

Lemmas used: [D10,D28,D3,D5,D7,D8,GD01,GD02,GL03,GL09,L3,L48]

Solving time: 172.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{a} 80 40
point A 80 95

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r H_{a}
cmark_t A
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Choosing randomly a point A on the line E_{a}H_{a}
online A E_{a} H_{a}
cmark_t A
color 200 200 200
drawline E_{a} H_{a}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0
```

```
% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0




% Constructing a line a which is perpendicular to line h_{a} and which passes through point H_{a}
perp a H_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0




% Generating random value V[_G53006]
random V[_G53006]


% Calculating value V[_G53027] using formula V[_G53006]*20
expression V[_G53027] { V[_G53006]*20 }


% Constructing a point B which is a point for which holds H_{a}B = V[_G53027] and angle AH_{a}B =
    90
turtle B A H_{a} 90 V[_G53027]
cmark_b B


% DET: points B and A are not the same
% Constructing a line c which passes through point B and point A
line c B A

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G53299} which is a foot of the point E_{a} on the line c
foot P_{\_G53299} E_{a} c
cmark_r P_{\_G53299}
color 200 200 200
drawline E_{a} P_{\_G53299}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    53299}
sim H_{c} P_{\_G53299} A
```

```
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines a and h_{c} are not parallel% DET: lines a and h_{c} are not the same
% Constructing a point C which belongs to line a and line h_{c}
intersec C a h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{c} are not parallel; line c and circle k(E_{a},A)
    intersect; points A and E_{a} are not the same
% Determination conditions: lines a and h_{c} are not the same; points H and H_{c} are not the same
    ; points A and H_{c} must be different; points B and A are not the same; points E_{a} and H_{a}
     are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 55 terms.

Time Complexity: Time spent by the prover is 0.997 seconds.

NDG conditions Points A and B are not identical

Points A and B are not identical

Line through points H_c and H_a is not perpendicular to line through points H_a and H

Line through points A and E_a is not parallel with line through points B and C

4.1.2 Proving H_a=_H_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

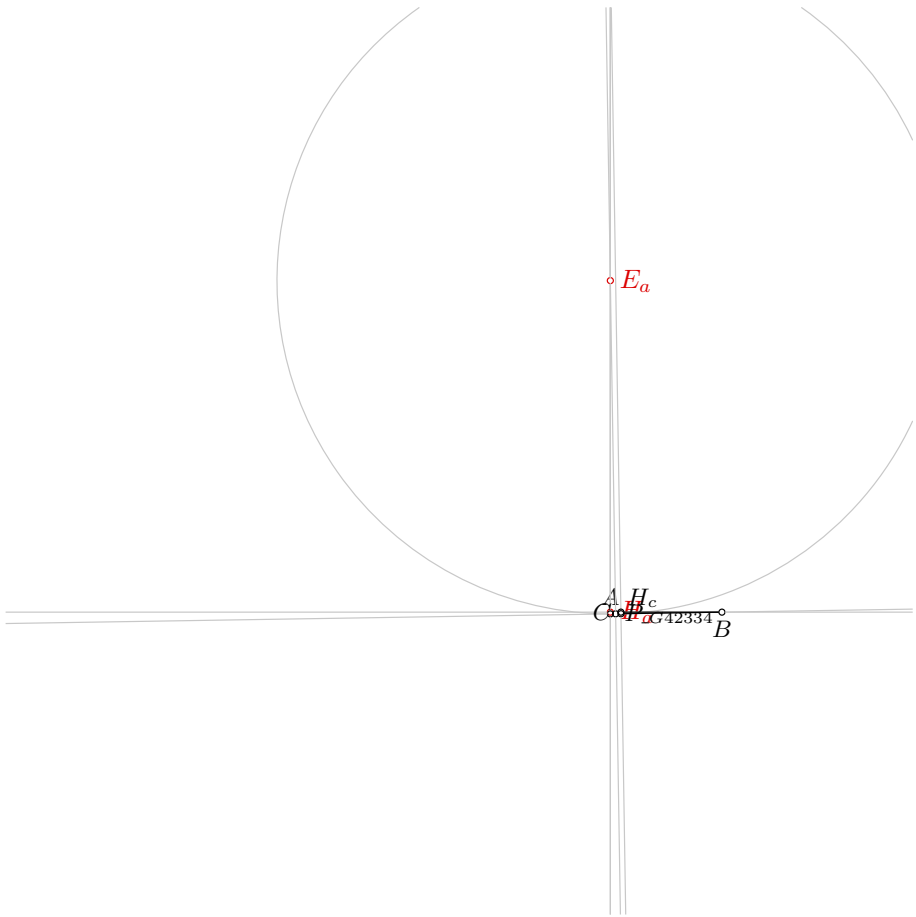

Figure 1: Illustration of the problem 0573

Time Complexity: Time spent by the prover is 0.155 seconds.

NDG conditions Points A and B are not identical

Points A and B are not identical

Line through points H_c and H_a is not perpendicular to line through points H_a and H

Line through points A and E_a is not parallel with line through points B and C

4.1.3 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.008 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving A=A

NDG conditions are:

$S_{H_aHH_c} \neq S_{T_a^1HH_c}$ i.e., lines $H_aT_a^1$ and HH_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

$S_{BAF^2_{\_h_a}} \neq S_{CAF^2_{\_h_a}}$ i.e., lines BC and $AF^2_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving H_a=_H_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 16 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.3 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 20 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving H_a=_H_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 20 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.4.3 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 574

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 574: Given a point E_a, a point H_b and a point A, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_b and E_a are not the same;
2. Choose freely a point A on the circle $k(E_a, A)$ (rule WOncircle);
3. Using the point A and the point E_a, construct a point H (rule W01); ;
4. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
5. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
6. Choose freely a point B on the line h_b (rule WOnline1) ;
7. Using the point B and the point A, construct a line c (rule W02); % DET: points B and A are not the same;
8. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
9. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
10. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same.

Non-degenerate conditions: lines b and h_c are not parallel; line c and circle $k(E_a, A)$ intersect; points H_b and E_a are not the same.

Determination conditions: lines b and h_c are not the same; points H and H_c are not the same; points A and H_c must be different; points B and A are not the same; points H_b and H are not the same; points A and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06,WOncircle1,WOnline1]

Lemmas used: [D10,D28,D3,D6,D7,GD01,GD02,GL03,L3,L47,L48]

Solving time: 699.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{b} 89.36 77.83
point A 80 95

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_l H_{b}
cmark_t A
color 0 0 0
fontsize 8

% NDG: points H_{b} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{b}
circle k(E_{a},A) E_{a} H_{b}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0




% Choosing randomly a point A on the circle with center E_{a} through point H_{b}
oncircle A E_{a} H_{b}
cmark_t A
color 200 200 200
drawcircle E_{a} H_{b}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0
```

```
% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% Choosing randomly a point B on the line H_{b}H
online B H_{b} H
cmark_b B
color 200 200 200
drawline H_{b} H
color 0 0 0


% DET: points B and A are not the same
% Constructing a line c which passes through point B and point A
line c B A

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G75738} which is a foot of the point E_{a} on the line c
foot P_{\_G75738} E_{a} c
cmark_r P_{\_G75738}
color 200 200 200
drawline E_{a} P_{\_G75738}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    75738}
sim H_{c} P_{\_G75738} A
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
```

```
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line c and circle k(E_{a},A)
    intersect; points H_{b} and E_{a} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H and H_{c} are not the same
    ; points A and H_{c} must be different; points B and A are not the same; points H_{b} and H are
     not the same; points A and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2 terms.

Time Complexity: Time spent by the prover is 0.025 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

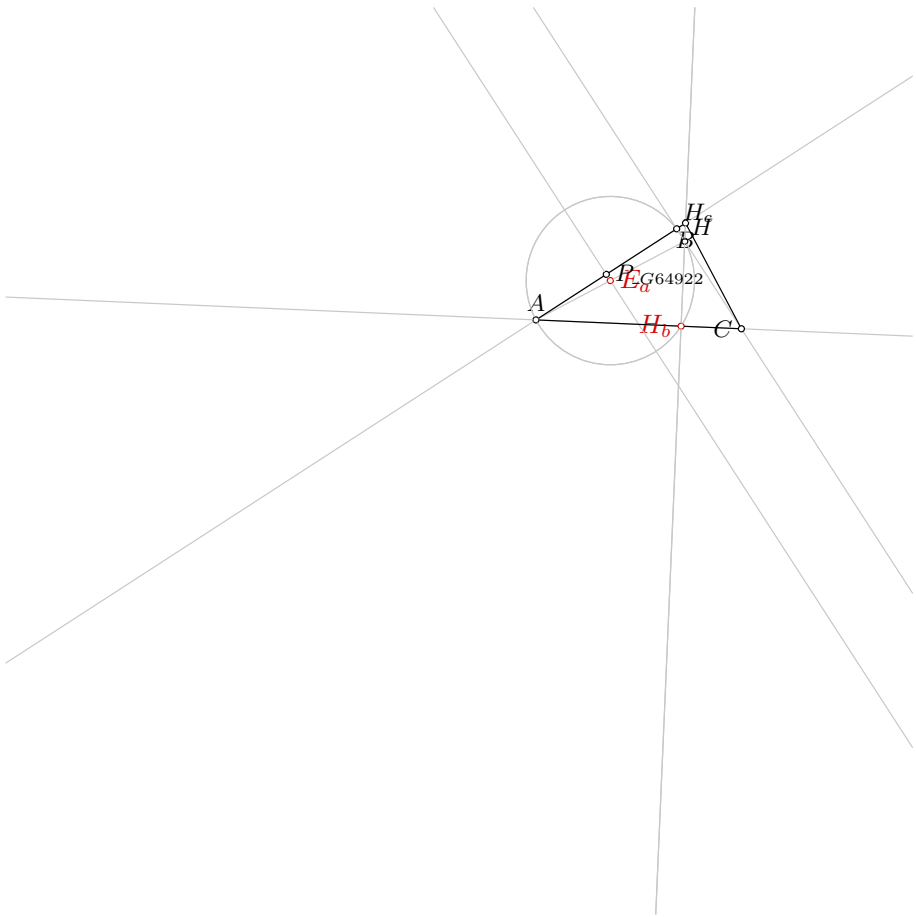

Figure 1: Illustration of the problem 0574

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving A=A

NDG conditions are:

$S_{AHH_c} \neq S_{H_bHH_c}$ i.e., lines AH_b and HH_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{CBF^2_{\_h_b}}$ i.e., lines AC and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 575

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 575: Given a point E_a, a point H_c and a point A, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
2. Choose freely a point A on the circle $k(E_a, A)$ (rule WOncircle);
3. Using the point A and the point E_a, construct a point H (rule W01); ;
4. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;
5. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
6. Choose freely a point B on the line c (rule WOnline1) ;
7. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
8. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
9. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
10. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; points H_c and E_a are not the same.

Determination conditions: lines h_c and b are not the same; points H_b and A are not the same; points H and H_b must be different; points B and H are not the same; points H_c and H are not the same; points A and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06,WOncircle1,WOnline1]

Lemmas used: [D10,D28,D3,D6,D7,D9,GD01,GD02,GL03,L3,L46,L47,L48]

Solving time: 694.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{c} 68.91 84.83
point A 80 95

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H_{c}
cmark_t A
color 0 0 0
fontsize 8

% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0




% Choosing randomly a point A on the circle with center E_{a} through point H_{c}
oncircle A E_{a} H_{c}
cmark_t A
color 200 200 200
drawcircle E_{a} H_{c}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0
```

```
% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% Choosing randomly a point B on the line AH_{c}
online B A H_{c}
cmark_b B
color 200 200 200
drawline A H_{c}
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G98836} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G98836} E_{a} h_{b}
cmark_r P_{\_G98836}
color 200 200 200
drawline E_{a} P_{\_G98836}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    98836}
sim H_{b} P_{\_G98836} H
cmark_l H_{b}


% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
```

```
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; points H_{c} and E_{a} are not the same
% Determination conditions: lines h_{c} and b are not the same; points H_{b} and A are not the same
    ; points H and H_{b} must be different; points B and H are not the same; points H_{c} and H are
     not the same; points A and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H_c=_H_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2241 terms.

Time Complexity: Time spent by the prover is 14.996 seconds.

NDG conditions Points A, H_c and E_a are not collinear

Points B and H are not identical

Line through points H_c and E_a is not parallel with line through points B and H

Line through points H_b and A is not parallel with line through points H_c and H

Points H and E_a are not identical

Points A and B are not identical

Points A and B are not identical

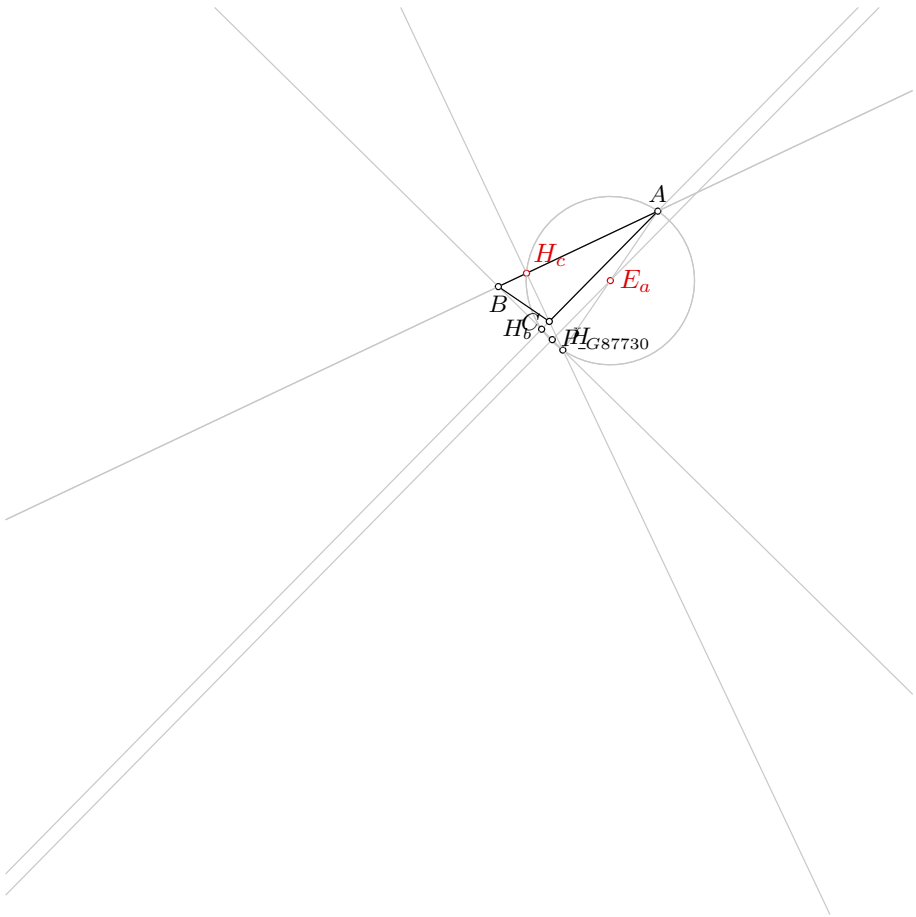

Figure 1: Illustration of the problem 0575

4.1.3 Proving $A{=}A$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2 terms.

Time Complexity: Time spent by the prover is 0.021 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving $E_a{=}\_E_a$

Proving failed

4.2.2 Proving $H_c{=}\_H_c$

Proving failed

4.2.3 Proving $A{=}A$

NDG conditions are:

$S_{H_cH_bA} \neq S_{HH_bA}$ i.e., lines H_cH and H_bA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^3_{\_h_c}} \neq S_{BCF^3_{\_h_c}}$ i.e., lines AB and $CF^3_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving $E_a{=}\_E_a$

Proving failed

4.3.2 Proving $H_c{=}\_H_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 280 terms.

Time Complexity: Time spent by the prover is 0.330 seconds.There are no ndg conditions.

4.3.3 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $E_a{=}\_E_a$

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 576

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 576: Given a point A, a point E_a and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 577

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 577: Given a point A, a point E_a and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point A and the point M_a, construct a point G (rule W01); ;
3. Using the point H and the point G, construct a point N (rule W01); ;
4. Using the point H and the point G, construct a point O (rule W01); ;
5. Using the point A and the point E_a, construct a line h_a (rule W02); % DET: points A and E_a are not the same;
6. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
7. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
9. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and E_a are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL09,L11,L12,L16,L19,L22,L55,L58]

Solving time: 9.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{a} 80 83.86
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{a}
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a line L_{\_G123557} which passes through point A and point M_{a}
line L_{\_G123557} A M_{a}

color 200 200 200
drawline L_{\_G123557}
color 0 0 0


% Constructing a point P_{\_G123658} with coordinates (0,0)
point P_{\_G123658} 0 0
cmark_r P_{\_G123658}

% Constructing a point P_{\_G123582} such that AP_{\_G123582}/AP_{\_G123658}=2
towards P_{\_G123582} A P_{\_G123658} 2
cmark_r P_{\_G123582}
color 200 200 200
drawsegment A P_{\_G123582}
color 0 0 0
```

```
% Constructing a point P_{\_G123627} such that AP_{\_G123627}/AP_{\_G123658}=3
towards P_{\_G123627} A P_{\_G123658} 3
cmark_r P_{\_G123627}
color 200 200 200
drawsegment A P_{\_G123627}
color 0 0 0

% Constructing a line L_{\_G123588} which passes through point M_{a} and point P_{\_G123627}
line L_{\_G123588} M_{a} P_{\_G123627}

color 200 200 200
drawline L_{\_G123588}
color 0 0 0


% Constructing a line L_{\_G123551} which contains the point P_{\_G123582} and is parallel to the
    line L_{\_G123588}
parallel L_{\_G123551} P_{\_G123582} L_{\_G123588}

color 200 200 200
drawline L_{\_G123551}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G123551} and line L_{\_G123557}
intersec G L_{\_G123551} L_{\_G123557}
cmark_t G



% Constructing a point N such that HN/HG=0.75
towards N H G 0.75
cmark_r N
color 200 200 200
drawsegment H G
color 0 0 0



% Constructing a point O such that HO/HG=1.5
towards O H G 1.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points A and E_{a} are not the same
% Constructing a line h_{a} which passes through point A and point E_{a}
line h_{a} A E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G124628} which is a foot of the point N on the line h_{a}
foot P_{\_G124628} N h_{a}
cmark_r P_{\_G124628}
color 200 200 200
drawline N P_{\_G124628}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G124628}
sim H_{a} P_{\_G124628} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

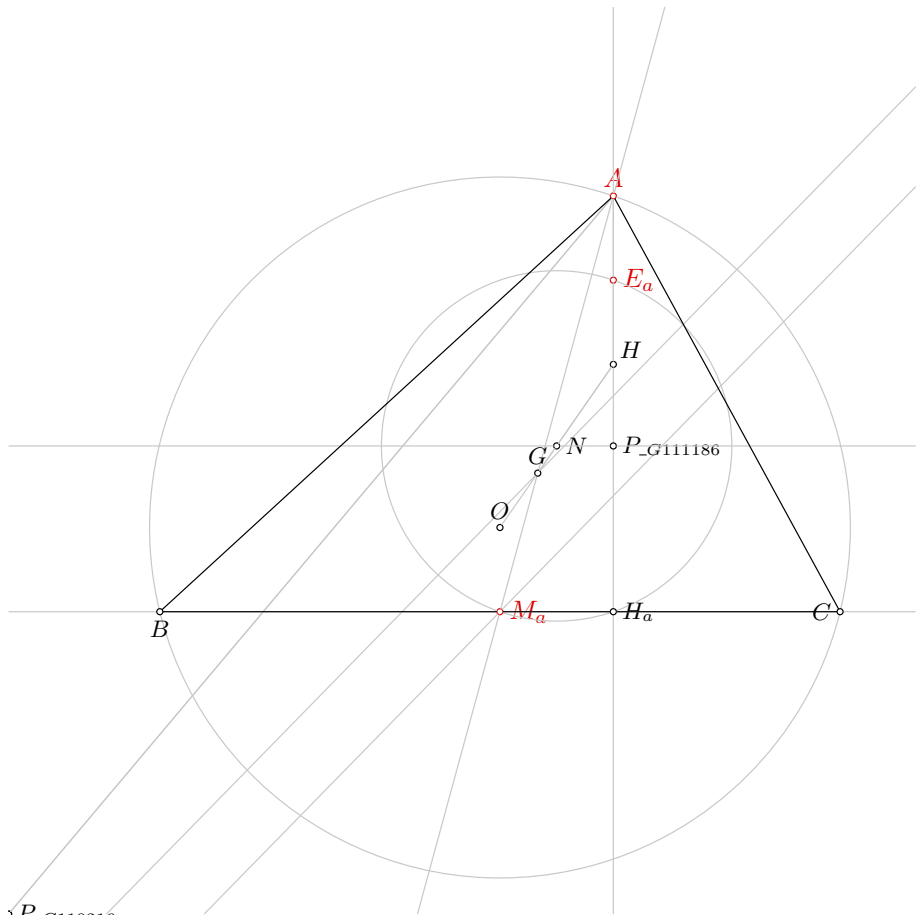

Figure 1: Illustration of the problem 0577

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points E_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and E_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving M_a=_M_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{P_{\_G111582}AM_a} \neq S_{P^0_{L_{\_G111551}}AM_a}$ i.e., lines $P_{\_G111582}P^0_{L_{\_G111551}}$ and AM_a are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=_E_a

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_a=_E_a

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving E_a=_E_a

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 578

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 578: Given a point A, a point E_a and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point A and the point M_b, construct a point C (rule W01); ;
3. Using the point A and the point M_b, construct a line b (rule W02); % DET: points A and M_b are not the same;
4. Using the point H and the point C, construct a line h_c (rule W02); % DET: points H and C are not the same;
5. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
6. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
7. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
8. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H and H_c must be different;
9. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
10. Using the line h_b and the line c, construct a point B (rule W03); % NDG: lines h_b and c are not parallel % DET: lines h_b and c are not the same.

Non-degenerate conditions: lines h_b and c are not parallel; line h_c and circle $k(E_a, A)$ intersect; line b and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines h_b and c are not the same; points H_c and A are not the same; points H and H_c must be different; points H_b and H are not the same; points A and H_b must be different; points H and C are not the same; points A and M_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D22,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 12.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{a} 80 83.86
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{a}
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and M_{b} are not the same
% Constructing a line b which passes through point A and point M_{b}
line b A M_{b}

color 200 200 200
drawline b
color 0 0 0
```

```
% DET: points H and C are not the same
% Constructing a line h_{c} which passes through point H and point C
line h_{c} H C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G145962} which is a foot of the point E_{a} on the line b
foot P_{\_G145962} E_{a} b
cmark_r P_{\_G145962}
color 200 200 200
drawline E_{a} P_{\_G145962}
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    145962}
sim H_{b} P_{\_G145962} A
cmark_l H_{b}


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G146200} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G146200} E_{a} h_{c}
cmark_r P_{\_G146200}
color 200 200 200
drawline E_{a} P_{\_G146200}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    146200}
sim H_{c} P_{\_G146200} H
cmark_rt H_{c}
```

```
% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{b} and c are not parallel% DET: lines h_{b} and c are not the same
% Constructing a point B which belongs to line h_{b} and line c
intersec B h_{b} c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and c are not parallel; line h_{c} and circle k(E_{a},A)
    intersect; line b and circle k(E_{a},A) intersect; points A and E_{a} are not the same
% Determination conditions: lines h_{b} and c are not the same; points H_{c} and A are not the same
    ; points H and H_{c} must be different; points H_{b} and H are not the same; points A and H_{b}
     must be different; points H and C are not the same; points A and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

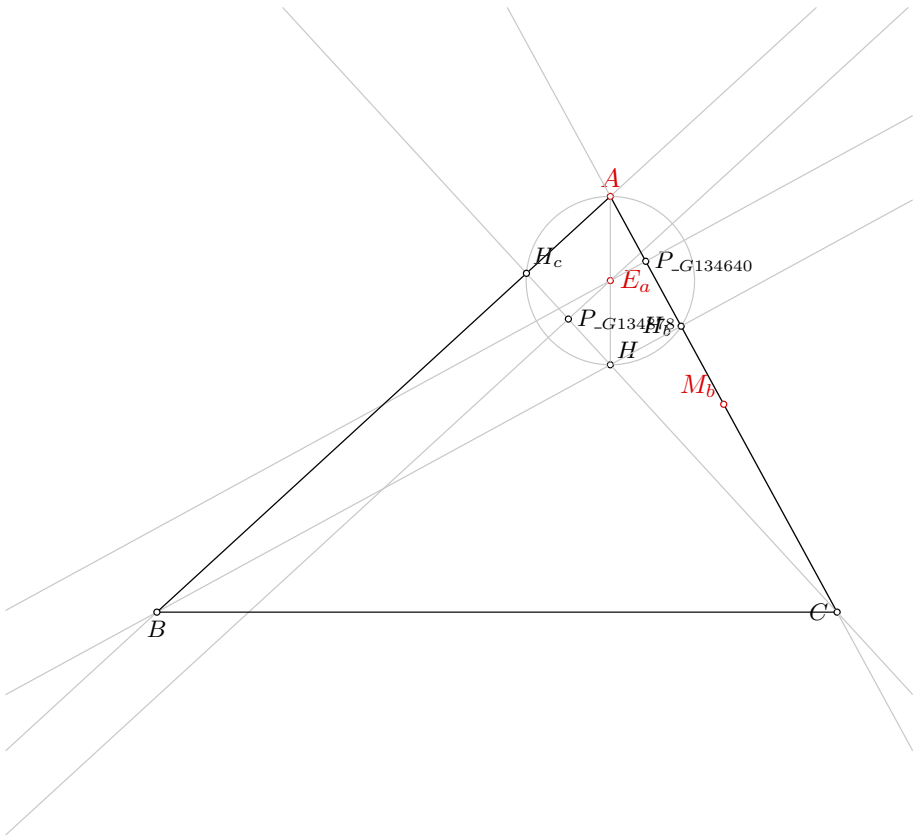

Figure 1: Illustration of the problem 0578

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving $A{=}A$

NDG conditions are:

$S_{H_bH_cA} \neq S_{HH_cA}$ i.e., lines H_bH and H_cA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_a{=}\_E_a$

Proving failed

4.2.3 Proving $M_b{=}\_M_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_a{=}\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 117 terms.

Time Complexity: Time spent by the prover is 0.410 seconds.There are no ndg conditions.

4.3.3 Proving $M_b{=}\_M_b$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 8 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving M_b=$\_M_b$

Proving failed

Problem 579

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 579: Given a point A, a point E_a and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point A and the point M_c, construct a point B (rule W01); ;
3. Using the point A and the point M_c, construct a line c (rule W02); % DET: points A and M_c are not the same;
4. Using the point H and the point B, construct a line h_b (rule W02); % DET: points H and B are not the same;
5. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
6. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
7. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
8. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
9. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
10. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; line c and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines h_c and b are not the same; points H_b and A are not the same; points H and H_b must be different; points H_c and H are not the same; points A and H_c must be different; points H and B are not the same; points A and M_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D20,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL09,L3,L46,L47,L48]

Solving time: 12.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{a} 80 83.86
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{a}
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and M_{c} are not the same
% Constructing a line c which passes through point A and point M_{c}
line c A M_{c}

color 200 200 200
drawline c
color 0 0 0
```

```
% DET: points H and B are not the same
% Constructing a line h_{b} which passes through point H and point B
line h_{b} H B

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G167563} which is a foot of the point E_{a} on the line c
foot P_{\_G167563} E_{a} c
cmark_r P_{\_G167563}
color 200 200 200
drawline E_{a} P_{\_G167563}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    167563}
sim H_{c} P_{\_G167563} A
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G167801} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G167801} E_{a} h_{b}
cmark_r P_{\_G167801}
color 200 200 200
drawline E_{a} P_{\_G167801}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    167801}
sim H_{b} P_{\_G167801} H
cmark_l H_{b}
```

```
% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; line c and circle k(E_{a},A) intersect; points A and E_{a} are not the same
% Determination conditions: lines h_{c} and b are not the same; points H_{b} and A are not the same
    ; points H and H_{b} must be different; points H_{c} and H are not the same; points A and H_{c}
     must be different; points H and B are not the same; points A and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.034 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

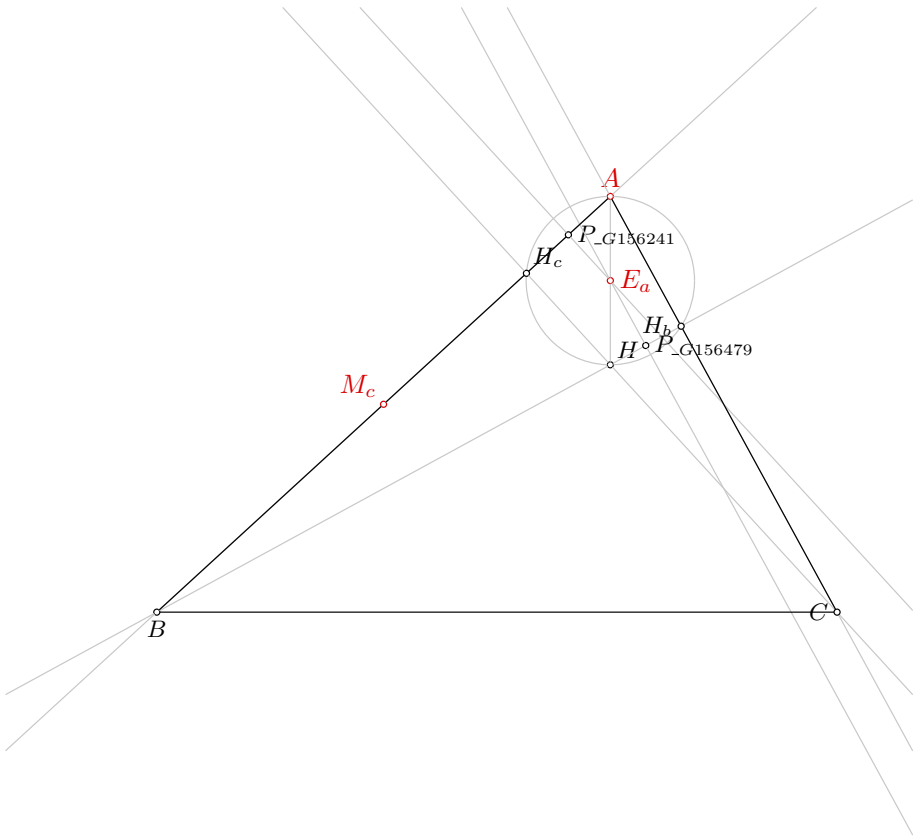

Figure 1: Illustration of the problem 0579

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving $A{=}A$

NDG conditions are:

$S_{H_cH_bA} \neq S_{HH_bA}$ i.e., lines H_cH and H_bA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_a{=}\_E_a$

Proving failed

4.2.3 Proving $M_c{=}\_M_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_a{=}\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 117 terms.

Time Complexity: Time spent by the prover is 0.350 seconds.There are no ndg conditions.

4.3.3 Proving $M_c{=}\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 8 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 580

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 580: Given a point A, a point E_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point N and the point H, construct a point O (rule W01); ;
3. Using the point N and the point H, construct a point G (rule W01); ;
4. Using the point A and the point G, construct a point M_a (rule W01); ;
5. Using the point A and the point E_a, construct a line h_a (rule W02); % DET: points A and E_a are not the same;
6. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
7. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
9. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and E_a are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L16,L19,L22,L55]

Solving time: 9.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{a} 80 83.86
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{a}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point O such that NO/NH=-1
towards O N H -1
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G202589} which passes through point N and point H
line L_{\_G202589} N H

color 200 200 200
drawline L_{\_G202589}
color 0 0 0


% Constructing a point P_{\_G202690} with coordinates (0,0)
point P_{\_G202690} 0 0
```

```
cmark_r P_{\_G202690}

% Constructing a point P_{\_G202614} such that NP_{\_G202614}/NP_{\_G202690}=-1
towards P_{\_G202614} N P_{\_G202690} -1
cmark_r P_{\_G202614}
color 200 200 200
drawsegment P_{\_G202690} P_{\_G202614}
color 0 0 0

% Constructing a point P_{\_G202659} such that NP_{\_G202659}/NP_{\_G202690}=3
towards P_{\_G202659} N P_{\_G202690} 3
cmark_r P_{\_G202659}
color 200 200 200
drawsegment N P_{\_G202659}
color 0 0 0

% Constructing a line L_{\_G202620} which passes through point H and point P_{\_G202659}
line L_{\_G202620} H P_{\_G202659}

color 200 200 200
drawline L_{\_G202620}
color 0 0 0


% Constructing a line L_{\_G202583} which contains the point P_{\_G202614} and is parallel to the
    line L_{\_G202620}
parallel L_{\_G202583} P_{\_G202614} L_{\_G202620}

color 200 200 200
drawline L_{\_G202583}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G202583} and line L_{\_G202589}
intersec G L_{\_G202583} L_{\_G202589}
cmark_t G



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points A and E_{a} are not the same
% Constructing a line h_{a} which passes through point A and point E_{a}
line h_{a} A E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G203585} which is a foot of the point N on the line h_{a}
foot P_{\_G203585} N h_{a}
cmark_r P_{\_G203585}
color 200 200 200
drawline N P_{\_G203585}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G203585}
sim H_{a} P_{\_G203585} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

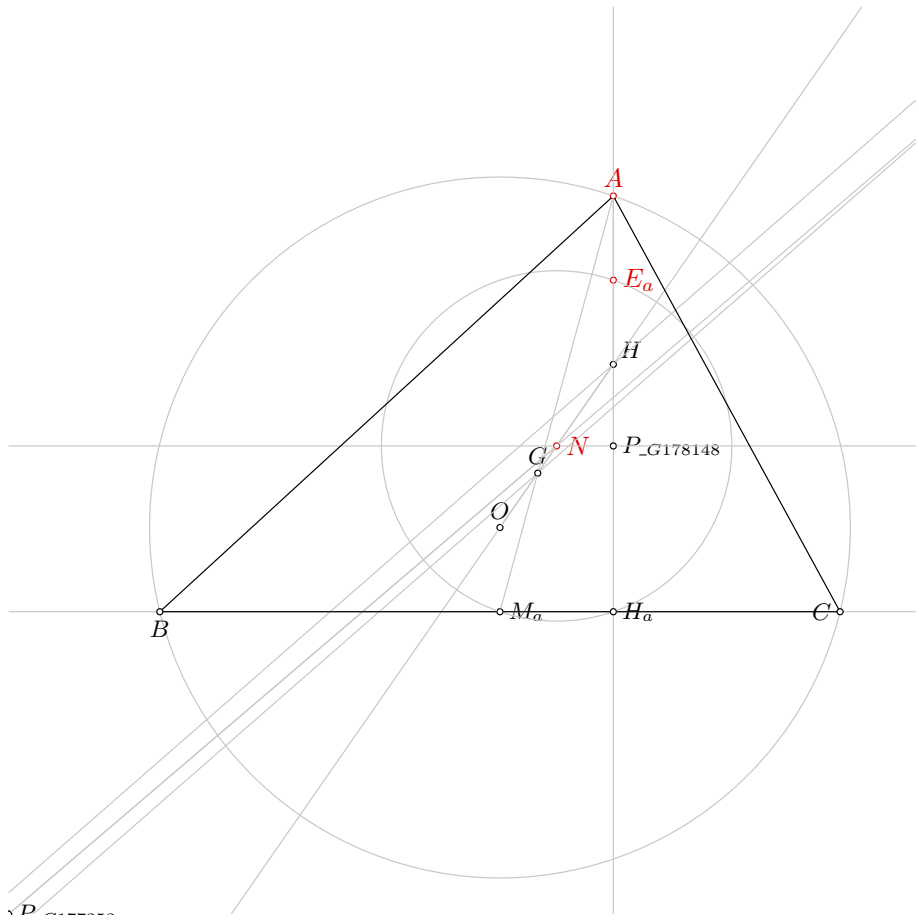

Figure 1: Illustration of the problem 0580

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points E_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and E_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=$\_E_a$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{P_{\_G178624}NH} \neq S_{P^0_{L_{\_G178593}}NH}$ i.e., lines $P_{\_G178624}P^0_{L_{\_G178593}}$ and NH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^4_{\_m_b}} \neq S_{F^3_{\_m_a}\_M_bF^4_{\_m_b}}$ i.e., lines $\_M_aF^3_{\_m_a}$ and $\_M_bF^4_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.2 Proving E_a=$\_E_a$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 581

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 581: Given a point A, a point E_a and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point O and the point H, construct a point N (rule W01); ;
3. Using the point O and the point H, construct a point G (rule W01); ;
4. Using the point A and the point G, construct a point M_a (rule W01); ;
5. Using the point A and the point E_a, construct a line h_a (rule W02); % DET: points A and E_a are not the same;
6. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
7. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
9. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and E_a are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L19,L22,L55,L58]

Solving time: 9.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{a} 80 83.86
point O 65 51.14

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{a}
cmark_t O
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point N such that ON/OH=0.5
towards N O H 0.5
cmark_r N
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a line L_{\_G231111} which passes through point O and point H
line L_{\_G231111} O H

color 200 200 200
drawline L_{\_G231111}
color 0 0 0


% Constructing a point P_{\_G231212} with coordinates (0,0)
point P_{\_G231212} 0 0
```

```
cmark_r P_{\_G231212}

% Constructing a point P_{\_G231136} such that OP_{\_G231136}/OP_{\_G231212}=1
towards P_{\_G231136} O P_{\_G231212} 1
cmark_r P_{\_G231136}
color 200 200 200
drawsegment O P_{\_G231136}
color 0 0 0

% Constructing a point P_{\_G231181} such that OP_{\_G231181}/OP_{\_G231212}=3
towards P_{\_G231181} O P_{\_G231212} 3
cmark_r P_{\_G231181}
color 200 200 200
drawsegment O P_{\_G231181}
color 0 0 0

% Constructing a line L_{\_G231142} which passes through point H and point P_{\_G231181}
line L_{\_G231142} H P_{\_G231181}

color 200 200 200
drawline L_{\_G231142}
color 0 0 0


% Constructing a line L_{\_G231105} which contains the point P_{\_G231136} and is parallel to the
    line L_{\_G231142}
parallel L_{\_G231105} P_{\_G231136} L_{\_G231142}

color 200 200 200
drawline L_{\_G231105}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G231105} and line L_{\_G231111}
intersec G L_{\_G231105} L_{\_G231111}
cmark_t G



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points A and E_{a} are not the same
% Constructing a line h_{a} which passes through point A and point E_{a}
line h_{a} A E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G232099} which is a foot of the point N on the line h_{a}
foot P_{\_G232099} N h_{a}
cmark_r P_{\_G232099}
color 200 200 200
drawline N P_{\_G232099}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G232099}
sim H_{a} P_{\_G232099} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

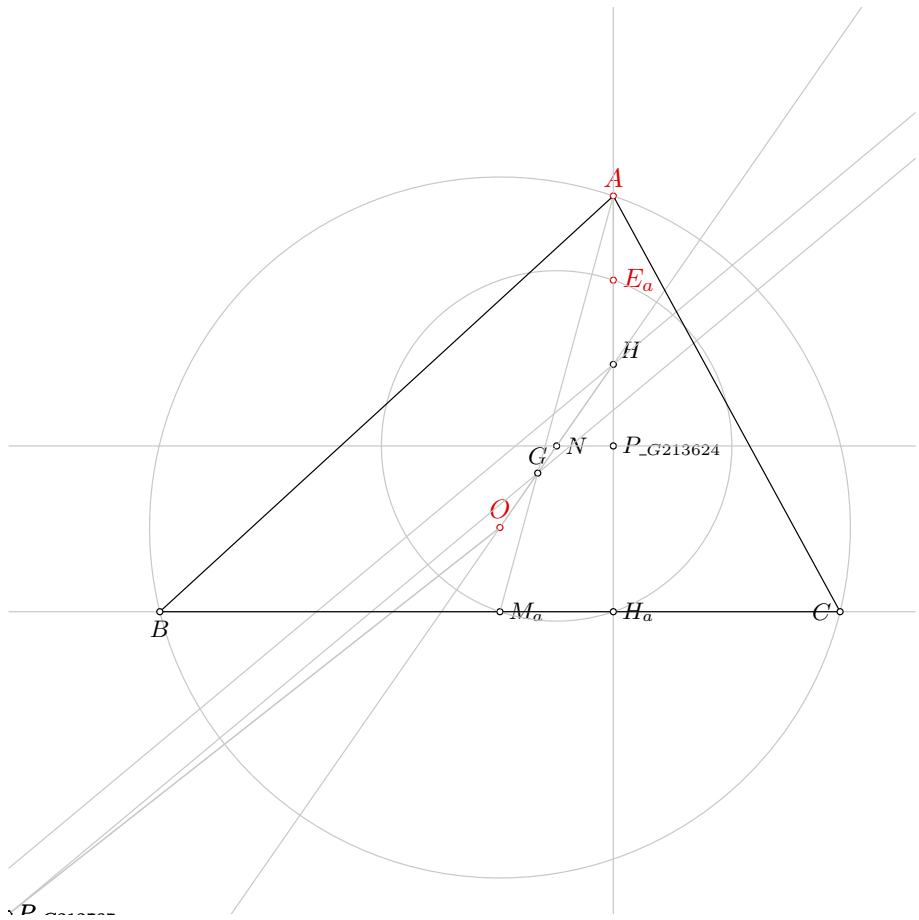

Figure 1: Illustration of the problem 0581

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points E_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and E_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=$\_E_a$

Proving failed

4.1.3 Proving O=$\_O$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{P\_G214106OH} \neq S_{P^0_{L\_G214075}OH}$ i.e., lines $P\_G214106P^0_{L\_G214075}$ and OH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^4_{\_m_b}} \neq S_{F^3_{\_m_a}\_M_bF^4_{\_m_b}}$ i.e., lines $\_M_aF^3_{\_m_a}$ and $\_M_bF^4_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving E_a=$\_E_a$

Proving failed

4.3.3 Proving O=$\_O$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving $O{=}\_O$

Proving failed

Problem 582

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 582: Given a point A, a point E_a and a point T_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point E_a, construct a point H (rule W01); ;
2. Using the point A and the point E_a, construct a line h_a (rule W02); % DET: points A and E_a are not the same;
3. Using the point A and the point T_a, construct a line s_a (rule W02); % DET: points A and T_a are not the same;
4. Using the point T_a and the line h_a, construct a line a (rule W10a); ;
5. Using the point E_a, the point A, the point T_a, the line s_a and the line h_a, construct a line AO (rule W17); % NDG: points A and T_a are not the same; points E_a and A are not the same % DET: points A and T_a are not the same;
6. Using the point E_a and the line AO, construct a line $m(H_bH_c)$ (rule W16); ;
7. Using the line $m(H_bH_c)$ and the line a, construct a point M_a (rule W03); % NDG: lines $m(H_bH_c)$ and a are not parallel % DET: lines $m(H_bH_c)$ and a are not the same;
8. Using the point M_a and the point A, construct a point G (rule W01); ;
9. Using the point H and the point G, construct a point O (rule W01); ;
10. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
11. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; lines $m(H_bH_c)$ and a are not parallel; points A and T_a are not the same; points E_a and A are not the same.

Determination conditions: lines $m(H_bH_c)$ and a are not the same; points A and T_a are not the same; points A and T_a are not the same; points A and E_a are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W16,W17]

Lemmas used: [D21,D23,D26,D28,D3,D8,GD01,GD02,GL01,GL03,GL04,GL09,GL17,L104,L11,L12,L38,L39,L4

Solving time: 27.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{a} 80 83.86
point T_{a} 70.86 40

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{a}
cmark_rb T_{a}
color 0 0 0
fontsize 8


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and E_{a} are not the same
% Constructing a line h_{a} which passes through point A and point E_{a}
line h_{a} A E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% DET: points A and T_{a} are not the same
% Constructing a line s_{a} which passes through point A and point T_{a}
line s_{a} A T_{a}

color 200 200 200
drawline s_{a}
color 0 0 0
```

```
% Constructing a line a which is perpendicular to line h_{a} and which passes through point T_{a}
perp a T_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and T_{a} are not the same; points E_{a} and A are not the same% DET: points A and
    T_{a} are not the same
% Constructing an angle V[_G6421] which is equal to the angle E_{a}AT_{a}
angle_o V[_G6421] E_{a} A T_{a}


% Calculating value angle[_G6500] using formula 1/pow(2,0)*V[_G6421]+0/pow(2,0)*180
expression angle[_G6500] { 1/pow(2,0)*V[_G6421]+0/pow(2,0)*180 }


% Constructing a point P_{\_G6497} which is an image of the point T_{a} in a rotation around the
    point A for the angle 1/pow(2,0)*V[_G6421]+0/pow(2,0)*180
rotate P_{\_G6497} A angle[_G6500] T_{a}
cmark_r P_{\_G6497}
color 200 200 200
drawarc_p A T_{a} angle[_G6500]
color 0 0 0

% Constructing a line AO which passes through point A and point P_{\_G6497}
line AO A P_{\_G6497}

color 200 200 200
drawline AO
color 0 0 0



% Constructing a line m(H_{b}H_{c}) which contains the point E_{a} and is parallel to the line AO
parallel m(H_{b}H_{c}) E_{a} AO

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: lines m(H_{b}H_{c}) and a are not parallel% DET: lines m(H_{b}H_{c}) and a are not the same
% Constructing a point M_{a} which belongs to line m(H_{b}H_{c}) and line a
intersec M_{a} m(H_{b}H_{c}) a
cmark_r M_{a}



% Constructing a line L_{\_G7014} which passes through point M_{a} and point A
```

```
line L_{\_G7014} M_{a} A

color 200 200 200
drawline L_{\_G7014}
color 0 0 0


% Constructing a point P_{\_G7115} with coordinates (0,0)
point P_{\_G7115} 0 0
cmark_r P_{\_G7115}

% Constructing a point P_{\_G7039} such that M_{a}P_{\_G7039}/M_{a}P_{\_G7115}=1
towards P_{\_G7039} M_{a} P_{\_G7115} 1
cmark_r P_{\_G7039}
color 200 200 200
drawsegment M_{a} P_{\_G7039}
color 0 0 0

% Constructing a point P_{\_G7084} such that M_{a}P_{\_G7084}/M_{a}P_{\_G7115}=3
towards P_{\_G7084} M_{a} P_{\_G7115} 3
cmark_r P_{\_G7084}
color 200 200 200
drawsegment M_{a} P_{\_G7084}
color 0 0 0

% Constructing a line L_{\_G7045} which passes through point A and point P_{\_G7084}
line L_{\_G7045} A P_{\_G7084}

color 200 200 200
drawline L_{\_G7045}
color 0 0 0


% Constructing a line L_{\_G7008} which contains the point P_{\_G7039} and is parallel to the line
    L_{\_G7045}
parallel L_{\_G7008} P_{\_G7039} L_{\_G7045}

color 200 200 200
drawline L_{\_G7008}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G7008} and line L_{\_G7014}
intersec G L_{\_G7008} L_{\_G7014}
cmark_t G



% Constructing a point O such that HO/HG=1.5
towards O H G 1.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0
```

```
% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    lines m(H_{b}H_{c}) and a are not parallel; points A and T_{a} are not the same; points E_{a}
    and A are not the same
% Determination conditions: lines m(H_{b}H_{c}) and a are not the same; points A and T_{a} are not
    the same; points A and T_{a} are not the same; points A and E_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 103 terms.

Time Complexity: Time spent by the prover is 4.005 seconds.

NDG conditions Points A and B are not identical

Points T_a, A and H are not collinear

Line through points $P\_{G256897}$ and A is not perpendicular to line through points A and E_a

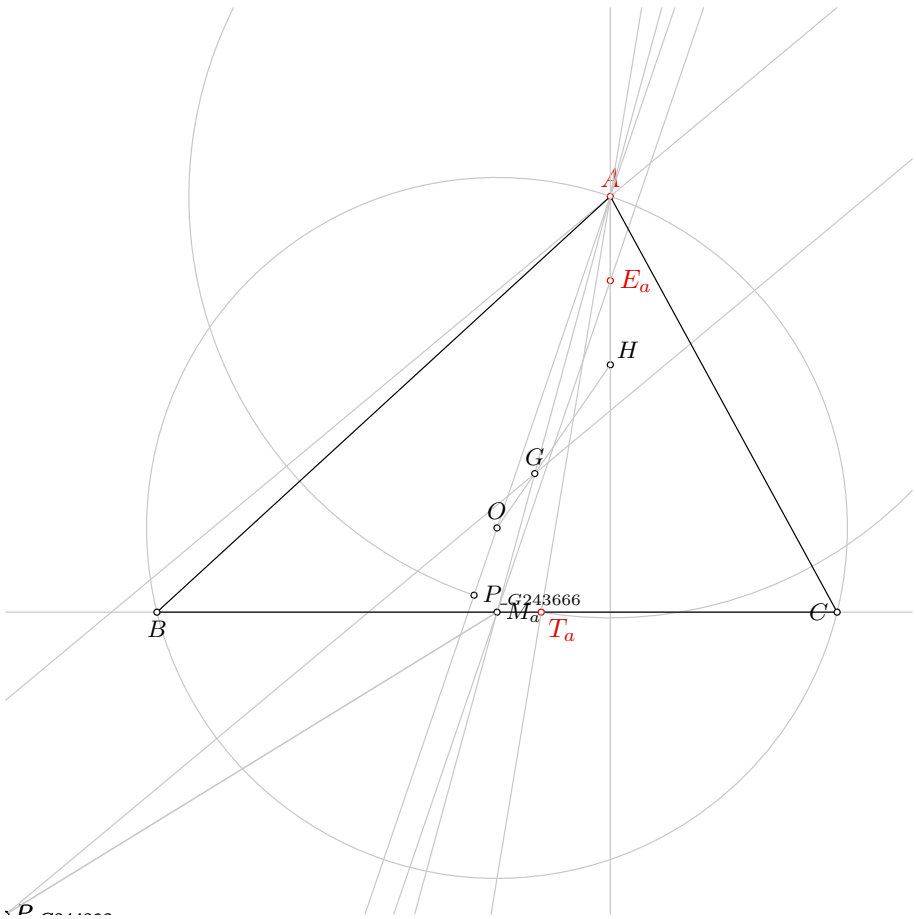

Figure 1: Illustration of the problem 0582

Points A, $P_{\_G257295}$ and M_a are not collinear

Points A and $P_{\_G257295}$ are not identical

Line through points A and E_a is not parallel with line through points B and C

4.1.3 Proving T_a=$\_T_a$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{T_aAE_a} \neq 0$ i.e., points T_a, A and E_a are not collinear (foot is not the point itself; construction based assumption)

$S_{E_aT_aF_a^0} \neq S_{P^1_{m(H_bH_c)}T_aF_a^0}$ i.e., lines $E_aP^1_{m(H_bH_c)}$ and $T_aF_a^0$ are not parallel (construction based assumption)

$S_{P_{\_G246088}M_aA} \neq S_{P^2_{L_{\_G246057}}M_aA}$ i.e., lines $P_{\_G246088}P^2_{L_{\_G246057}}$ and M_aA are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving T_a=$\_T_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_a=$\_E_a$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 3720 terms.

Time Complexity: Time spent by the prover is 8.090 seconds.There are no ndg conditions.

4.3.3 Proving T_a=$\_T_a$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 8 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving $T_a{=}\_T_a$

Proving failed

Problem 583

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 583: Given a point A, a point E_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 584

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 584: Given a point A, a point E_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 585

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 585: Given a point A, a point E_b and a point E_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 586

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 586: Given a point A, a point E_b and a point G, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 587

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 587: Given a point A, a point E_b and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point H, construct a point E_a (rule W01); ;
2. Using the point E_b and the point H, construct a point B (rule W01); ;
3. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
4. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
5. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
6. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
7. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
8. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
9. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
10. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; line c and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines h_c and b are not the same; points H_b and A are not the same; points H and H_b must be different; points H_c and H are not the same; points A and H_c must be different; points E_b and H are not the same; points A and B are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D29,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 11.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{b} 50 56.36
point H 80 72.73

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{b}
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0
```

```
% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G41621} which is a foot of the point E_{a} on the line c
foot P_{\_G41621} E_{a} c
cmark_r P_{\_G41621}
color 200 200 200
drawline E_{a} P_{\_G41621}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    41621}
sim H_{c} P_{\_G41621} A
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G41859} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G41859} E_{a} h_{b}
cmark_r P_{\_G41859}
color 200 200 200
drawline E_{a} P_{\_G41859}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    41859}
sim H_{b} P_{\_G41859} H
cmark_l H_{b}
```

```
% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; line c and circle k(E_{a},A) intersect; points A and E_{a} are not the same
% Determination conditions: lines h_{c} and b are not the same; points H_{b} and A are not the same
    ; points H and H_{b} must be different; points H_{c} and H are not the same; points A and H_{c}
     must be different; points E_{b} and H are not the same; points A and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving H=_H

Proving failed

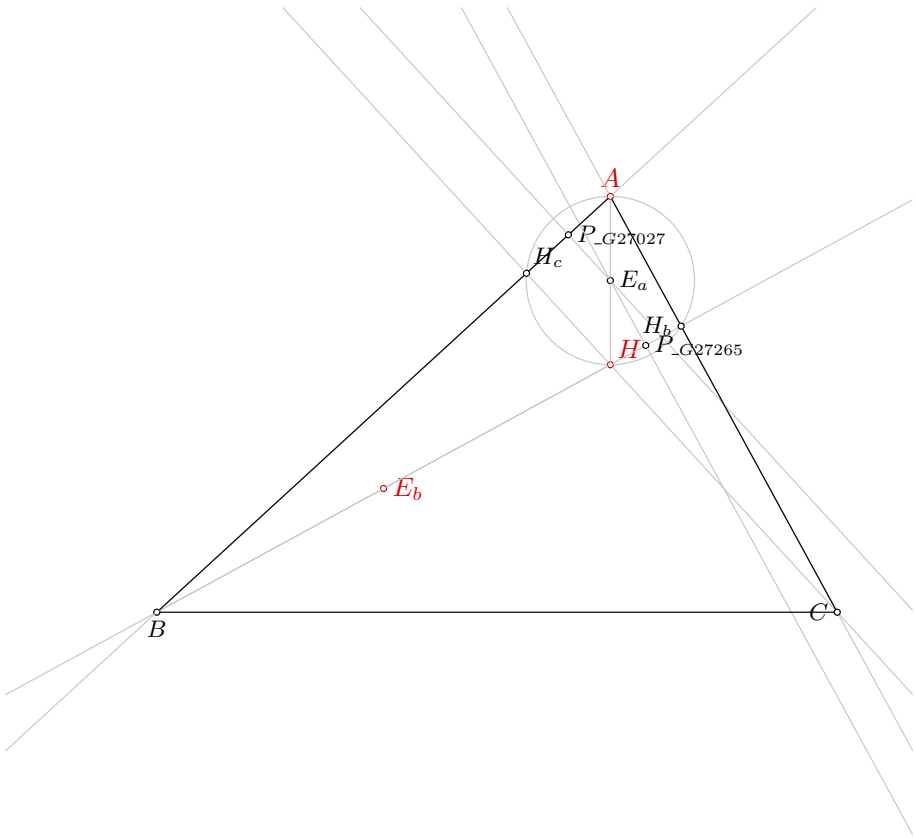

Figure 1: Illustration of the problem 0587

4.2 GCLC - Area method

4.2.1 Proving $A{=}A$

NDG conditions are:

$S_{H_cH_bA} \neq S_{HH_bA}$ i.e., lines H_cH and H_bA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_b{=}\_E_b$

Proving failed

4.2.3 Proving $H{=}\_H$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_b{=}\_E_b$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 767 terms.

Time Complexity: Time spent by the prover is 0.520 seconds.There are no ndg conditions.

4.3.3 Proving $H{=}\_H$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 138 terms.

Time Complexity: Time spent by the prover is 0.090 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_b{=}\_E_b$

Proving failed

4.4.3 Proving $H{=}\_H$

Proving failed

Problem 588

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 588: Given a point A, a point E_b and a point H_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;
2. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;
3. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H_a, construct a point H (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H_a and H must be different;
4. Using the point E_b and the point H, construct a point B (rule W01); ;
5. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
6. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
7. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
8. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
9. Using the line a and the line h_c, construct a point C (rule W03); % NDG: lines a and h_c are not parallel % DET: lines a and h_c are not the same.

Non-degenerate conditions: lines a and h_c are not parallel; line c and circle $k(E_b, B)$ intersect; line h_a and circle $k(E_b, B)$ intersect; points H_a and E_b are not the same.

Determination conditions: lines a and h_c are not the same; points H and H_c are not the same; points B and H_c must be different; points H_a and B are not the same; points A and B are not the same; points H_a and H must be different; points A and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,L3,L49,L50,L51]

Solving time: 8.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{b} 50 56.36
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{b}
cmark_r H_{a}
color 0 0 0
fontsize 8

% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H_{a} and H must be different
% Constructing a point P_{\_G63395} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G63395} E_{b} h_{a}
cmark_r P_{\_G63395}
color 200 200 200
drawline E_{b} P_{\_G63395}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    63395}
sim H P_{\_G63395} H_{a}
cmark_rt H



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G63758} which is a foot of the point E_{b} on the line c
foot P_{\_G63758} E_{b} c
cmark_r P_{\_G63758}
color 200 200 200
drawline E_{b} P_{\_G63758}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    63758}
sim H_{c} P_{\_G63758} B
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
```

```
color 0 0 0



% NDG: lines a and h_{c} are not parallel% DET: lines a and h_{c} are not the same
% Constructing a point C which belongs to line a and line h_{c}
intersec C a h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{c} are not parallel; line c and circle k(E_{b},B)
    intersect; line h_{a} and circle k(E_{b},B) intersect; points H_{a} and E_{b} are not the same
% Determination conditions: lines a and h_{c} are not the same; points H and H_{c} are not the same
    ; points B and H_{c} must be different; points H_{a} and B are not the same; points A and B are
     not the same; points H_{a} and H must be different; points A and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=$\_E_b$

Proving failed

4.1.3 Proving H_a=$\_H_a$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_aHH_c} \neq S_{BHH_c}$ i.e., lines H_aB and HH_c are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

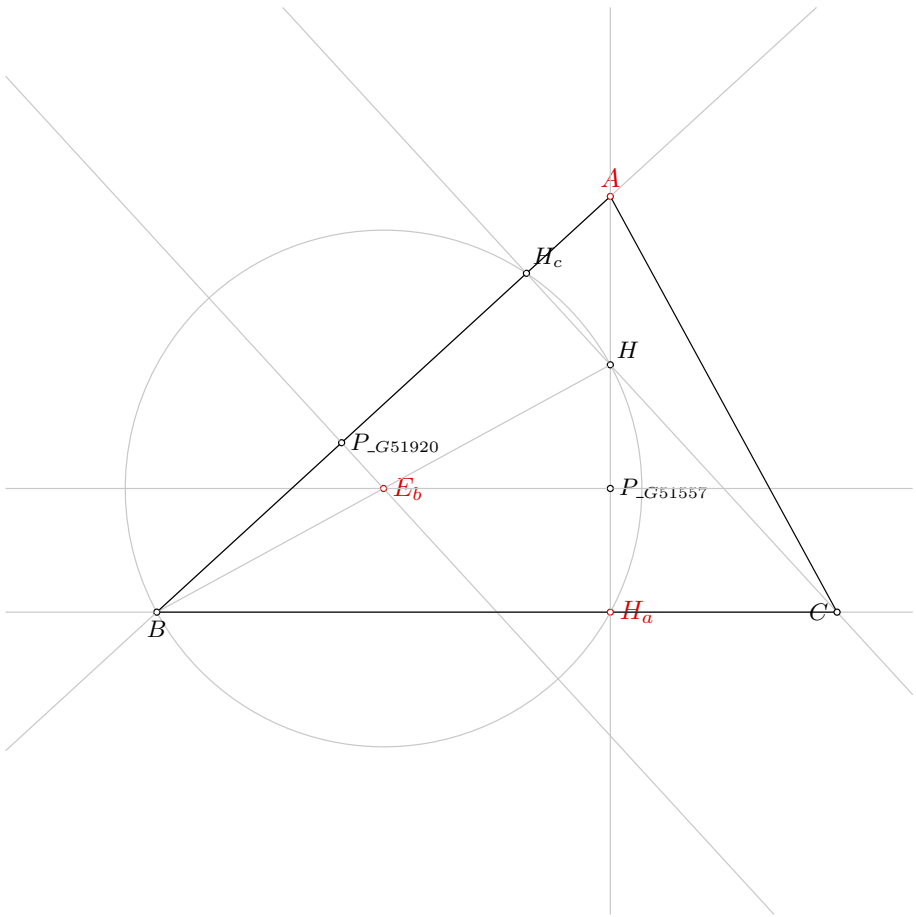

Figure 1: Illustration of the problem 0588

$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=_E_b

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Proving failed

4.3.2 Proving E_b=_E_b

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Proving failed

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 589

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 589: Given a point E_b, a point H_b and a point A, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Using the point H_b and the line h_b, construct a line b (rule W10a); ;
3. Choose freely a point A on the line b (rule WOnline2);
4. Choose freely a point B on the line h_b (rule WOnline1) ;
5. Using the point B and the point E_b, construct a point H (rule W01); ;
6. Using the point B and the point A, construct a line c (rule W02); % DET: points B and A are not the same;
7. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
8. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
9. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
10. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same.

Non-degenerate conditions: lines b and h_c are not parallel; line c and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines b and h_c are not the same; points H and H_c are not the same; points B and H_c must be different; points B and A are not the same; points E_b and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,WOnline1,WOnline2]

Lemmas used: [D10,D29,D3,D6,D7,D9,GD01,GD02,GL03,GL09,L3,L51]

Solving time: 63.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{b} 89.36 77.83
point A 80 95

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_l H_{b}
cmark_t A
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0




% Constructing a line b which is perpendicular to line h_{b} and which passes through point H_{b}
perp b H_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0




% Generating random value V[_G85528]
random V[_G85528]


% Calculating value V[_G85549] using formula V[_G85528]*20
expression V[_G85549] { V[_G85528]*20 }
```

```
% Constructing a point A which is a point for which holds H_{b}A = V[_G85549] and angle E_{b}H_{b}A
     = 90
turtle A E_{b} H_{b} 90 V[_G85549]
cmark_t A



% Choosing randomly a point B on the line E_{b}H_{b}
online B E_{b} H_{b}
cmark_b B
color 200 200 200
drawline E_{b} H_{b}
color 0 0 0



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points B and A are not the same
% Constructing a line c which passes through point B and point A
line c B A

color 200 200 200
drawline c
color 0 0 0



% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G86069} which is a foot of the point E_{b} on the line c
foot P_{\_G86069} E_{b} c
cmark_r P_{\_G86069}
color 200 200 200
drawline E_{b} P_{\_G86069}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    86069}
sim H_{c} P_{\_G86069} B
```

```
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line c and circle k(E_{b},B)
    intersect; points B and E_{b} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H and H_{c} are not the same
    ; points B and H_{c} must be different; points B and A are not the same; points E_{b} and H_{b}
     are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 55 terms.

Time Complexity: Time spent by the prover is 0.955 seconds.

NDG conditions Points A and B are not identical

Point E_b is not on circle with center H_b and point from it B

Line through points B and H_c is not perpendicular to line through points H_c and E_b

Points A, C and E_b are not collinear

4.1.2 Proving H_b=_H_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

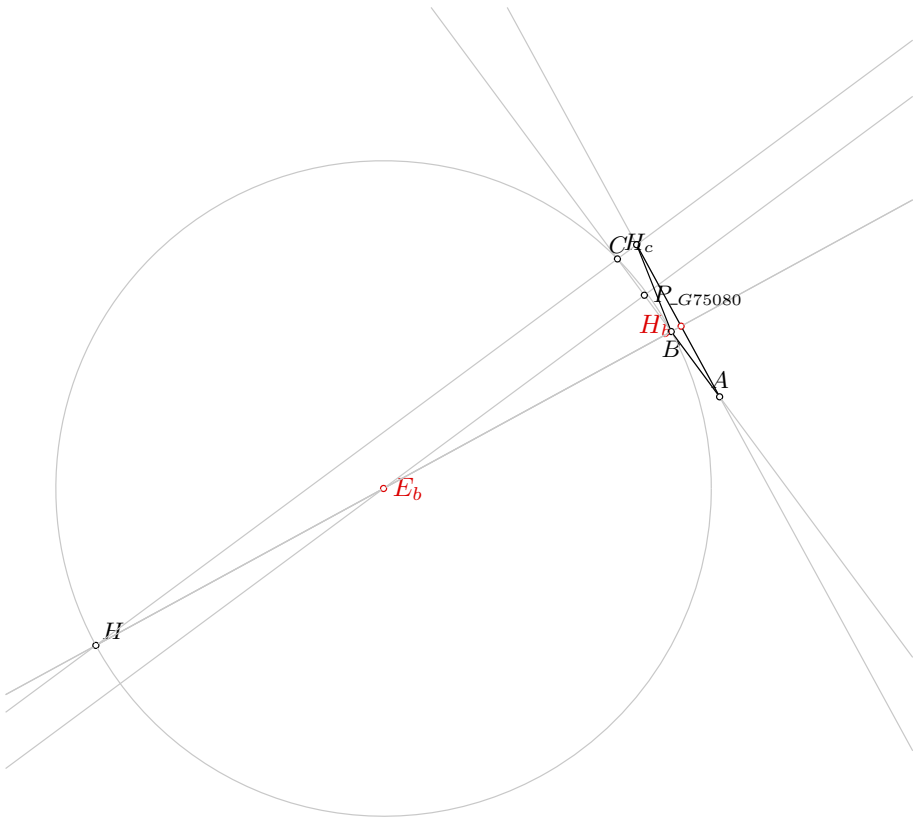

Figure 1: Illustration of the problem 0589

Time Complexity: Time spent by the prover is 0.152 seconds.

NDG conditions Points A and B are not identical

Point E_b is not on circle with center H_b and point from it B

Line through points B and H_c is not perpendicular to line through points H_c and E_b

Points A, C and E_b are not collinear

4.1.3 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.013 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving A=A

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving H_b=_H_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 16 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.3 Proving A=A

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 20 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving H_b=$\_H_b$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 20 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.4.3 Proving A=A

Proving failed

Problem 590

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 590: Given a point A, a point E_b and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;
2. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
3. Using the circle $k(E_b, B)$, the line c, the point E_b and the point H_c, construct a point B (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points H_c and B must be different;
4. Using the point E_b and the point B, construct a point H (rule W01); ;
5. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
6. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
7. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H and H_a must be different;
8. Using the point B and the point H_a, construct a line a (rule W02); % DET: points B and H_a are not the same;
9. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; line h_a and circle $k(E_b, B)$ intersect; line c and circle $k(E_b, B)$ intersect; points H_c and E_b are not the same.

Determination conditions: lines h_c and a are not the same; points B and H_a are not the same; points H and H_a must be different; points H_c and H are not the same; points A and H are not the same; points H_c and B must be different; points A and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,L3,L49,L50,L51]

Solving time: 8.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{b} 50 56.36
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{b}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points H_{c} and B must be different
% Constructing a point P_{\_G108276} which is a foot of the point E_{b} on the line c
foot P_{\_G108276} E_{b} c
cmark_r P_{\_G108276}
color 200 200 200
drawline E_{b} P_{\_G108276}
color 0 0 0
```

```
% Constructing a point B which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    108276}
sim B P_{\_G108276} H_{c}
cmark_b B


% Constructing a point H such that E_{b}H/E_{b}B=-1
towards H E_{b} B -1
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G108639} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G108639} E_{b} h_{a}
cmark_r P_{\_G108639}
color 200 200 200
drawline E_{b} P_{\_G108639}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    108639}
sim H_{a} P_{\_G108639} H
cmark_r H_{a}


% DET: points B and H_{a} are not the same
% Constructing a line a which passes through point B and point H_{a}
line a B H_{a}

color 200 200 200
drawline a
```

```
color 0 0 0



% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; line h_{a} and circle k(E_{b},B)
    intersect; line c and circle k(E_{b},B) intersect; points H_{c} and E_{b} are not the same
% Determination conditions: lines h_{c} and a are not the same; points B and H_{a} are not the same
    ; points H and H_{a} must be different; points H_{c} and H are not the same; points A and H are
     not the same; points H_{c} and B must be different; points A and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving H_c=_H_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 1176 terms.

Time Complexity: Time spent by the prover is 7.687 seconds.

NDG conditions Points A, H_c and E_b are not collinear

Points A, H_c and E_b are not collinear

Points A and H are not identical

Points A and H are not identical

Line through points B and H_a is not parallel with line through points H_c and H

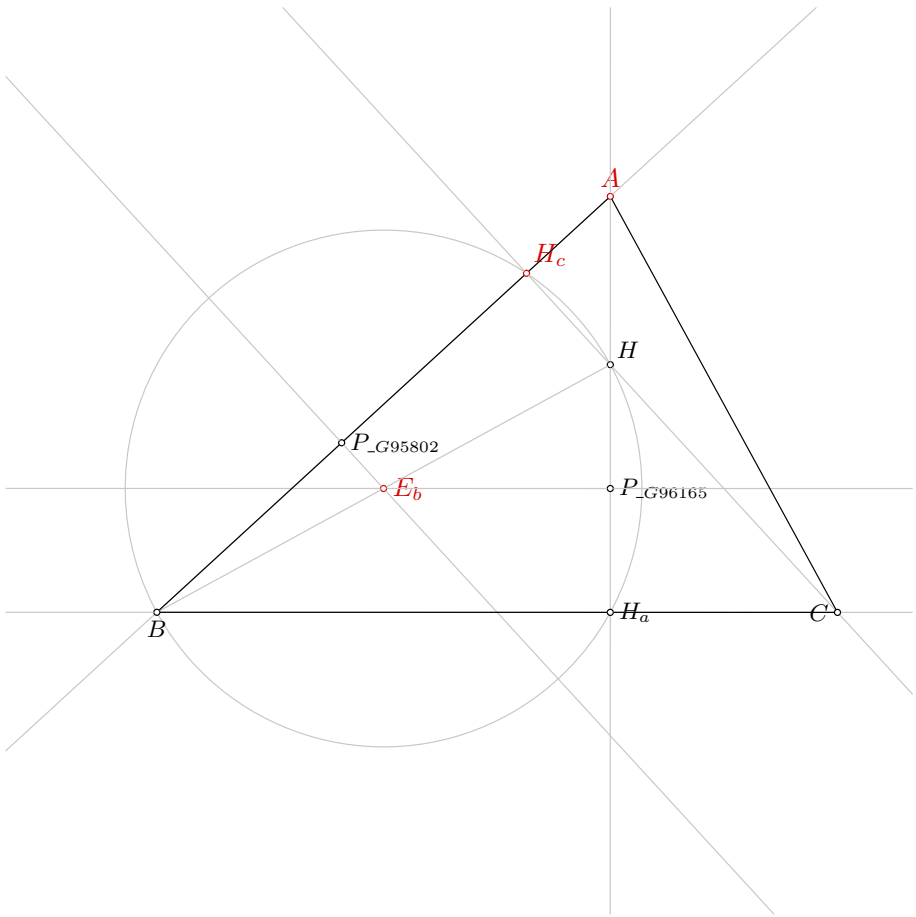

Figure 1: Illustration of the problem 0590

Line through points A and E_b is not parallel with line through points H_c and H

Points A and B are not identical

Points A, B and E_b are not collinear

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_cBH_a} \neq S_{HBH_a}$ i.e., lines H_cH and BH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^2_{\_h_c}} \neq S_{BCF^2_{\_h_c}}$ i.e., lines AB and $CF^2_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving H_c=$\_H_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Proving failed

4.3.2 Proving E_b=$\_E_b$

Proving failed

4.3.3 Proving H_c=$\_H_c$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Proving failed

4.4.2 Proving E_b=$\_E_b$

Proving failed

4.4.3 Proving H_c=$\_H_c$

Proving failed

Problem 591

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 591: Given a point A, a point E_b and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 592

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 592: Given a point A, a point E_b and a point M_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 593

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 593: Given a point A, a point E_b and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point M_b, construct a point C (rule W01); ;
2. Using the point A and the point M_b, construct a line b (rule W02); % DET: points A and M_b are not the same;
3. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
4. Using the point E_b and the line b, construct a line h_b (rule W10b); ;
5. Using the line h_b and the line b, construct a point H_b (rule W03); % NDG: lines h_b and b are not parallel % DET: lines h_b and b are not the same;
6. Using the point A and the point H_b, construct a line $m(AH_b)$ (rule W14); % DET: points A and H_b are not the same;
7. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;
8. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;
9. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
10. Using the circle $k(N, M_a)$ and the line $m(AH_b)$, construct a point M_c and a point E_a (rule W04); % NDG: line $m(AH_b)$ and circle $k(N, M_a)$ intersect;

11. Using the point M_c and the point A, construct a point B (rule W01); .

Non-degenerate conditions: line $m(AH_b)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel; lines h_b and b are not parallel.

Determination conditions: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points A and H_b are not the same; lines h_b and b are not the same; points E_b and M_b are not the same; points A and M_b are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14]

Lemmas used: [D20,D22,D29,D3,D32,D6,D9,GD01,GD02,GL01,GL03,GL04,GL09,L17,L18,L19,L21,L22,L23,L

Solving time: 2.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{b} 50 56.36
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{b}
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and M_{b} are not the same
% Constructing a line b which passes through point A and point M_{b}
line b A M_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
```

```
color 0 0 0



% Constructing a line h_{b} which is perpendicular to line b and which passes through point E_{b}
perp h_{b} E_{b} b

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines h_{b} and b are not parallel% DET: lines h_{b} and b are not the same
% Constructing a point H_{b} which belongs to line h_{b} and line b
intersec H_{b} h_{b} b
cmark_l H_{b}


% DET: points A and H_{b} are not the same
% Constructing bisector m(AH_{b}) of the segment AH_{b}
med m(AH_{b}) A H_{b}

color 200 200 200
drawline m(AH_{b})
color 0 0 0

color 200 200 200
drawsegment A H_{b}
color 0 0 0


% DET: points E_{b} and M_{b} are not the same
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0


% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(AH_{b}) and circle k(N,M_{a}) intersect
% Constructing points M_{c} and E_{a} which are in intersection of k(N,M_{a}) and m(AH_{b})
intersec2 M_{c} E_{a} k(N,M_{a}) m(AH_{b})
cmark_lt M_{c}
cmark_r E_{a}



% Constructing a point B such that M_{c}B/M_{c}A=-1
towards B M_{c} A -1
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(AH_{b}) and circle k(N,M_{a}) intersect; points E_{b} and N are
     not the same; lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel; lines h_{b} and b are
    not parallel
% Determination conditions: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the same; points E_{b}
    and M_{b} are not the same; points A and H_{b} are not the same; lines h_{b} and b are not the
    same; points E_{b} and M_{b} are not the same; points A and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

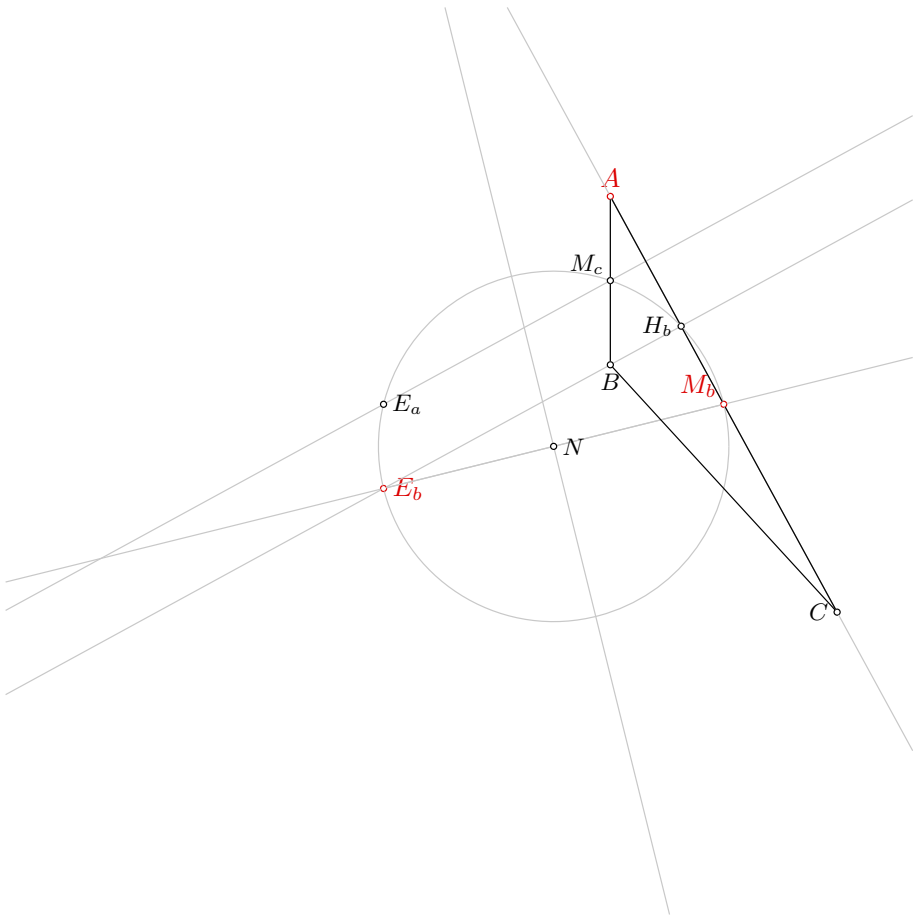

Figure 1: Illustration of the problem 0593

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{E_bAM_b} \neq 0$ i.e., points E_b, A and M_b are not collinear (foot is not the point itself; construction based assumption)

$S_{E_bAM_b} \neq S_{F^0_{h_b}AM_b}$ i.e., lines $E_bF^0_{h_b}$ and AM_b are not parallel (construction based assumption)

$S_{M^3_{m(E_bM_b)}E_bM_b} \neq S_{T^4_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^3_{m(E_bM_b)}T^4_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=_E_b

Proving failed

4.2.3 Proving M_b=_M_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_b=_E_b

Proving failed

4.3.3 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 13 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 594

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 594: Given a point A, a point E_b and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point M_c, construct a point B (rule W01); ;
2. Using the point E_b and the point B, construct a point H (rule W01); ;
3. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
4. Using the point E_b and the point B, construct a line h_b (rule W02); % DET: points E_b and B are not the same;
5. Using the point A and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points A and M_c are not the same;
6. Using the circle $k(M_c, A)$, the line h_a, the point M_c and the point A, construct a point H_a (rule W05); % NDG: line h_a and circle $k(M_c, A)$ intersect % DET: points A and H_a must be different;
7. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
8. Using the circle $k(M_c, A)$, the line h_b, the point M_c and the point B, construct a point H_b (rule W05); % NDG: line h_b and circle $k(M_c, A)$ intersect % DET: points B and H_b must be different;
9. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
10. Using the line a and the line b, construct a point C (rule W03); % NDG: lines a and b are not parallel % DET: lines a and b are not the same.

Non-degenerate conditions: lines a and b are not parallel; line h_b and circle $k(M_c, A)$ intersect; line h_a and circle $k(M_c, A)$ intersect; points A and M_c are not the same.

Determination conditions: lines a and b are not the same; points H_b and A are not the same; points B and H_b must be different; points H_a and B are not the same; points A and H_a must be different; points E_b and B are not the same; points A and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D20,D29,D3,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L40,L41,L42]

Solving time: 10.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{b} 50 56.36
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{b}
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point H such that E_{b}H/E_{b}B=-1
towards H E_{b} B -1
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% DET: points E_{b} and B are not the same
% Constructing a line h_{b} which passes through point E_{b} and point B
line h_{b} E_{b} B

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points A and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point A
circle k(M_{c},A) M_{c} A

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: line h_{a} and circle k(M_{c},A) intersect% DET: points A and H_{a} must be different
% Constructing a point P_{\_G156024} which is a foot of the point M_{c} on the line h_{a}
foot P_{\_G156024} M_{c} h_{a}
cmark_r P_{\_G156024}
color 200 200 200
drawline M_{c} P_{\_G156024}
color 0 0 0

% Constructing a point H_{a} which is an image of the point A in the symmetry to point/line P_{\_G
    156024}
sim H_{a} P_{\_G156024} A
cmark_r H_{a}


% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: line h_{b} and circle k(M_{c},A) intersect% DET: points B and H_{b} must be different
% Constructing a point P_{\_G156262} which is a foot of the point M_{c} on the line h_{b}
foot P_{\_G156262} M_{c} h_{b}
cmark_r P_{\_G156262}
color 200 200 200
drawline M_{c} P_{\_G156262}
color 0 0 0

% Constructing a point H_{b} which is an image of the point B in the symmetry to point/line P_{\_G
    156262}
sim H_{b} P_{\_G156262} B
cmark_l H_{b}
```

```
% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: lines a and b are not parallel% DET: lines a and b are not the same
% Constructing a point C which belongs to line a and line b
intersec C a b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and b are not parallel; line h_{b} and circle k(M_{c},A)
    intersect; line h_{a} and circle k(M_{c},A) intersect; points A and M_{c} are not the same
% Determination conditions: lines a and b are not the same; points H_{b} and A are not the same;
    points B and H_{b} must be different; points H_{a} and B are not the same; points A and H_{a}
    must be different; points E_{b} and B are not the same; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.034 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

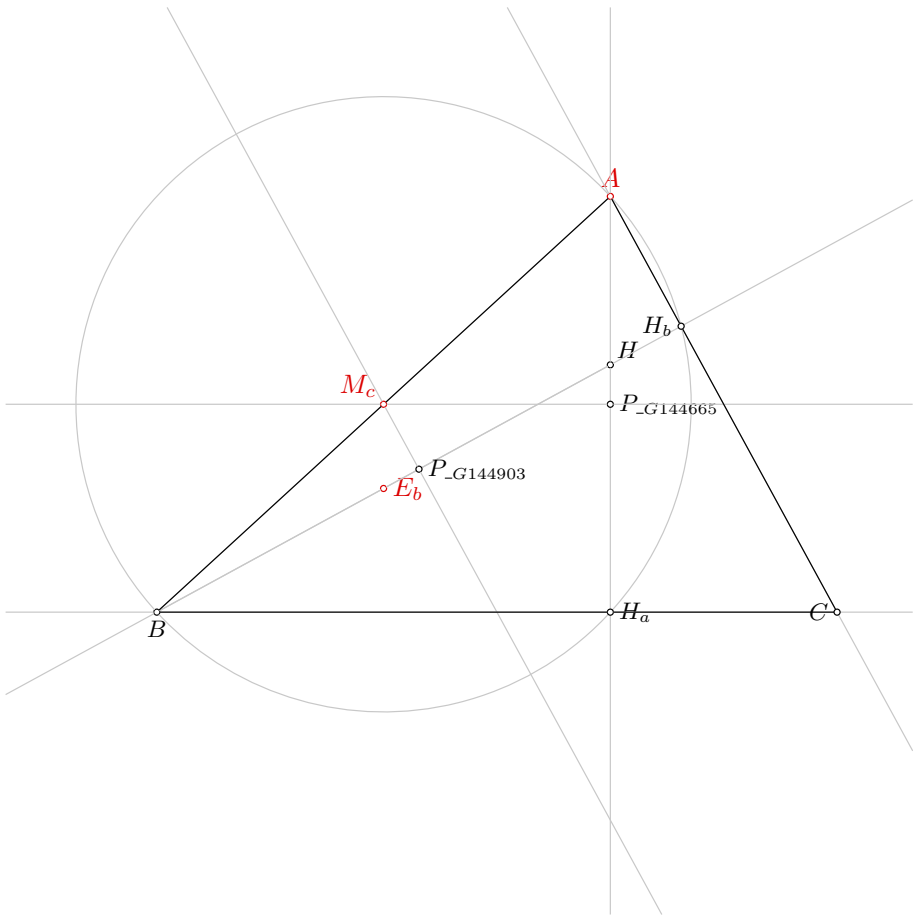

Figure 1: Illustration of the problem 0594

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_aH_bA} \neq S_{BH_bA}$ i.e., lines H_aB and H_bA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving M_c=$\_M_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving E_b=$\_E_b$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 124 terms.

Time Complexity: Time spent by the prover is 0.470 seconds.There are no ndg conditions.

4.3.3 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving E_b=$\_E_b$

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 595

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 595: Given a point A, a point E_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
2. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
3. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
4. Using the point M_b and the point A, construct a point C (rule W01); ;
5. Using the point A and the point M_b, construct a line b (rule W02); % DET: points A and M_b are not the same;
6. Using the circle $k(N, M_a)$, the line b, the point N and the point M_b, construct a point H_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points M_b and H_b must be different;
7. Using the point H_b and the point E_b, construct a line h_b (rule W02); % DET: points H_b and E_b are not the same;
8. Using the point A and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points A and M_b are not the same;
9. Using the circle $k(N, M_a)$ and the circle $k(M_b, C)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_b, C)$ intersect % DET: circles $k(N, M_a)$ and $k(M_b, C)$ are not the same;

10. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

11. Using the line h_b and the line h_a, construct a point H (rule W03); % NDG: lines h_b and h_a are not parallel % DET: lines h_b and h_a are not the same;

12. Using the point E_b and the point H, construct a point B (rule W01); .

Non-degenerate conditions: lines h_b and h_a are not parallel; circles $k(N, M_a)$ and $k(M_b, C)$ intersect; points A and M_b are not the same; line b and circle $k(N, M_a)$ intersect; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: lines h_b and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points H_b and E_b are not the same; points M_b and H_b must be different; points A and M_b are not the same; points E_b and M_b must be different; points E_b and N are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D22,D29,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L17,L19,L20,L21,L23,L43

Solving time: 4.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{b} 50 56.36
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{b}
cmark_r N
color 0 0 0
fontsize 8

% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
```

```
color 0 0 0


% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}


% Constructing a point C such that M_{b}C/M_{b}A=-1
towards C M_{b} A -1
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and M_{b} are not the same
% Constructing a line b which passes through point A and point M_{b}
line b A M_{b}

color 200 200 200
drawline b
color 0 0 0


% NDG: line b and circle k(N,M_{a}) intersect% DET: points M_{b} and H_{b} must be different
% Constructing a point P_{\_G192447} which is a foot of the point N on the line b
foot P_{\_G192447} N b
cmark_r P_{\_G192447}
color 200 200 200
drawline N P_{\_G192447}
color 0 0 0

% Constructing a point H_{b} which is an image of the point M_{b} in the symmetry to point/line P
    _{\_G192447}
sim H_{b} P_{\_G192447} M_{b}
cmark_l H_{b}


% DET: points H_{b} and E_{b} are not the same
% Constructing a line h_{b} which passes through point H_{b} and point E_{b}
line h_{b} H_{b} E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0


% NDG: points A and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point A
```

```
circle k(M_{b},C) M_{b} A

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{b},C) intersect% DET: circles k(N,M_{a}) and k(M_{b},C) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{b},C)
intersec2 H_{a} H_{c} k(N,M_{a}) k(M_{b},C)
cmark_r H_{a}
cmark_rt H_{c}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{b} and h_{a} are not parallel% DET: lines h_{b} and h_{a} are not the same
% Constructing a point H which belongs to line h_{b} and line h_{a}
intersec H h_{b} h_{a}
cmark_rt H



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{b
    },C) intersect; points A and M_{b} are not the same; line b and circle k(N,M_{a}) intersect;
    line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; points E_{b} and N are not the same
% Determination conditions: lines h_{b} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{b},C) are not the same; points H_{b} and E_{b} are not the
    same; points M_{b} and H_{b} must be different; points A and M_{b} are not the same; points E_{
    b} and M_{b} must be different; points E_{b} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

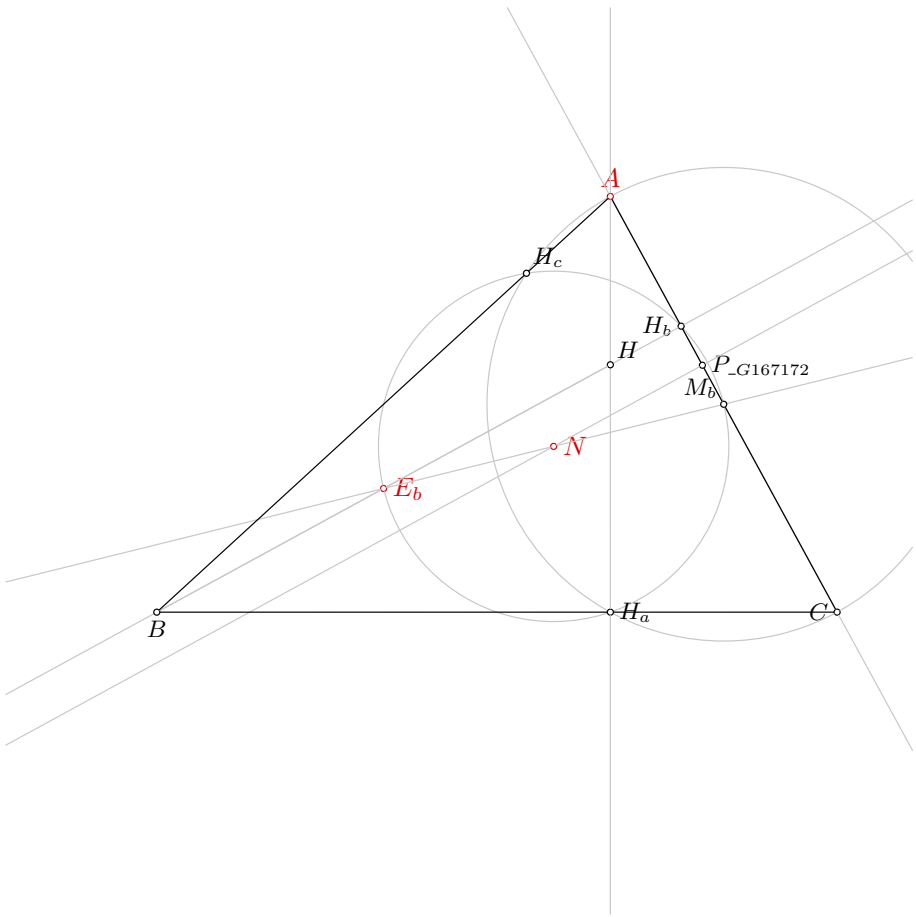

Figure 1: Illustration of the problem 0595

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.03 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=$\_E_b$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_bAH_a} \neq S_{E_bAH_a}$ i.e., lines H_bE_b and AH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Proving failed

4.3.2 Proving E_b=$\_E_b$

Proving failed

4.3.3 Proving $N{=}\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Proving failed

4.4.2 Proving $E_b{=}\_E_b$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 596

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 596: Given a point A, a point E_b and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 597

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 597: Given a point A, a point E_b and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 598

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 598: Given a point A, a point E_b and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 599

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 599: Given a point A, a point E_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 600

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 600: Given a point A, a point E_c and a point G, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 601

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 601: Given a point A, a point E_c and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point H, construct a point E_a (rule W01); ;
2. Using the point E_c and the point H, construct a point C (rule W01); ;
3. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
4. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
5. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
6. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
7. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
8. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H and H_c must be different;
9. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
10. Using the line h_b and the line c, construct a point B (rule W03); % NDG: lines h_b and c are not parallel % DET: lines h_b and c are not the same.

Non-degenerate conditions: lines h_b and c are not parallel; line h_c and circle $k(E_a, A)$ intersect; line b and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines h_b and c are not the same; points H_c and A are not the same; points H and H_c must be different; points H_b and H are not the same; points A and H_b must be different; points E_c and H are not the same; points A and C are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D3,D30,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 10.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{c} 95 56.36
point H 80 72.73

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{c}
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0
```

```
% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G229866} which is a foot of the point E_{a} on the line b
foot P_{\_G229866} E_{a} b
cmark_r P_{\_G229866}
color 200 200 200
drawline E_{a} P_{\_G229866}
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    229866}
sim H_{b} P_{\_G229866} A
cmark_l H_{b}


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G230104} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G230104} E_{a} h_{c}
cmark_r P_{\_G230104}
color 200 200 200
drawline E_{a} P_{\_G230104}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    230104}
sim H_{c} P_{\_G230104} H
cmark_rt H_{c}
```

```
% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{b} and c are not parallel% DET: lines h_{b} and c are not the same
% Constructing a point B which belongs to line h_{b} and line c
intersec B h_{b} c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and c are not parallel; line h_{c} and circle k(E_{a},A)
    intersect; line b and circle k(E_{a},A) intersect; points A and E_{a} are not the same
% Determination conditions: lines h_{b} and c are not the same; points H_{c} and A are not the same
    ; points H and H_{c} must be different; points H_{b} and H are not the same; points A and H_{b}
     must be different; points E_{c} and H are not the same; points A and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H=_H

Proving failed

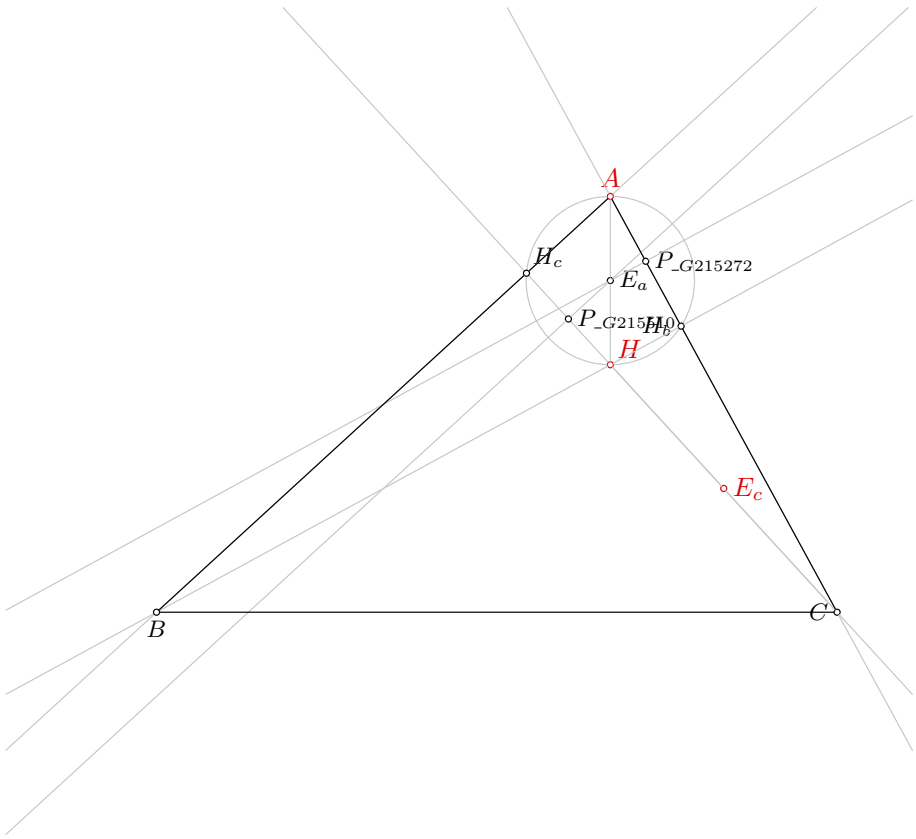

Figure 1: Illustration of the problem 0601

4.2 GCLC - Area method

4.2.1 Proving $A{=}A$

NDG conditions are:

$S_{H_bH_cA} \neq S_{HH_cA}$ i.e., lines H_bH and H_cA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_c{=}\_E_c$

Proving failed

4.2.3 Proving $H{=}\_H$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_c{=}\_E_c$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 1023 terms.

Time Complexity: Time spent by the prover is 0.760 seconds.There are no ndg conditions.

4.3.3 Proving $H{=}\_H$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 182 terms.

Time Complexity: Time spent by the prover is 0.150 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_c{=}\_E_c$

Proving failed

4.4.3 Proving $H{=}\_H$

Proving failed

Problem 602

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 602: Given a point A, a point E_c and a point H_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;
2. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;
3. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H_a, construct a point H (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H_a and H must be different;
4. Using the point E_c and the point H, construct a point C (rule W01); ;
5. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
6. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
7. Using the circle $k(E_c, C)$, the line b, the point E_c and the point C, construct a point H_b (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points C and H_b must be different;
8. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
9. Using the line a and the line h_b, construct a point B (rule W03); % NDG: lines a and h_b are not parallel % DET: lines a and h_b are not the same.

Non-degenerate conditions: lines a and h_b are not parallel; line b and circle $k(E_c, C)$ intersect; line h_a and circle $k(E_c, C)$ intersect; points H_a and E_c are not the same.

Determination conditions: lines a and h_b are not the same; points H and H_b are not the same; points C and H_b must be different; points H_a and C are not the same; points A and C are not the same; points H_a and H must be different; points A and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,L52,L53,L54]

Solving time: 8.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{c} 95 56.36
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{c}
cmark_r H_{a}
color 0 0 0
fontsize 8

% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H_{a} and H must be different
% Constructing a point P_{\_G252719} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G252719} E_{c} h_{a}
cmark_r P_{\_G252719}
color 200 200 200
drawline E_{c} P_{\_G252719}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    252719}
sim H P_{\_G252719} H_{a}
cmark_rt H


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points C and H_{b} must be different
% Constructing a point P_{\_G253082} which is a foot of the point E_{c} on the line b
foot P_{\_G253082} E_{c} b
cmark_r P_{\_G253082}
color 200 200 200
drawline E_{c} P_{\_G253082}
color 0 0 0

% Constructing a point H_{b} which is an image of the point C in the symmetry to point/line P_{\_G
    253082}
sim H_{b} P_{\_G253082} C
cmark_l H_{b}


% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
```

```
color 0 0 0



% NDG: lines a and h_{b} are not parallel% DET: lines a and h_{b} are not the same
% Constructing a point B which belongs to line a and line h_{b}
intersec B a h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{b} are not parallel; line b and circle k(E_{c},C)
    intersect; line h_{a} and circle k(E_{c},C) intersect; points H_{a} and E_{c} are not the same
% Determination conditions: lines a and h_{b} are not the same; points H and H_{b} are not the same
    ; points C and H_{b} must be different; points H_{a} and C are not the same; points A and C are
     not the same; points H_{a} and H must be different; points A and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=$\_E_c$

Proving failed

4.1.3 Proving H_a=$\_H_a$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_aHH_b} \neq S_{CHH_b}$ i.e., lines H_aC and HH_b are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

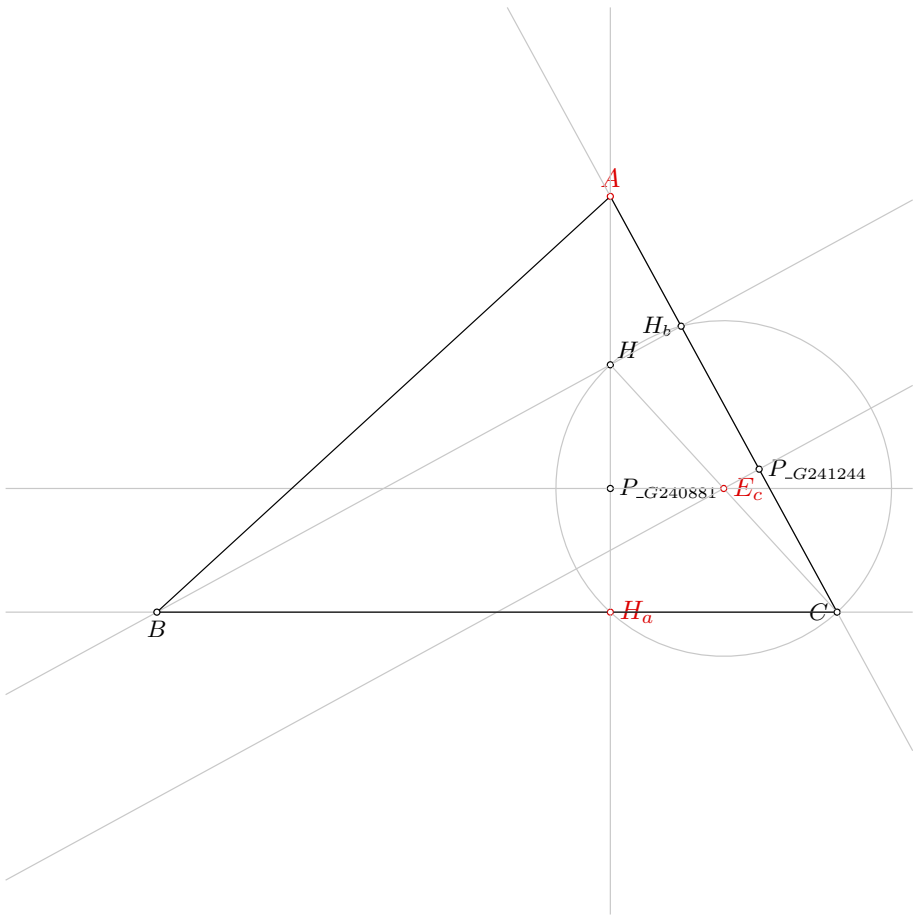

Figure 1: Illustration of the problem 0602

$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 603

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 603: Given a point A, a point E_c and a point H_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
2. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
3. Using the circle $k(E_c, C)$, the line b, the point E_c and the point H_b, construct a point C (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points H_b and C must be different;
4. Using the point E_c and the point C, construct a point H (rule W01); ;
5. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
6. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
7. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H and H_a must be different;
8. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;
9. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; line h_a and circle $k(E_c, C)$ intersect; line b and circle $k(E_c, C)$ intersect; points H_b and E_c are not the same.

Determination conditions: lines h_b and a are not the same; points C and H_a are not the same; points H and H_a must be different; points H_b and H are not the same; points A and H are not the same; points H_b and C must be different; points A and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,L52,L53,L54]

Solving time: 8.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{c} 95 56.36
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{c}
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points H_{b} and C must be different
% Constructing a point P_{\_G19665} which is a foot of the point E_{c} on the line b
foot P_{\_G19665} E_{c} b
cmark_r P_{\_G19665}
color 200 200 200
drawline E_{c} P_{\_G19665}
color 0 0 0
```

```
% Constructing a point C which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    19665}
sim C P_{\_G19665} H_{b}
cmark_l C



% Constructing a point H such that E_{c}H/E_{c}C=-1
towards H E_{c} C -1
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G20028} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G20028} E_{c} h_{a}
cmark_r P_{\_G20028}
color 200 200 200
drawline E_{c} P_{\_G20028}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    20028}
sim H_{a} P_{\_G20028} H
cmark_r H_{a}


% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
```

```
color 0 0 0



% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; line h_{a} and circle k(E_{c},C)
    intersect; line b and circle k(E_{c},C) intersect; points H_{b} and E_{c} are not the same
% Determination conditions: lines h_{b} and a are not the same; points C and H_{a} are not the same
    ; points H and H_{a} must be different; points H_{b} and H are not the same; points A and H are
     not the same; points H_{b} and C must be different; points A and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H_b=_H_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 1176 terms.

Time Complexity: Time spent by the prover is 7.679 seconds.

NDG conditions Points H_b and E_c are not identical

Points H_b and E_c are not identical

Points A and H are not identical

Points A and H are not identical

Line through points H_b and H is not parallel with line through points C and H_a

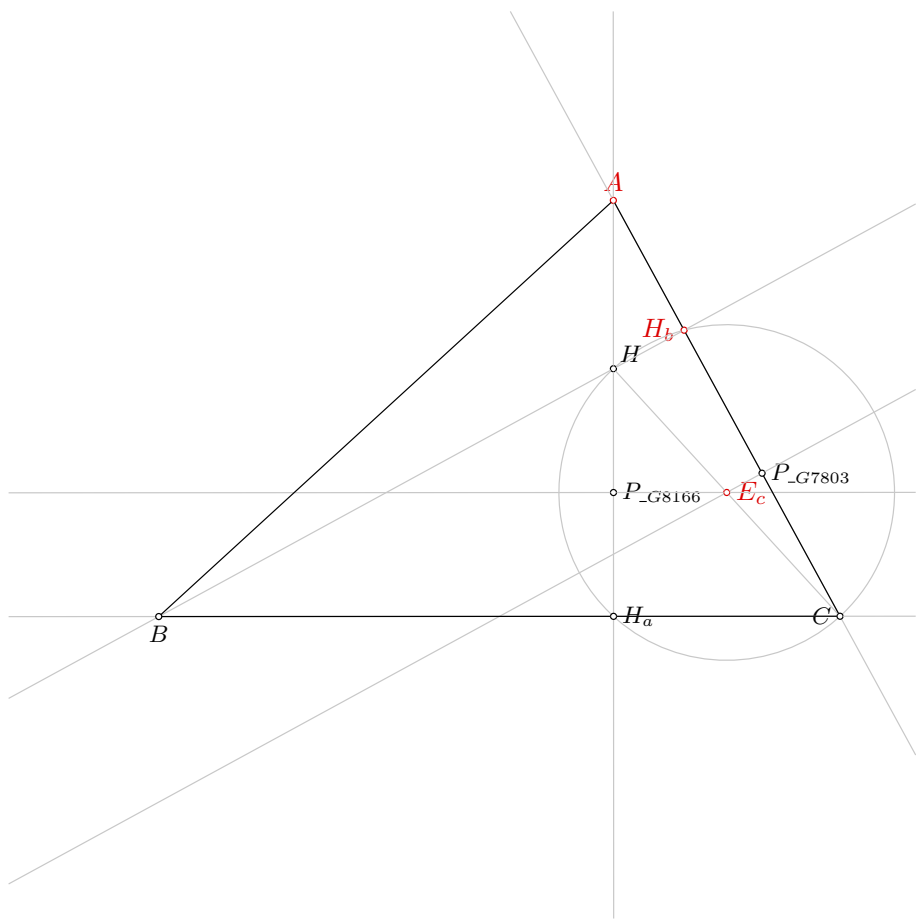

Figure 1: Illustration of the problem 0603

Line through points H_b and H is not parallel with line through points E_c and A

Points A and C are not identical

Points A and C are not identical

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_bCH_a} \neq S_{HCH_a}$ i.e., lines H_bH and CH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving H_b=$\_H_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Proving failed

4.3.2 Proving E_c=$\_E_c$

Proving failed

4.3.3 Proving H_b=$\_H_b$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Proving failed

4.4.2 Proving E_c=$\_E_c$

Proving failed

4.4.3 Proving H_b=$\_H_b$

Proving failed

Problem 604

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 604: Given a point E_c, a point H_c and a point A, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Using the point H_c and the line h_c, construct a line c (rule W10a); ;
3. Choose freely a point A on the line c (rule WOnline2);
4. Using the point A and the point H_c, construct a line $m(AH_c)$ (rule W14); % DET: points A and H_c are not the same;
5. Using the point E_c and the point H_c, construct a line $m(E_cH_c)$ (rule W14); % DET: points E_c and H_c are not the same;
6. Choose freely a point B on the line c (rule WOnline1) ;
7. Using the point B and the point A, construct a point M_c (rule W01); ;
8. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
9. Using the line $m(E_cH_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not the same;
10. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
11. Using the circle $k(N, M_a)$ and the line $m(AH_c)$, construct a point M_b and a point E_a (rule W04); % NDG: line $m(AH_c)$ and circle $k(N, M_a)$ intersect;

12. Using the point A and the point M_b, construct a point C (rule W01); .

Non-degenerate conditions: line $m(AH_c)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same; lines $m(E_cH_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points E_c and H_c are not the same; points A and H_c are not the same; points E_c and H_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W14,WOnline1,WOnline2]

Lemmas used: [D10,D20,D22,D30,D32,D7,GD02,GL01,GL03,GL04,GL09,L17,L19,L20,L21,L22,L24,L3,L41,L4

Solving time: 54.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{c} 68.91 84.83
point A 80 95

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H_{c}
cmark_t A
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% Constructing a line c which is perpendicular to line h_{c} and which passes through point H_{c}
perp c H_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0



% Generating random value V[_G43770]
random V[_G43770]
```

```
% Calculating value V[_G43791] using formula V[_G43770]*20
expression V[_G43791] { V[_G43770]*20 }


% Constructing a point A which is a point for which holds H_{c}A = V[_G43791] and angle E_{c}H_{c}A
     = 90
turtle A E_{c} H_{c} 90 V[_G43791]
cmark_t A


% DET: points A and H_{c} are not the same
% Constructing bisector m(AH_{c}) of the segment AH_{c}
med m(AH_{c}) A H_{c}

color 200 200 200
drawline m(AH_{c})
color 0 0 0

color 200 200 200
drawsegment A H_{c}
color 0 0 0


% DET: points E_{c} and H_{c} are not the same
% Constructing bisector m(E_{c}H_{c}) of the segment E_{c}H_{c}
med m(E_{c}H_{c}) E_{c} H_{c}

color 200 200 200
drawline m(E_{c}H_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} H_{c}
color 0 0 0



% Choosing randomly a point B on the line AH_{c}
online B A H_{c}
cmark_b B
color 200 200 200
drawline A H_{c}
color 0 0 0



% Constructing a point M_{c} such that BM_{c}/BA=0.5
towards M_{c} B A 0.5
cmark_lt M_{c}
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
```

```
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}H_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}H_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}H_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(AH_{c}) and circle k(N,M_{a}) intersect
% Constructing points M_{b} and E_{a} which are in intersection of k(N,M_{a}) and m(AH_{c})
intersec2 M_{b} E_{a} k(N,M_{a}) m(AH_{c})
cmark_lt M_{b}
cmark_r E_{a}



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(AH_{c}) and circle k(N,M_{a}) intersect; points E_{c} and N are
     not the same; lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not parallel
% Determination conditions: lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and M_{c} are not the same; points E_{c} and H_{c} are not the same; points A and H_{c} are not
     the same; points E_{c} and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

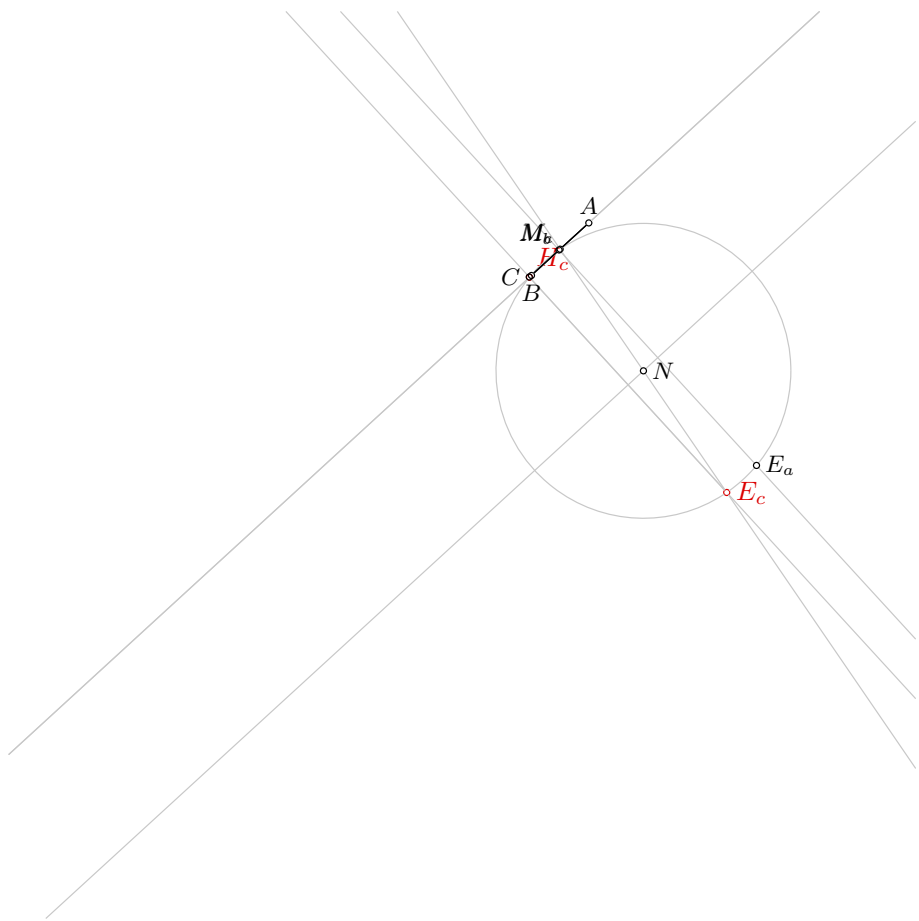

Figure 1: Illustration of the problem 0604

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 59 terms.

Time Complexity: Time spent by the prover is 0.717 seconds.

NDG conditions Points A and B are not identical

Points A, B and C are not collinear

Point M_c is not the midpoint of segment with endpoints B and C

4.1.2 Proving H_c=_H_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 4 terms.

Time Complexity: Time spent by the prover is 0.141 seconds.

NDG conditions Points A and B are not identical

4.1.3 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.007 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving A=A

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving $A{=}A$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $E_c{=}\_E_c$

Proving failed

4.4.2 Proving $H_c{=}\_H_c$

Proving failed

4.4.3 Proving $A{=}A$

Proving failed

Problem 605

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 605: Given a point A, a point E_c and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 606

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 606: Given a point A, a point E_c and a point M_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 607

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 607: Given a point A, a point E_c and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point M_b, construct a point C (rule W01); ;
2. Using the point E_c and the point C, construct a point H (rule W01); ;
3. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
4. Using the point E_c and the point C, construct a line h_c (rule W02); % DET: points E_c and C are not the same;
5. Using the point A and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points A and M_b are not the same;
6. Using the circle $k(M_b, C)$, the line h_a, the point M_b and the point A, construct a point H_a (rule W05); % NDG: line h_a and circle $k(M_b, C)$ intersect % DET: points A and H_a must be different;
7. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
8. Using the circle $k(M_b, C)$, the line h_c, the point M_b and the point C, construct a point H_c (rule W05); % NDG: line h_c and circle $k(M_b, C)$ intersect % DET: points C and H_c must be different;
9. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
10. Using the line a and the line c, construct a point B (rule W03); % NDG: lines a and c are not parallel % DET: lines a and c are not the same.

Non-degenerate conditions: lines a and c are not parallel; line h_c and circle $k(M_b, C)$ intersect; line h_a and circle $k(M_b, C)$ intersect; points A and M_b are not the same.

Determination conditions: lines a and c are not the same; points H_c and A are not the same; points C and H_c must be different; points H_a and C are not the same; points A and H_a must be different; points E_c and C are not the same; points A and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D22,D3,D30,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L43,L44,L45]

Solving time: 10.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{c} 95 56.36
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{c}
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point H such that E_{c}H/E_{c}C=-1
towards H E_{c} C -1
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% DET: points E_{c} and C are not the same
% Constructing a line h_{c} which passes through point E_{c} and point C
line h_{c} E_{c} C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points A and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point A
circle k(M_{b},C) M_{b} A

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: line h_{a} and circle k(M_{b},C) intersect% DET: points A and H_{a} must be different
% Constructing a point P_{\_G72966} which is a foot of the point M_{b} on the line h_{a}
foot P_{\_G72966} M_{b} h_{a}
cmark_r P_{\_G72966}
color 200 200 200
drawline M_{b} P_{\_G72966}
color 0 0 0

% Constructing a point H_{a} which is an image of the point A in the symmetry to point/line P_{\_G
    72966}
sim H_{a} P_{\_G72966} A
cmark_r H_{a}


% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: line h_{c} and circle k(M_{b},C) intersect% DET: points C and H_{c} must be different
% Constructing a point P_{\_G73204} which is a foot of the point M_{b} on the line h_{c}
foot P_{\_G73204} M_{b} h_{c}
cmark_r P_{\_G73204}
color 200 200 200
drawline M_{b} P_{\_G73204}
color 0 0 0

% Constructing a point H_{c} which is an image of the point C in the symmetry to point/line P_{\_G
    73204}
sim H_{c} P_{\_G73204} C
cmark_rt H_{c}
```

```
% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: lines a and c are not parallel% DET: lines a and c are not the same
% Constructing a point B which belongs to line a and line c
intersec B a c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and c are not parallel; line h_{c} and circle k(M_{b},C)
    intersect; line h_{a} and circle k(M_{b},C) intersect; points A and M_{b} are not the same
% Determination conditions: lines a and c are not the same; points H_{c} and A are not the same;
    points C and H_{c} must be different; points H_{a} and C are not the same; points A and H_{a}
    must be different; points E_{c} and C are not the same; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

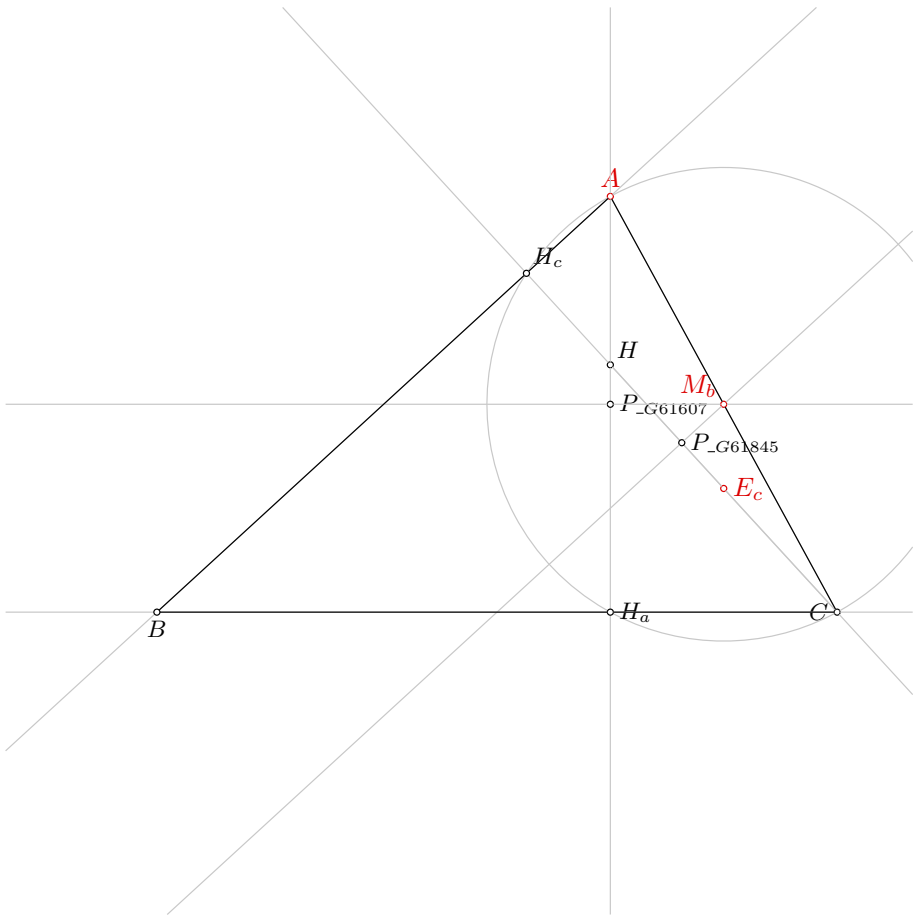

Figure 1: Illustration of the problem 0607

Time Complexity: Time spent by the prover is 0.034 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_aH_cA} \neq S_{CH_cA}$ i.e., lines H_aC and H_cA are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving M_b=$\_M_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving E_c=$\_E_c$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 124 terms.

Time Complexity: Time spent by the prover is 0.420 seconds.There are no ndg conditions.

4.3.3 Proving M_b=$\_M_b$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving E_c=$\_E_c$

Proving failed

4.4.3 Proving M_b=$\_M_b$

Proving failed

Problem 608

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 608: Given a point A, a point E_c and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point M_c, construct a point B (rule W01); ;
2. Using the point A and the point M_c, construct a line c (rule W02); % DET: points A and M_c are not the same;
3. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
4. Using the point E_c and the line c, construct a line h_c (rule W10b); ;
5. Using the line h_c and the line c, construct a point H_c (rule W03); % NDG: lines h_c and c are not parallel % DET: lines h_c and c are not the same;
6. Using the point A and the point H_c, construct a line $m(AH_c)$ (rule W14); % DET: points A and H_c are not the same;
7. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;
8. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;
9. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
10. Using the circle $k(N, M_a)$ and the line $m(AH_c)$, construct a point M_b and a point E_a (rule W04); % NDG: line $m(AH_c)$ and circle $k(N, M_a)$ intersect;

11. Using the point M_b and the point A, construct a point C (rule W01); .

Non-degenerate conditions: line $m(AH_c)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel; lines h_c and c are not parallel.

Determination conditions: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points A and H_c are not the same; lines h_c and c are not the same; points E_c and M_c are not the same; points A and M_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14]

Lemmas used: [D10,D20,D22,D30,D32,D7,GD01,GD02,GL01,GL03,GL04,GL09,L17,L18,L19,L20,L22,L24,L3,I

Solving time: 2.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{c} 95 56.36
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{c}
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and M_{c} are not the same
% Constructing a line c which passes through point A and point M_{c}
line c A M_{c}

color 200 200 200
drawline c
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
```

```
color 0 0 0



% Constructing a line h_{c} which is perpendicular to line c and which passes through point E_{c}
perp h_{c} E_{c} c

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines h_{c} and c are not parallel% DET: lines h_{c} and c are not the same
% Constructing a point H_{c} which belongs to line h_{c} and line c
intersec H_{c} h_{c} c
cmark_rt H_{c}


% DET: points A and H_{c} are not the same
% Constructing bisector m(AH_{c}) of the segment AH_{c}
med m(AH_{c}) A H_{c}

color 200 200 200
drawline m(AH_{c})
color 0 0 0

color 200 200 200
drawsegment A H_{c}
color 0 0 0


% DET: points E_{c} and M_{c} are not the same
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0


% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(AH_{c}) and circle k(N,M_{a}) intersect
% Constructing points M_{b} and E_{a} which are in intersection of k(N,M_{a}) and m(AH_{c})
intersec2 M_{b} E_{a} k(N,M_{a}) m(AH_{c})
cmark_lt M_{b}
cmark_r E_{a}



% Constructing a point C such that M_{b}C/M_{b}A=-1
towards C M_{b} A -1
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(AH_{c}) and circle k(N,M_{a}) intersect; points E_{c} and N are
     not the same; lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel; lines h_{c} and c are
    not parallel
% Determination conditions: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and M_{c} are not the same; points A and H_{c} are not the same; lines h_{c} and c are not the
    same; points E_{c} and M_{c} are not the same; points A and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.03 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Proving failed

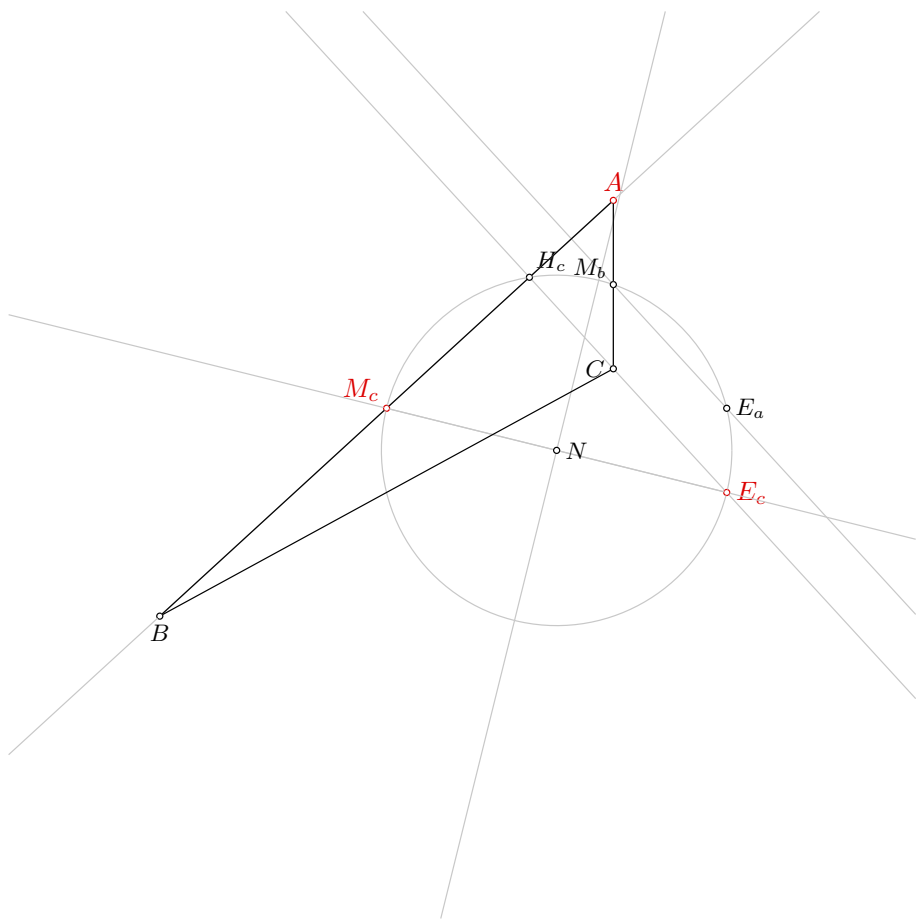

Figure 1: Illustration of the problem 0608

4.1.3 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{E_cAM_c} \neq 0$ i.e., points E_c, A and M_c are not collinear (foot is not the point itself; construction based assumption)

$S_{E_cAM_c} \neq S_{F^0_{h_c}AM_c}$ i.e., lines $E_cF^0_{h_c}$ and AM_c are not parallel (construction based assumption)

$S_{M^3_{m(E_cM_c)}E_cM_c} \neq S_{T^4_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^3_{m(E_cM_c)}T^4_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving M_c=$\_M_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_c=$\_E_c$

Proving failed

4.3.3 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 13 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 609

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 609: Given a point A, a point E_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
2. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
3. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
4. Using the point M_c and the point A, construct a point B (rule W01); ;
5. Using the point A and the point M_c, construct a line c (rule W02); % DET: points A and M_c are not the same;
6. Using the circle $k(N, M_a)$, the line c, the point N and the point M_c, construct a point H_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points M_c and H_c must be different;
7. Using the point H_c and the point E_c, construct a line h_c (rule W02); % DET: points H_c and E_c are not the same;
8. Using the point A and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points A and M_c are not the same;
9. Using the circle $k(N, M_a)$ and the circle $k(M_c, A)$, construct a point H_a and a point H_b (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_c, A)$ intersect % DET: circles $k(N, M_a)$ and $k(M_c, A)$ are not the same;

10. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

11. Using the line h_c and the line h_a, construct a point H (rule W03); % NDG: lines h_c and h_a are not parallel % DET: lines h_c and h_a are not the same;

12. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: lines h_c and h_a are not parallel; circles $k(N, M_a)$ and $k(M_c, A)$ intersect; points A and M_c are not the same; line c and circle $k(N, M_a)$ intersect; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: lines h_c and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points H_c and E_c are not the same; points M_c and H_c must be different; points A and M_c are not the same; points E_c and M_c must be different; points E_c and N are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D10,D20,D3,D30,D32,D5,D7,D8,GD01,GD02,GL01,GL03,GL04,GL09,L18,L19,L20,L21,L24,L3

Solving time: 4.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point E_{c} 95 56.36
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_r E_{c}
cmark_r N
color 0 0 0
fontsize 8

% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
```

```
color 0 0 0


% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}


% Constructing a point B such that M_{c}B/M_{c}A=-1
towards B M_{c} A -1
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and M_{c} are not the same
% Constructing a line c which passes through point A and point M_{c}
line c A M_{c}

color 200 200 200
drawline c
color 0 0 0


% NDG: line c and circle k(N,M_{a}) intersect% DET: points M_{c} and H_{c} must be different
% Constructing a point P_{\_G131808} which is a foot of the point N on the line c
foot P_{\_G131808} N c
cmark_r P_{\_G131808}
color 200 200 200
drawline N P_{\_G131808}
color 0 0 0

% Constructing a point H_{c} which is an image of the point M_{c} in the symmetry to point/line P
    _{\_G131808}
sim H_{c} P_{\_G131808} M_{c}
cmark_rt H_{c}


% DET: points H_{c} and E_{c} are not the same
% Constructing a line h_{c} which passes through point H_{c} and point E_{c}
line h_{c} H_{c} E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0


% NDG: points A and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point A
```

```
circle k(M_{c},A) M_{c} A

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{c},A) intersect% DET: circles k(N,M_{a}) and k(M_{c},A) are not
    the same
% Constructing points H_{a} and H_{b} which are in intersection of k(N,M_{a}) and k(M_{c},A)
intersec2 H_{a} H_{b} k(N,M_{a}) k(M_{c},A)
cmark_r H_{a}
cmark_l H_{b}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{c} and h_{a} are not parallel% DET: lines h_{c} and h_{a} are not the same
% Constructing a point H which belongs to line h_{c} and line h_{a}
intersec H h_{c} h_{a}
cmark_rt H



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{c
    },A) intersect; points A and M_{c} are not the same; line c and circle k(N,M_{a}) intersect;
    line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: lines h_{c} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{c},A) are not the same; points H_{c} and E_{c} are not the
    same; points M_{c} and H_{c} must be different; points A and M_{c} are not the same; points E_{
    c} and M_{c} must be different; points E_{c} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

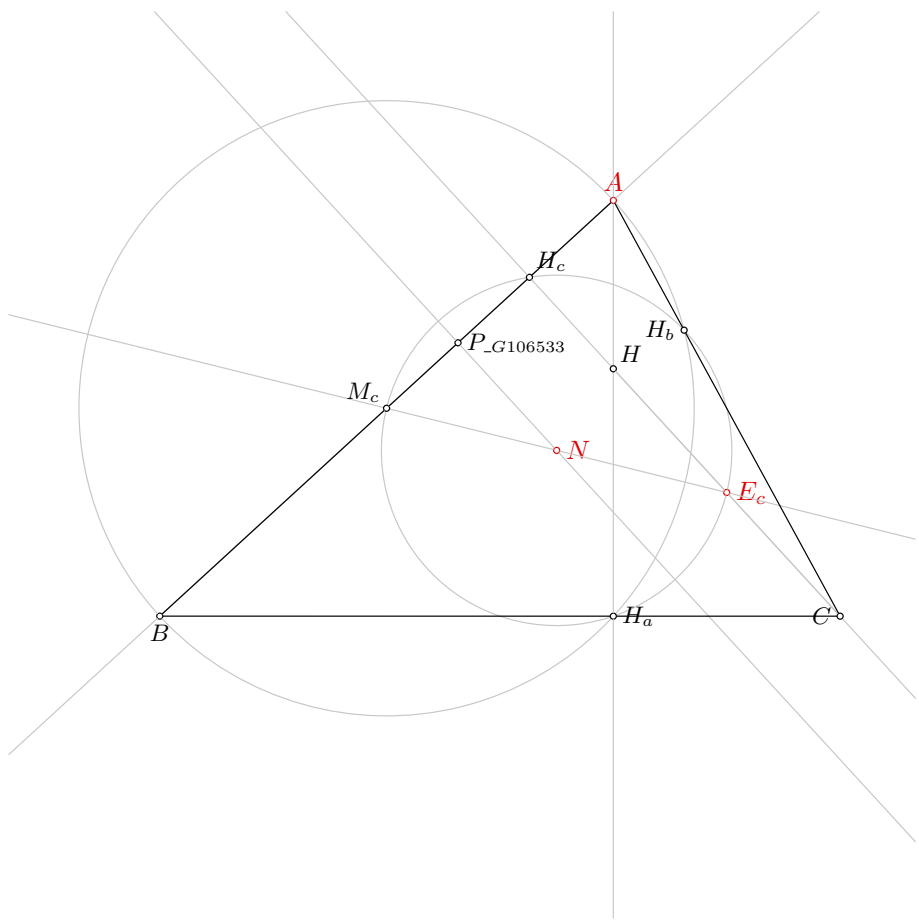

Figure 1: Illustration of the problem 0609

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=$\_E_c$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{H_cAH_a} \neq S_{E_cAH_a}$ i.e., lines H_cE_c and AH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Proving failed

4.3.2 Proving E_c=$\_E_c$

Proving failed

4.3.3 Proving $N{=}\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Proving failed

4.4.2 Proving $E_c{=}\_E_c$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 610

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 610: Given a point A, a point E_c and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 611

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 611: Given a point A, a point E_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 612

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 612: Given a point A, a point E_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 613

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 613: Given a point A, a point E_c and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 614

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 614: Given a point A, a point G and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point G, construct a point M_a (rule W01); ;
2. Using the point G and the point N, construct a point H (rule W01); ;
3. Using the point A and the point H, construct a point E_a (rule W01); ;
4. Using the point G and the point N, construct a point O (rule W01); ;
5. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
6. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
7. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
9. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points M_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L19,L22,L55]

Solving time: 9.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point G 70 58.33
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_t G
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0



% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point O such that GO/GN=-2
```

```
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G180067} which is a foot of the point N on the line h_{a}
foot P_{\_G180067} N h_{a}
cmark_r P_{\_G180067}
color 200 200 200
drawline N P_{\_G180067}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G180067}
sim H_{a} P_{\_G180067} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
```

```
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points M_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving G=$\_G$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{AB\_M_b} \neq S_{\_M_aB\_M_b}$ i.e., lines A_M_a and B_M_b are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

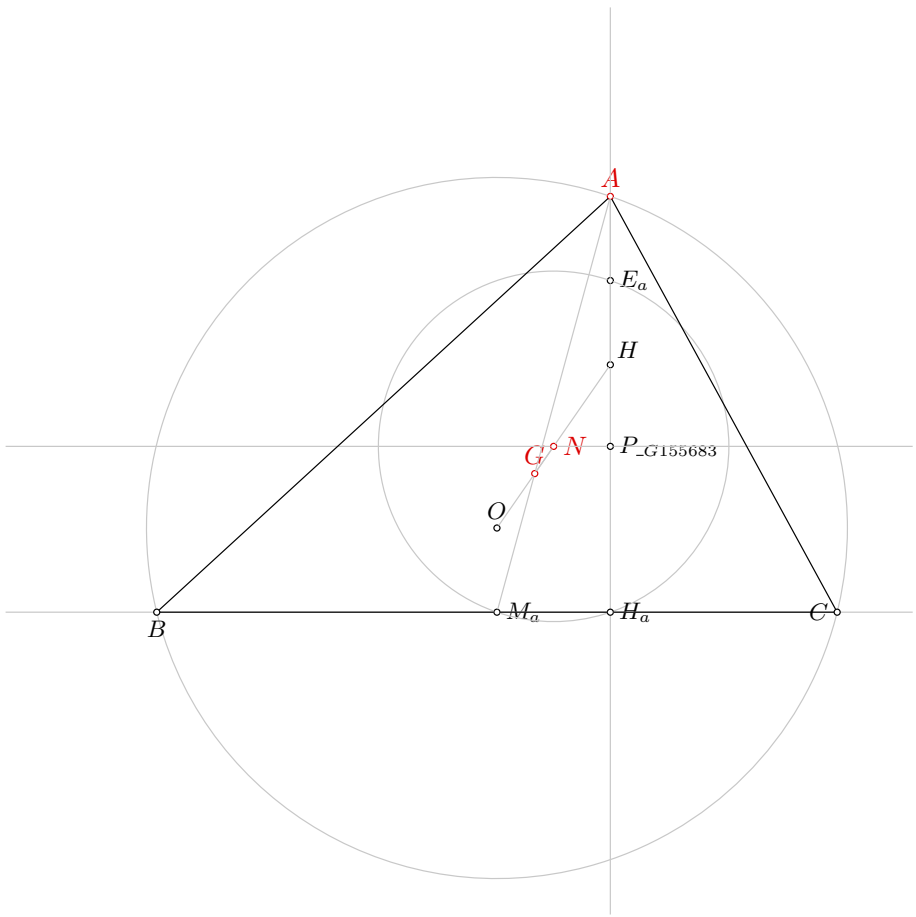

Figure 1: Illustration of the problem 0614

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 615

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 615: Given a point A, a point H and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point H, construct a point E_a (rule W01); ;
2. Using the point H and the point N, construct a point O (rule W01); ;
3. Using the point H and the point N, construct a point G (rule W01); ;
4. Using the point A and the point G, construct a point M_a (rule W01); ;
5. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
6. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
7. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
9. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL09,L11,L12,L16,L19,L22,L55]

Solving time: 9.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point H 80 72.73
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_rt H
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G214237} which passes through point H and point N
line L_{\_G214237} H N

color 200 200 200
drawline L_{\_G214237}
color 0 0 0


% Constructing a point P_{\_G214338} with coordinates (0,0)
point P_{\_G214338} 0 0
```

```
cmark_r P_{\_G214338}

% Constructing a point P_{\_G214262} such that HP_{\_G214262}/HP_{\_G214338}=4
towards P_{\_G214262} H P_{\_G214338} 4
cmark_r P_{\_G214262}
color 200 200 200
drawsegment H P_{\_G214262}
color 0 0 0

% Constructing a point P_{\_G214307} such that HP_{\_G214307}/HP_{\_G214338}=3
towards P_{\_G214307} H P_{\_G214338} 3
cmark_r P_{\_G214307}
color 200 200 200
drawsegment H P_{\_G214307}
color 0 0 0

% Constructing a line L_{\_G214268} which passes through point N and point P_{\_G214307}
line L_{\_G214268} N P_{\_G214307}

color 200 200 200
drawline L_{\_G214268}
color 0 0 0


% Constructing a line L_{\_G214231} which contains the point P_{\_G214262} and is parallel to the
    line L_{\_G214268}
parallel L_{\_G214231} P_{\_G214262} L_{\_G214268}

color 200 200 200
drawline L_{\_G214231}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G214231} and line L_{\_G214237}
intersec G L_{\_G214231} L_{\_G214237}
cmark_t G



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G215225} which is a foot of the point N on the line h_{a}
foot P_{\_G215225} N h_{a}
cmark_r P_{\_G215225}
color 200 200 200
drawline N P_{\_G215225}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G215225}
sim H_{a} P_{\_G215225} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

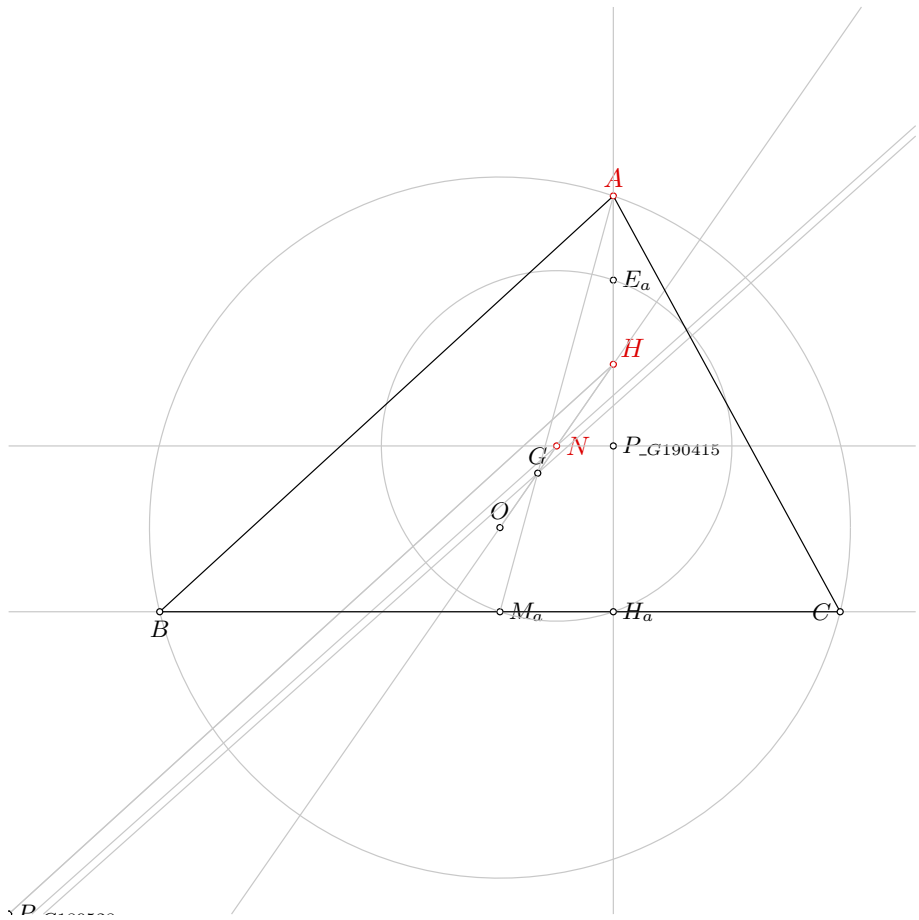

Figure 1: Illustration of the problem 0615

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points E_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{P_{\_G190900}HN} \neq S_{P^0_{L_{\_G190869}}HN}$ i.e., lines $P_{\_G190900}P^0_{L_{\_G190869}}$ and HN are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^4_{\_m_b}} \neq S_{F^3_{\_m_a}\_M_bF^4_{\_m_b}}$ i.e., lines $\_M_aF^3_{\_m_a}$ and $\_M_bF^4_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $H{=}\_H$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 616

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 616: Given a point A, a point H_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;
2. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;
3. Using the circle $k(N, M_a)$, the line h_a, the point N and the point H_a, construct a point E_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points H_a and E_a must be different;
4. Using the point E_a and the point A, construct a point H (rule W01); ;
5. Using the point N and the point H, construct a point O (rule W01); ;
6. Using the point N and the point H, construct a point G (rule W01); ;
7. Using the point A and the point G, construct a point M_a (rule W01); ;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points H_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points H_a and E_a must be different; points A and H_a are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L16,L19,L22,L55]

Solving time: 3.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point H_{a} 80 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_r H_{a}
cmark_r N
color 0 0 0
fontsize 8

% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points H_{a} and E_{a} must be different
% Constructing a point P_{\_G246728} which is a foot of the point N on the line h_{a}
foot P_{\_G246728} N h_{a}
cmark_r P_{\_G246728}
color 200 200 200
drawline N P_{\_G246728}
color 0 0 0
```

```
% Constructing a point E_{a} which is an image of the point H_{a} in the symmetry to point/line P
    _{\_G246728}
sim E_{a} P_{\_G246728} H_{a}
cmark_r E_{a}



% Constructing a point H such that E_{a}H/E_{a}A=-1
towards H E_{a} A -1
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point O such that NO/NH=-1
towards O N H -1
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G246990} which passes through point N and point H
line L_{\_G246990} N H

color 200 200 200
drawline L_{\_G246990}
color 0 0 0


% Constructing a point P_{\_G247091} with coordinates (0,0)
point P_{\_G247091} 0 0
cmark_r P_{\_G247091}

% Constructing a point P_{\_G247015} such that NP_{\_G247015}/NP_{\_G247091}=-1
towards P_{\_G247015} N P_{\_G247091} -1
cmark_r P_{\_G247015}
color 200 200 200
drawsegment P_{\_G247091} P_{\_G247015}
color 0 0 0

% Constructing a point P_{\_G247060} such that NP_{\_G247060}/NP_{\_G247091}=3
towards P_{\_G247060} N P_{\_G247091} 3
cmark_r P_{\_G247060}
color 200 200 200
drawsegment N P_{\_G247060}
color 0 0 0

% Constructing a line L_{\_G247021} which passes through point H and point P_{\_G247060}
line L_{\_G247021} H P_{\_G247060}

color 200 200 200
drawline L_{\_G247021}
```

```
color 0 0 0


% Constructing a line L_{\_G246984} which contains the point P_{\_G247015} and is parallel to the
    line L_{\_G247021}
parallel L_{\_G246984} P_{\_G247015} L_{\_G247021}

color 200 200 200
drawline L_{\_G246984}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G246984} and line L_{\_G246990}
intersec G L_{\_G246984} L_{\_G246990}
cmark_t G



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
```

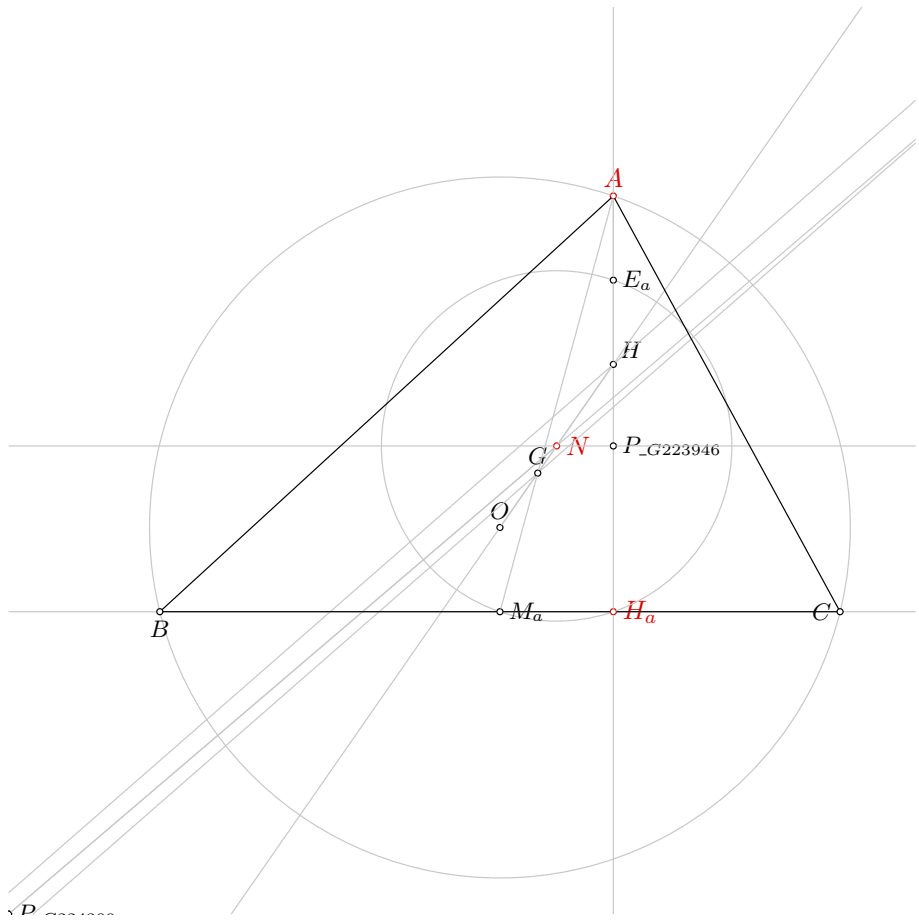

Figure 1: Illustration of the problem 0616

```
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points H_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points H_{a} and E_{a} must be
     different; points A and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H_a=$\_H_a$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{P\_G225677NH} \neq S_{P^0_{L\_G225646}NH}$ i.e., lines $P\_G225677P^0_{L\_G225646}$ and NH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAF^1_{\_h_a}} \neq S_{CAF^1_{\_h_a}}$ i.e., lines BC and $AF^1_{\_h_a}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^1_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving H_a=$\_H_a$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Proving failed

4.3.2 Proving H_a=$\_H_a$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 617

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 617: Given a point A, a point H_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
2. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;
3. Using the circle $k(N, M_a)$, the line b, the point N and the point H_b, construct a point M_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points H_b and M_b must be different;
4. Using the point M_b and the point A, construct a point C (rule W01); ;
5. Using the point N and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points N and M_b are not the same;
6. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point M_b, construct a point E_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_b and E_b must be different;
7. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
8. Using the point A and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points A and M_b are not the same;
9. Using the circle $k(N, M_a)$ and the circle $k(M_b, C)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_b, C)$ intersect % DET: circles $k(N, M_a)$ and $k(M_b, C)$ are not the same;

10. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

11. Using the line h_b and the line h_a, construct a point H (rule W03); % NDG: lines h_b and h_a are not parallel % DET: lines h_b and h_a are not the same;

12. Using the point N and the point H, construct a point G (rule W01); ;

13. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: lines h_b and h_a are not parallel; circles $k(N, M_a)$ and $k(M_b, C)$ intersect; points A and M_b are not the same; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; line b and circle $k(N, M_a)$ intersect; points H_b and N are not the same.

Determination conditions: lines h_b and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points E_b and H_b are not the same; points M_b and E_b must be different; points N and M_b are not the same; points H_b and M_b must be different; points A and H_b are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D22,D29,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L16,L17,L19,L20,L21,L23

Solving time: 4.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point H_{b} 89.36 77.83
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_l H_{b}
cmark_r N
color 0 0 0
fontsize 8

% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line b and circle k(N,M_{a}) intersect% DET: points H_{b} and M_{b} must be different
% Constructing a point P_{\_G31606} which is a foot of the point N on the line b
foot P_{\_G31606} N b
cmark_r P_{\_G31606}
color 200 200 200
drawline N P_{\_G31606}
color 0 0 0

% Constructing a point M_{b} which is an image of the point H_{b} in the symmetry to point/line P
    _{\_G31606}
sim M_{b} P_{\_G31606} H_{b}
cmark_lt M_{b}



% Constructing a point C such that M_{b}C/M_{b}A=-1
towards C M_{b} A -1
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points N and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point N and point M_{b}
line m(H_{a}H_{c}) N M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{b} and E_{b} must be
    different
% Constructing a point E_{b} which is an image of the point M_{b} in the symmetry to point/line N
sim E_{b} N M_{b}
cmark_r E_{b}


% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points A and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point A
circle k(M_{b},C) M_{b} A

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{b},C) intersect% DET: circles k(N,M_{a}) and k(M_{b},C) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{b},C)
intersec2 H_{a} H_{c} k(N,M_{a}) k(M_{b},C)
cmark_r H_{a}
cmark_rt H_{c}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{b} and h_{a} are not parallel% DET: lines h_{b} and h_{a} are not the same
% Constructing a point H which belongs to line h_{b} and line h_{a}
intersec H h_{b} h_{a}
cmark_rt H



% Constructing a line L_{\_G32404} which passes through point N and point H
line L_{\_G32404} N H

color 200 200 200
drawline L_{\_G32404}
color 0 0 0


% Constructing a point P_{\_G32505} with coordinates (0,0)
point P_{\_G32505} 0 0
cmark_r P_{\_G32505}

% Constructing a point P_{\_G32429} such that NP_{\_G32429}/NP_{\_G32505}=-1
towards P_{\_G32429} N P_{\_G32505} -1
cmark_r P_{\_G32429}
color 200 200 200
drawsegment P_{\_G32505} P_{\_G32429}
color 0 0 0

% Constructing a point P_{\_G32474} such that NP_{\_G32474}/NP_{\_G32505}=3
towards P_{\_G32474} N P_{\_G32505} 3
```

```
cmark_r P_{\_G32474}
color 200 200 200
drawsegment N P_{\_G32474}
color 0 0 0

% Constructing a line L_{\_G32435} which passes through point H and point P_{\_G32474}
line L_{\_G32435} H P_{\_G32474}

color 200 200 200
drawline L_{\_G32435}
color 0 0 0


% Constructing a line L_{\_G32398} which contains the point P_{\_G32429} and is parallel to the
    line L_{\_G32435}
parallel L_{\_G32398} P_{\_G32429} L_{\_G32435}

color 200 200 200
drawline L_{\_G32398}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G32398} and line L_{\_G32404}
intersec G L_{\_G32398} L_{\_G32404}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{b
    },C) intersect; points A and M_{b} are not the same; line m(H_{a}H_{c}) and circle k(N,M_{a})
    intersect; line b and circle k(N,M_{a}) intersect; points H_{b} and N are not the same
% Determination conditions: lines h_{b} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{b},C) are not the same; points E_{b} and H_{b} are not the
    same; points M_{b} and E_{b} must be different; points N and M_{b} are not the same; points H_{
    b} and M_{b} must be different; points A and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

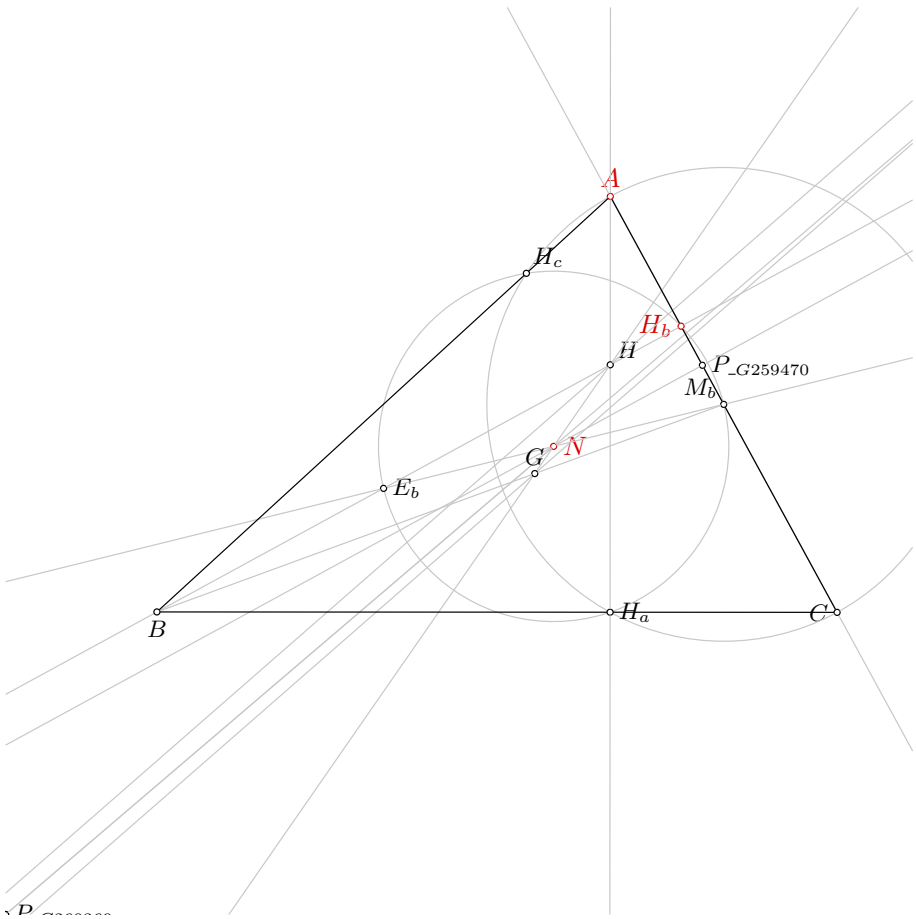

Figure 1: Illustration of the problem 0617

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H_b=$\_H_b$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 76 terms.

Time Complexity: Time spent by the prover is 0.756 seconds.

NDG conditions Points M_b and N are not identical

Line through points M_b and H_b is not perpendicular to line through points H_b and N

Line through points H_b and E_b is not parallel with line through points A and H_a

Points A, E_b and $P_{\_G23985}$ are not collinear

Points A and C are not identical

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{E_bAH_a} \neq S_{H_bAH_a}$ i.e., lines E_bH_b and AH_a are not parallel (construction based assumption)

$S_{P_{\_G8676}NH} \neq S_{P^0_{L_{\_G8645}}NH}$ i.e., lines $P_{\_G8676}P^0_{L_{\_G8645}}$ and NH are not parallel (construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^4_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^4_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving H_b=$\_H_b$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $A{=}A$

Proving failed

4.3.2 Proving $H_b{=}\_H_b$

Proving failed

4.3.3 Proving $N{=}\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Proving failed

4.4.2 Proving $H_b{=}\_H_b$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 618

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 618: Given a point A, a point H_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;

2. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;

3. Using the circle $k(N, M_a)$, the line c, the point N and the point H_c, construct a point M_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points H_c and M_c must be different;

4. Using the point M_c and the point A, construct a point B (rule W01); ;

5. Using the point N and the point M_c, construct a line $m(H_aH_b)$ (rule W02); % DET: points N and M_c are not the same;

6. Using the circle $k(N, M_a)$, the line $m(H_aH_b)$, the point N and the point M_c, construct a point E_c (rule W05a); % NDG: line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect % DET: points M_c and E_c must be different;

7. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;

8. Using the point A and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points A and M_c are not the same;

9. Using the circle $k(N, M_a)$ and the circle $k(M_c, A)$, construct a point H_a and a point H_b (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_c, A)$ intersect % DET: circles $k(N, M_a)$ and $k(M_c, A)$ are not the same;

10. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

11. Using the line h_c and the line h_a, construct a point H (rule W03); % NDG: lines h_c and h_a are not parallel % DET: lines h_c and h_a are not the same;

12. Using the point N and the point H, construct a point G (rule W01); ;

13. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: lines h_c and h_a are not parallel; circles $k(N, M_a)$ and $k(M_c, A)$ intersect; points A and M_c are not the same; line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect; line c and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: lines h_c and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points E_c and H_c are not the same; points M_c and E_c must be different; points N and M_c are not the same; points H_c and M_c must be different; points A and H_c are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D10,D20,D3,D30,D32,D5,D7,D8,GD01,GD02,GL01,GL03,GL04,GL09,L16,L18,L19,L20,L21,L2

Solving time: 4.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point H_{c} 68.91 84.83
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_rt H_{c}
cmark_r N
color 0 0 0
fontsize 8

% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line c and circle k(N,M_{a}) intersect% DET: points H_{c} and M_{c} must be different
% Constructing a point P_{\_G71818} which is a foot of the point N on the line c
foot P_{\_G71818} N c
cmark_r P_{\_G71818}
color 200 200 200
drawline N P_{\_G71818}
color 0 0 0

% Constructing a point M_{c} which is an image of the point H_{c} in the symmetry to point/line P
    _{\_G71818}
sim M_{c} P_{\_G71818} H_{c}
cmark_lt M_{c}



% Constructing a point B such that M_{c}B/M_{c}A=-1
towards B M_{c} A -1
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points N and M_{c} are not the same
% Constructing a line m(H_{a}H_{b}) which passes through point N and point M_{c}
line m(H_{a}H_{b}) N M_{c}

color 200 200 200
drawline m(H_{a}H_{b})
color 0 0 0



% NDG: line m(H_{a}H_{b}) and circle k(N,M_{a}) intersect% DET: points M_{c} and E_{c} must be
    different
% Constructing a point E_{c} which is an image of the point M_{c} in the symmetry to point/line N
sim E_{c} N M_{c}
cmark_r E_{c}


% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points A and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point A
circle k(M_{c},A) M_{c} A

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{c},A) intersect% DET: circles k(N,M_{a}) and k(M_{c},A) are not
    the same
% Constructing points H_{a} and H_{b} which are in intersection of k(N,M_{a}) and k(M_{c},A)
intersec2 H_{a} H_{b} k(N,M_{a}) k(M_{c},A)
cmark_r H_{a}
cmark_l H_{b}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{c} and h_{a} are not parallel% DET: lines h_{c} and h_{a} are not the same
% Constructing a point H which belongs to line h_{c} and line h_{a}
intersec H h_{c} h_{a}
cmark_rt H



% Constructing a line L_{\_G72616} which passes through point N and point H
line L_{\_G72616} N H

color 200 200 200
drawline L_{\_G72616}
color 0 0 0


% Constructing a point P_{\_G72717} with coordinates (0,0)
point P_{\_G72717} 0 0
cmark_r P_{\_G72717}

% Constructing a point P_{\_G72641} such that NP_{\_G72641}/NP_{\_G72717}=-1
towards P_{\_G72641} N P_{\_G72717} -1
cmark_r P_{\_G72641}
color 200 200 200
drawsegment P_{\_G72717} P_{\_G72641}
color 0 0 0

% Constructing a point P_{\_G72686} such that NP_{\_G72686}/NP_{\_G72717}=3
towards P_{\_G72686} N P_{\_G72717} 3
```

```
cmark_r P_{\_G72686}
color 200 200 200
drawsegment N P_{\_G72686}
color 0 0 0

% Constructing a line L_{\_G72647} which passes through point H and point P_{\_G72686}
line L_{\_G72647} H P_{\_G72686}

color 200 200 200
drawline L_{\_G72647}
color 0 0 0


% Constructing a line L_{\_G72610} which contains the point P_{\_G72641} and is parallel to the
    line L_{\_G72647}
parallel L_{\_G72610} P_{\_G72641} L_{\_G72647}

color 200 200 200
drawline L_{\_G72610}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G72610} and line L_{\_G72616}
intersec G L_{\_G72610} L_{\_G72616}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{c
    },A) intersect; points A and M_{c} are not the same; line m(H_{a}H_{b}) and circle k(N,M_{a})
    intersect; line c and circle k(N,M_{a}) intersect; points H_{c} and N are not the same
% Determination conditions: lines h_{c} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{c},A) are not the same; points E_{c} and H_{c} are not the
    same; points M_{c} and E_{c} must be different; points N and M_{c} are not the same; points H_{
    c} and M_{c} must be different; points A and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

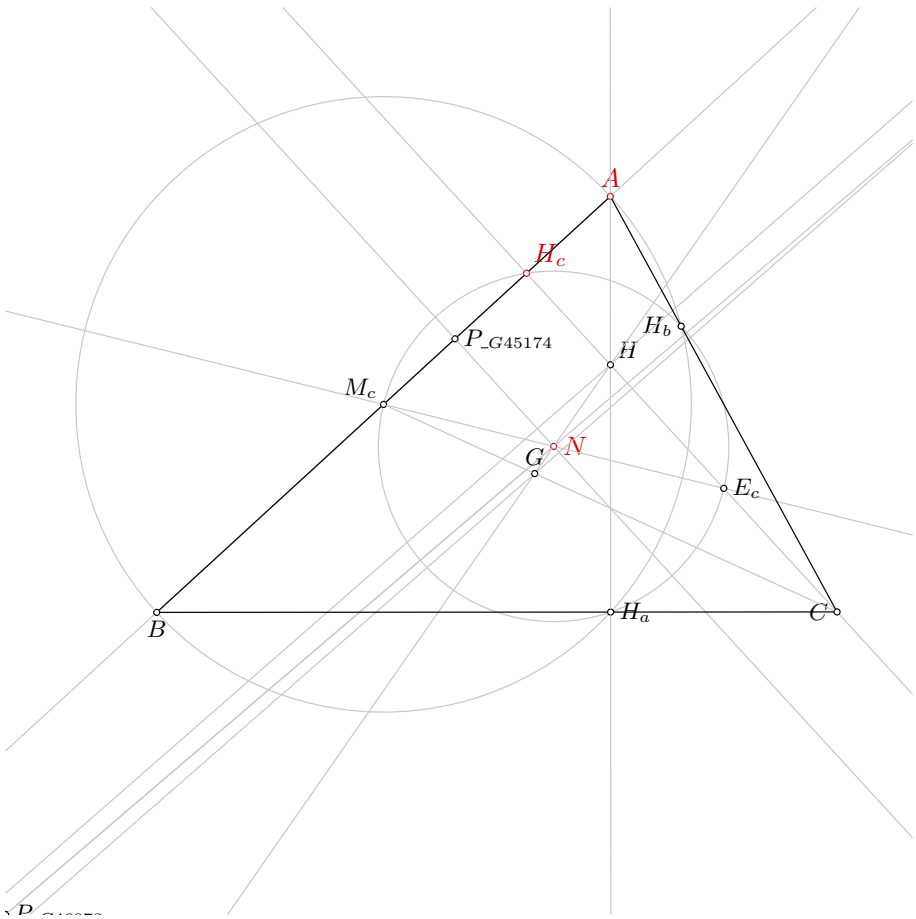

Figure 1: Illustration of the problem 0618

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H_c=$\_H_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 76 terms.

Time Complexity: Time spent by the prover is 0.855 seconds.

NDG conditions Points M_c and N are not identical

Line through points A and $P_{\_G63873}$ is not perpendicular to line through points $P_{\_G63873}$ and M_c

Line through points A and H_a is not parallel with line through points E_c and H_c

Points E_c, H_c and $P_{\_G63873}$ are not collinear

Line through points A and H_c is not perpendicular to line through points H_c and B

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{E_cAH_a} \neq S_{H_cAH_a}$ i.e., lines E_cH_c and AH_a are not parallel (construction based assumption)

$S_{P_{\_G47916}NH} \neq S_{P^0_{L_{\_G47885}}NH}$ i.e., lines $P_{\_G47916}P^0_{L_{\_G47885}}$ and NH are not parallel (construction based assumption)

$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)

$S_{ACF^1_{\_h_c}} \neq S_{BCF^1_{\_h_c}}$ i.e., lines AB and $CF^1_{\_h_c}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^5_{\_h_b}} \neq S_{F^4_{\_h_a}BF^5_{\_h_b}}$ i.e., lines $AF^4_{\_h_a}$ and $BF^5_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving H_c=$\_H_c$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $A{=}A$

Proving failed

4.3.2 Proving $H_c{=}\_H_c$

Proving failed

4.3.3 Proving $N{=}\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Proving failed

4.4.2 Proving $H_c{=}\_H_c$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 619

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 619: Given a point A, a point I and a point N, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 620

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 620: Given a point A, a point M_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point M_a, construct a point G (rule W01); ;
2. Using the point N and the point G, construct a point O (rule W01); ;
3. Using the point N and the point G, construct a point H (rule W01); ;
4. Using the point A and the point H, construct a point E_a (rule W01); ;
5. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
6. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
7. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
9. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points M_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L19,L22,L55]

Solving time: 8.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point M_{a} 65 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_r M_{a}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a line L_{\_G109567} which passes through point A and point M_{a}
line L_{\_G109567} A M_{a}

color 200 200 200
drawline L_{\_G109567}
color 0 0 0


% Constructing a point P_{\_G109668} with coordinates (0,0)
point P_{\_G109668} 0 0
cmark_r P_{\_G109668}

% Constructing a point P_{\_G109592} such that AP_{\_G109592}/AP_{\_G109668}=2
towards P_{\_G109592} A P_{\_G109668} 2
cmark_r P_{\_G109592}
color 200 200 200
drawsegment A P_{\_G109592}
color 0 0 0

% Constructing a point P_{\_G109637} such that AP_{\_G109637}/AP_{\_G109668}=3
towards P_{\_G109637} A P_{\_G109668} 3
cmark_r P_{\_G109637}
color 200 200 200
drawsegment A P_{\_G109637}
color 0 0 0

% Constructing a line L_{\_G109598} which passes through point M_{a} and point P_{\_G109637}
line L_{\_G109598} M_{a} P_{\_G109637}
```

```
color 200 200 200
drawline L_{\_G109598}
color 0 0 0


% Constructing a line L_{\_G109561} which contains the point P_{\_G109592} and is parallel to the
    line L_{\_G109598}
parallel L_{\_G109561} P_{\_G109592} L_{\_G109598}

color 200 200 200
drawline L_{\_G109561}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G109561} and line L_{\_G109567}
intersec G L_{\_G109561} L_{\_G109567}
cmark_t G



% Constructing a point O such that NO/NG=3
towards O N G 3
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0



% Constructing a point H such that NH/NG=-3
towards H N G -3
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G110703} which is a foot of the point N on the line h_{a}
foot P_{\_G110703} N h_{a}
cmark_r P_{\_G110703}
color 200 200 200
drawline N P_{\_G110703}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G110703}
sim H_{a} P_{\_G110703} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

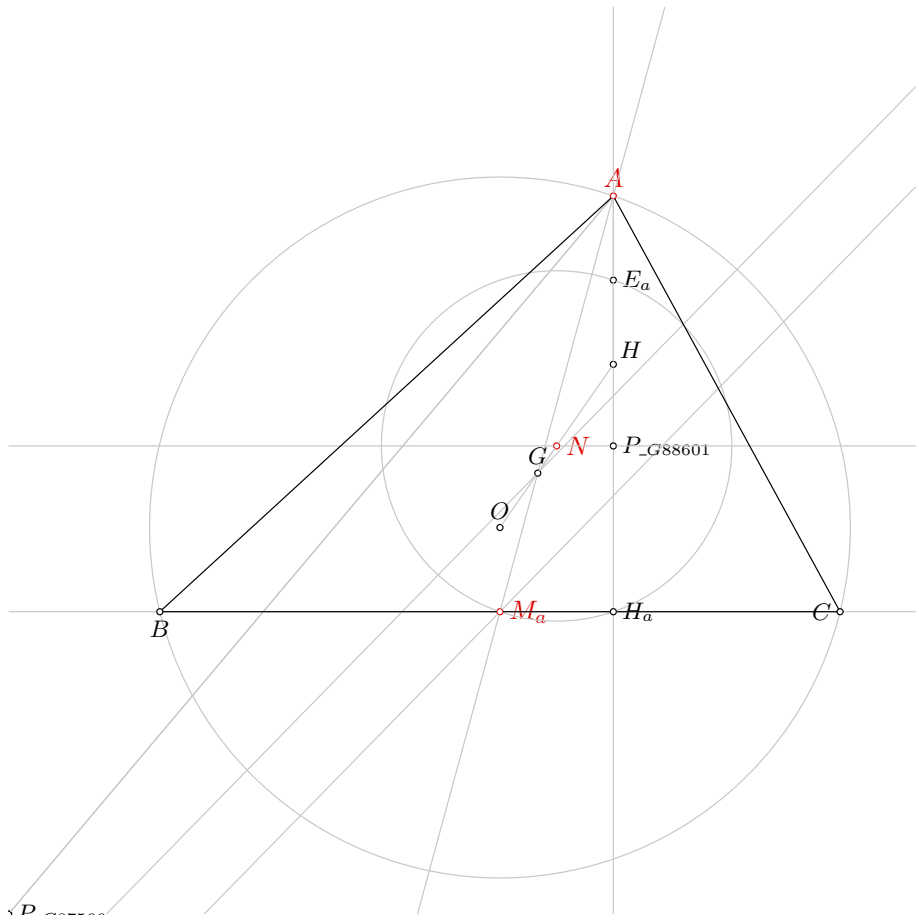

Figure 1: Illustration of the problem 0620

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points M_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving M_a=$\_M_a$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{P_{\_G88926}AM_a} \neq S_{P^0_{L_{\_G88895}}AM_a}$ i.e., lines $P_{\_G88926}P^0_{L_{\_G88895}}$ and AM_a are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving M_a=$\_M_a$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.2 Proving M_a=$\_M_a$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $M_a{=}\_M_a$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 621

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 621: Given a point A, a point M_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point M_b, construct a point C (rule W01); ;
2. Using the point A and the point M_b, construct a line b (rule W02); % DET: points A and M_b are not the same;
3. Using the point M_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points M_b and N are not the same;
4. Using the point A and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points A and M_b are not the same;
5. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
6. Using the circle $k(N, M_a)$, the line b, the point N and the point M_b, construct a point H_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points M_b and H_b must be different;
7. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point M_b, construct a point E_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_b and E_b must be different;
8. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
9. Using the circle $k(M_b, C)$ and the circle $k(N, M_a)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(M_b, C)$ and $k(N, M_a)$ intersect % DET: circles $k(M_b, C)$ and $k(N, M_a)$ are not the same;

10. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

11. Using the line h_b and the line h_a, construct a point H (rule W03); % NDG: lines h_b and h_a are not parallel % DET: lines h_b and h_a are not the same;

12. Using the point N and the point H, construct a point G (rule W01); ;

13. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: lines h_b and h_a are not parallel; circles $k(M_b, C)$ and $k(N, M_a)$ intersect; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; line b and circle $k(N, M_a)$ intersect; points M_b and N are not the same; points A and M_b are not the same.

Determination conditions: lines h_b and h_a are not the same; points A and H_a are not the same; circles $k(M_b, C)$ and $k(N, M_a)$ are not the same; points E_b and H_b are not the same; points M_b and E_b must be different; points M_b and H_b must be different; points M_b and N are not the same; points A and M_b are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D22,D29,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L16,L17,L19,L20,L21,L23

Solving time: 5.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point M_{b} 95 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_lt M_{b}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and M_{b} are not the same
% Constructing a line b which passes through point A and point M_{b}
line b A M_{b}

color 200 200 200
```

```
drawline b
color 0 0 0



% DET: points M_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point M_{b} and point N
line m(H_{a}H_{c}) M_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: points A and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point A
circle k(M_{b},C) M_{b} A

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line b and circle k(N,M_{a}) intersect% DET: points M_{b} and H_{b} must be different
% Constructing a point P_{\_G147508} which is a foot of the point N on the line b
foot P_{\_G147508} N b
cmark_r P_{\_G147508}
color 200 200 200
drawline N P_{\_G147508}
color 0 0 0

% Constructing a point H_{b} which is an image of the point M_{b} in the symmetry to point/line P
    _{\_G147508}
sim H_{b} P_{\_G147508} M_{b}
cmark_l H_{b}


% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{b} and E_{b} must be
    different
% Constructing a point E_{b} which is an image of the point M_{b} in the symmetry to point/line N
sim E_{b} N M_{b}
cmark_r E_{b}
```

```
% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: circles k(M_{b},C) and k(N,M_{a}) intersect% DET: circles k(M_{b},C) and k(N,M_{a}) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(M_{b},C) and k(N,M_{a})
intersec2 H_{a} H_{c} k(M_{b},C) k(N,M_{a})
cmark_r H_{a}
cmark_rt H_{c}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{b} and h_{a} are not parallel% DET: lines h_{b} and h_{a} are not the same
% Constructing a point H which belongs to line h_{b} and line h_{a}
intersec H h_{b} h_{a}
cmark_rt H



% Constructing a line L_{\_G148010} which passes through point N and point H
line L_{\_G148010} N H

color 200 200 200
drawline L_{\_G148010}
color 0 0 0


% Constructing a point P_{\_G148111} with coordinates (0,0)
point P_{\_G148111} 0 0
cmark_r P_{\_G148111}

% Constructing a point P_{\_G148035} such that NP_{\_G148035}/NP_{\_G148111}=-1
towards P_{\_G148035} N P_{\_G148111} -1
cmark_r P_{\_G148035}
color 200 200 200
drawsegment P_{\_G148111} P_{\_G148035}
color 0 0 0

% Constructing a point P_{\_G148080} such that NP_{\_G148080}/NP_{\_G148111}=3
towards P_{\_G148080} N P_{\_G148111} 3
```

```
cmark_r P_{\_G148080}
color 200 200 200
drawsegment N P_{\_G148080}
color 0 0 0

% Constructing a line L_{\_G148041} which passes through point H and point P_{\_G148080}
line L_{\_G148041} H P_{\_G148080}

color 200 200 200
drawline L_{\_G148041}
color 0 0 0


% Constructing a line L_{\_G148004} which contains the point P_{\_G148035} and is parallel to the
    line L_{\_G148041}
parallel L_{\_G148004} P_{\_G148035} L_{\_G148041}

color 200 200 200
drawline L_{\_G148004}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G148004} and line L_{\_G148010}
intersec G L_{\_G148004} L_{\_G148010}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and h_{a} are not parallel; circles k(M_{b},C) and k(N,M_{
    a}) intersect; line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; line b and circle k(N,M_{a})
     intersect; points M_{b} and N are not the same; points A and M_{b} are not the same
% Determination conditions: lines h_{b} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(M_{b},C) and k(N,M_{a}) are not the same; points E_{b} and H_{b} are not the
    same; points M_{b} and E_{b} must be different; points M_{b} and H_{b} must be different;
    points M_{b} and N are not the same; points A and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

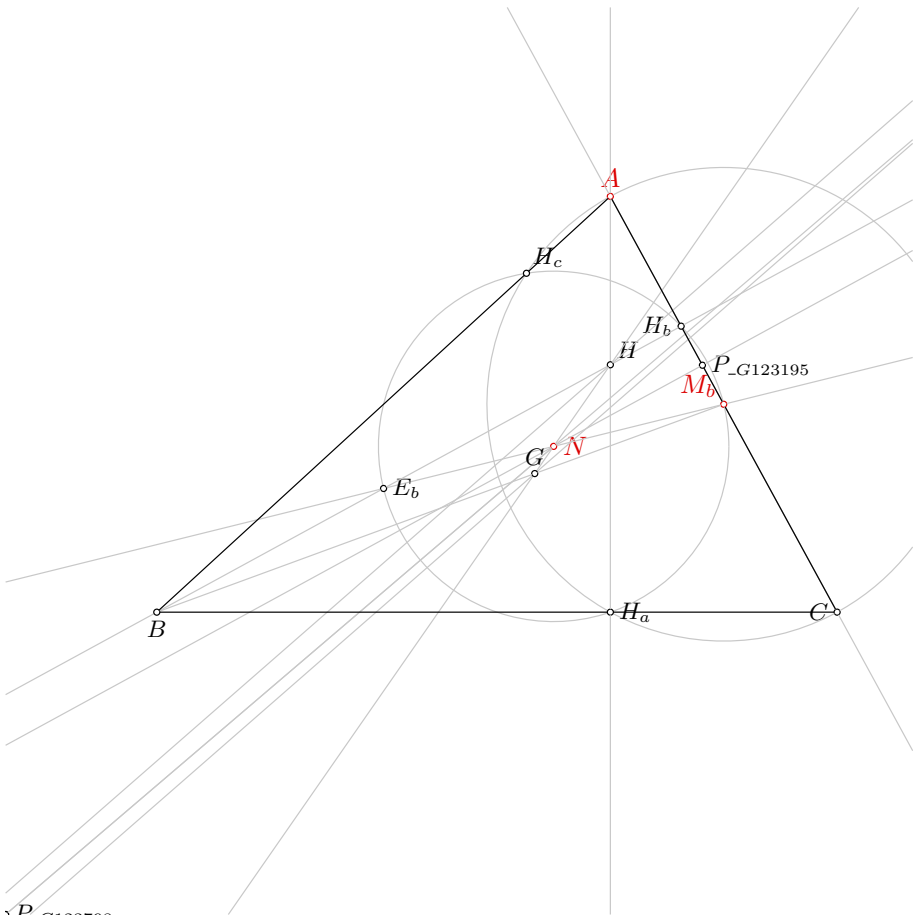

Figure 1: Illustration of the problem 0621

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving M_b=$\_M_b$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.036 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{E_bAH_a} \neq S_{H_bAH_a}$ i.e., lines E_bH_b and AH_a are not parallel (construction based assumption)

$S_{P_{\_G125638}NH} \neq S_{P^0_{L_{\_G125607}}NH}$ i.e., lines $P_{\_G125638}P^0_{L_{\_G125607}}$ and NH are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving M_b=$\_M_b$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 18 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 622

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 622: Given a point A, a point M_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point A and the point M_c, construct a point B (rule W01); ;
2. Using the point A and the point M_c, construct a line c (rule W02); % DET: points A and M_c are not the same;
3. Using the point M_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points M_c and N are not the same;
4. Using the point A and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points A and M_c are not the same;
5. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
6. Using the circle $k(N, M_a)$, the line c, the point N and the point M_c, construct a point H_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points M_c and H_c must be different;
7. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point M_c, construct a point E_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points M_c and E_c must be different;
8. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
9. Using the circle $k(M_c, A)$ and the circle $k(N, M_a)$, construct a point H_b and a point H_a (rule W07); % NDG: circles $k(M_c, A)$ and $k(N, M_a)$ intersect % DET: circles $k(M_c, A)$ and $k(N, M_a)$ are not the same;

10. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;

11. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; circles $k(M_c, A)$ and $k(N, M_a)$ intersect; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; line c and circle $k(N, M_a)$ intersect; points M_c and N are not the same; points A and M_c are not the same.

Determination conditions: lines h_c and b are not the same; points A and H_b are not the same; circles $k(M_c, A)$ and $k(N, M_a)$ are not the same; points E_c and H_c are not the same; points M_c and E_c must be different; points M_c and H_c must be different; points M_c and N are not the same; points A and M_c are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D10,D20,D30,D32,D6,D7,GD01,GD02,GL01,GL03,GL09,L18,L19,L20,L21,L24,L3,L41,L42,L53

Solving time: 4.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point M_{c} 50 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t A
cmark_lt M_{c}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and M_{c} are not the same
% Constructing a line c which passes through point A and point M_{c}
line c A M_{c}

color 200 200 200
drawline c
color 0 0 0
```

```
% DET: points M_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point M_{c} and point N
line m(H_{b}H_{a}) M_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: points A and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point A
circle k(M_{c},A) M_{c} A

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line c and circle k(N,M_{a}) intersect% DET: points M_{c} and H_{c} must be different
% Constructing a point P_{\_G180208} which is a foot of the point N on the line c
foot P_{\_G180208} N c
cmark_r P_{\_G180208}
color 200 200 200
drawline N P_{\_G180208}
color 0 0 0

% Constructing a point H_{c} which is an image of the point M_{c} in the symmetry to point/line P
    _{\_G180208}
sim H_{c} P_{\_G180208} M_{c}
cmark_rt H_{c}


% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points M_{c} and E_{c} must be
    different
% Constructing a point E_{c} which is an image of the point M_{c} in the symmetry to point/line N
sim E_{c} N M_{c}
cmark_r E_{c}


% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}
```

```
color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: circles k(M_{c},A) and k(N,M_{a}) intersect% DET: circles k(M_{c},A) and k(N,M_{a}) are not
    the same
% Constructing points H_{b} and H_{a} which are in intersection of k(M_{c},A) and k(N,M_{a})
intersec2 H_{b} H_{a} k(M_{c},A) k(N,M_{a})
cmark_l H_{b}
cmark_r H_{a}


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; circles k(M_{c},A) and k(N,M_{a})
    intersect; line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect; line c and circle k(N,M_{a})
    intersect; points M_{c} and N are not the same; points A and M_{c} are not the same
% Determination conditions: lines h_{c} and b are not the same; points A and H_{b} are not the same
    ; circles k(M_{c},A) and k(N,M_{a}) are not the same; points E_{c} and H_{c} are not the same;
    points M_{c} and E_{c} must be different; points M_{c} and H_{c} must be different; points M_{c
    } and N are not the same; points A and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

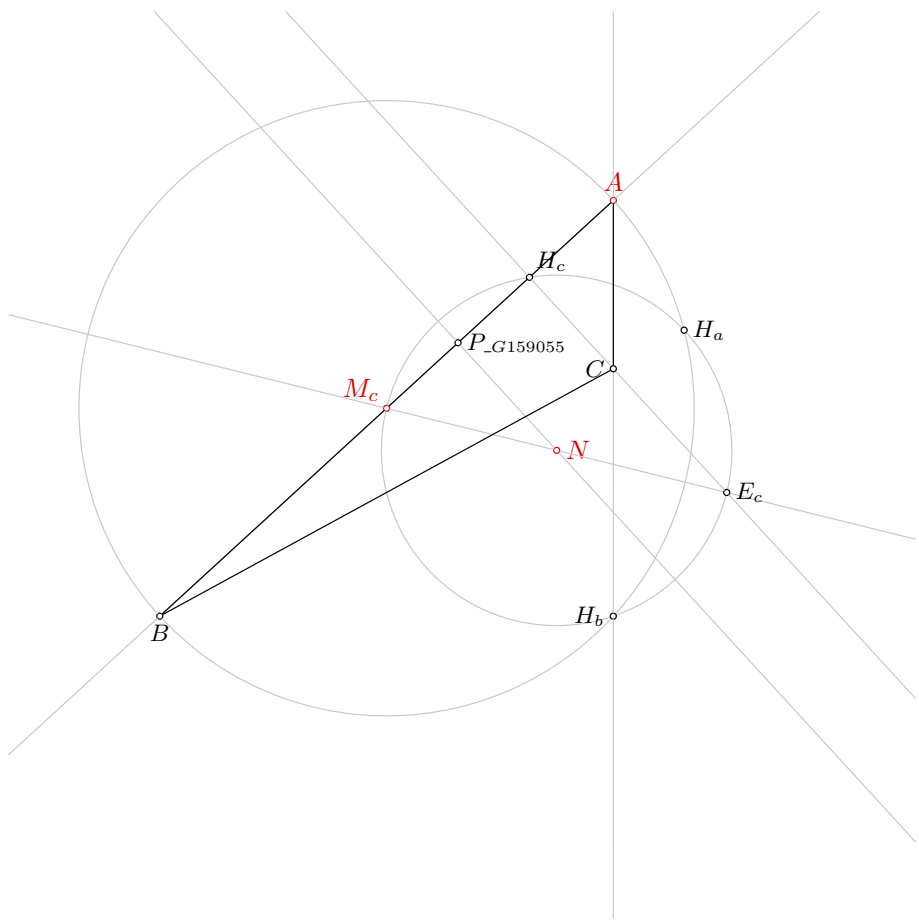

Figure 1: Illustration of the problem 0622

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.03 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{E_cAH_b} \neq S_{H_cAH_b}$ i.e., lines E_cH_c and AH_b are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving M_c=$\_M_c$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 8 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.3 Proving N=_N

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 778 terms.

Time Complexity: Time spent by the prover is 2.710 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 623

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 623: Given a point A, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point A and the point G, construct a point M_a (rule W01); ;
3. Using the point N and the point O, construct a point H (rule W01); ;
4. Using the point A and the point H, construct a point E_a (rule W01); ;
5. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
6. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
7. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
9. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points M_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L19,L22,L55]

Solving time: 8.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point A 80 95
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_t A
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G217840} which passes through point N and point O
line L_{\_G217840} N O

color 200 200 200
drawline L_{\_G217840}
color 0 0 0


% Constructing a point P_{\_G217941} with coordinates (0,0)
point P_{\_G217941} 0 0
cmark_r P_{\_G217941}

% Constructing a point P_{\_G217865} such that NP_{\_G217865}/NP_{\_G217941}=1
towards P_{\_G217865} N P_{\_G217941} 1
cmark_r P_{\_G217865}
color 200 200 200
drawsegment N P_{\_G217865}
color 0 0 0

% Constructing a point P_{\_G217910} such that NP_{\_G217910}/NP_{\_G217941}=3
towards P_{\_G217910} N P_{\_G217941} 3
cmark_r P_{\_G217910}
color 200 200 200
drawsegment N P_{\_G217910}
color 0 0 0

% Constructing a line L_{\_G217871} which passes through point O and point P_{\_G217910}
line L_{\_G217871} O P_{\_G217910}
```

```
color 200 200 200
drawline L_{\_G217871}
color 0 0 0


% Constructing a line L_{\_G217834} which contains the point P_{\_G217865} and is parallel to the
    line L_{\_G217871}
parallel L_{\_G217834} P_{\_G217865} L_{\_G217871}

color 200 200 200
drawline L_{\_G217834}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G217834} and line L_{\_G217840}
intersec G L_{\_G217834} L_{\_G217840}
cmark_t G



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G218985} which is a foot of the point N on the line h_{a}
foot P_{\_G218985} N h_{a}
cmark_r P_{\_G218985}
color 200 200 200
drawline N P_{\_G218985}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G218985}
sim H_{a} P_{\_G218985} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

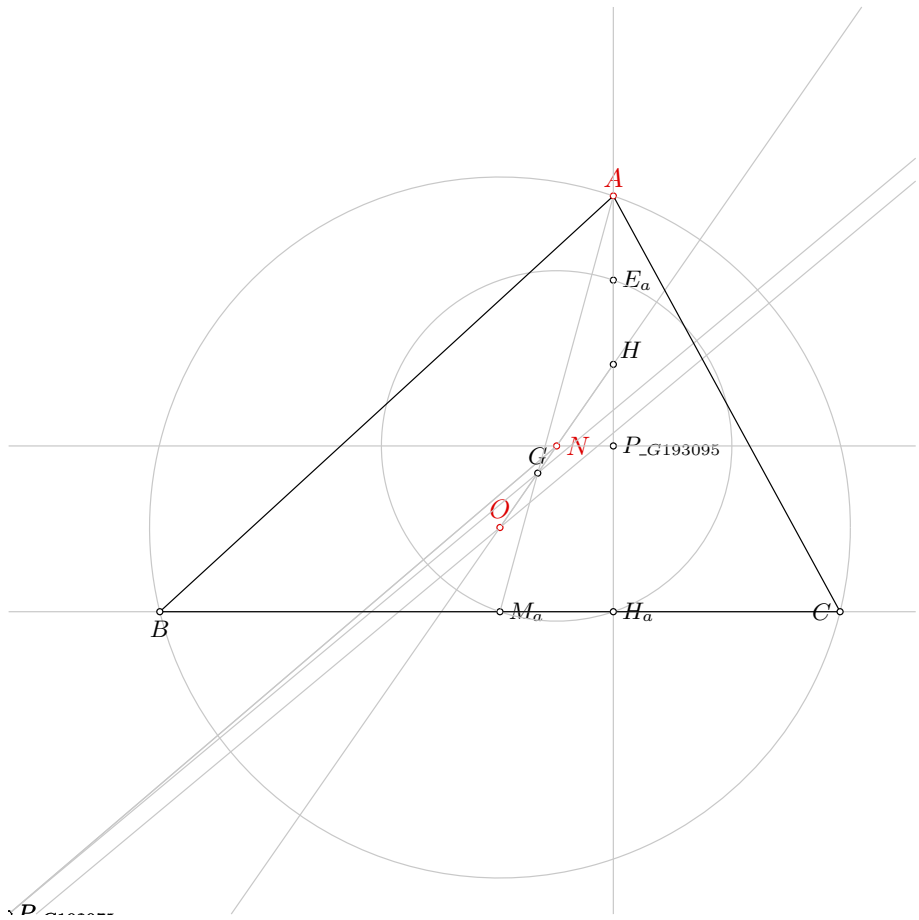

Figure 1: Illustration of the problem 0623

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points M_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving A=A

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving O=$\_O$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving A=A

NDG conditions are:

$S_{P\_G193423NO} \neq S_{P^0_{L\_G193392}NO}$ i.e., lines $P\_G193423P^0_{L\_G193392}$ and NO are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving A=A

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving O=$\_O$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $A{=}A$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4.2 Proving $N{=}\_N$

Proving failed

4.4.3 Proving $O{=}\_O$

Proving failed

Problem 624

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 624: Given a point A, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 625

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 625: Given a point A, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 626

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 626: Given a point A, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 627

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 627: Given a point B, a point C and a point E_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point C, construct a point M_a (rule W01); ;
2. Using the point B and the point C, construct a line a (rule W02); % DET: points B and C are not the same;
3. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
4. Using the point E_a and the line a, construct a line h_a (rule W10b); ;
5. Using the line h_a and the line a, construct a point H_a (rule W03); % NDG: lines h_a and a are not parallel % DET: lines h_a and a are not the same;
6. Using the point B and the point H_a, construct a line $m(BH_a)$ (rule W14); % DET: points B and H_a are not the same;
7. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;
8. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;
9. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
10. Using the circle $k(N, M_a)$ and the line $m(BH_a)$, construct a point M_c and a point E_b (rule W04); % NDG: line $m(BH_a)$ and circle $k(N, M_a)$ intersect;

11. Using the point M_c and the point B, construct a point A (rule W01); .

Non-degenerate conditions: line $m(BH_a)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel; lines h_a and a are not parallel.

Determination conditions: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points B and H_a are not the same; lines h_a and a are not the same; points E_a and M_a are not the same; points B and C are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14]

Lemmas used: [D20,D21,D28,D3,D32,D5,D8,GD01,GD02,GL01,GL03,GL04,GL09,L18,L20,L21,L22,L23,L38,L

Solving time: 2.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point C 110 40
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_b B
cmark_l C
cmark_r E_{a}
color 0 0 0
fontsize 8


% Constructing a point M_{a} such that BM_{a}/BC=0.5
towards M_{a} B C 0.5
cmark_r M_{a}
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points B and C are not the same
% Constructing a line a which passes through point B and point C
line a B C

color 200 200 200
drawline a
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
```

```
color 0 0 0



% Constructing a line h_{a} which is perpendicular to line a and which passes through point E_{a}
perp h_{a} E_{a} a

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{a} and a are not parallel% DET: lines h_{a} and a are not the same
% Constructing a point H_{a} which belongs to line h_{a} and line a
intersec H_{a} h_{a} a
cmark_r H_{a}


% DET: points B and H_{a} are not the same
% Constructing bisector m(BH_{a}) of the segment BH_{a}
med m(BH_{a}) B H_{a}

color 200 200 200
drawline m(BH_{a})
color 0 0 0

color 200 200 200
drawsegment B H_{a}
color 0 0 0


% DET: points E_{a} and M_{a} are not the same
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0


% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(BH_{a}) and circle k(N,M_{a}) intersect
% Constructing points M_{c} and E_{b} which are in intersection of k(N,M_{a}) and m(BH_{a})
intersec2 M_{c} E_{b} k(N,M_{a}) m(BH_{a})
cmark_lt M_{c}
cmark_r E_{b}



% Constructing a point A such that M_{c}A/M_{c}B=-1
towards A M_{c} B -1
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(BH_{a}) and circle k(N,M_{a}) intersect; points E_{a} and N are
     not the same; lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel; lines h_{a} and a are
    not parallel
% Determination conditions: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the same; points E_{a}
    and M_{a} are not the same; points B and H_{a} are not the same; lines h_{a} and a are not the
    same; points E_{a} and M_{a} are not the same; points B and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving C=C

Status: Theorem has been proved.

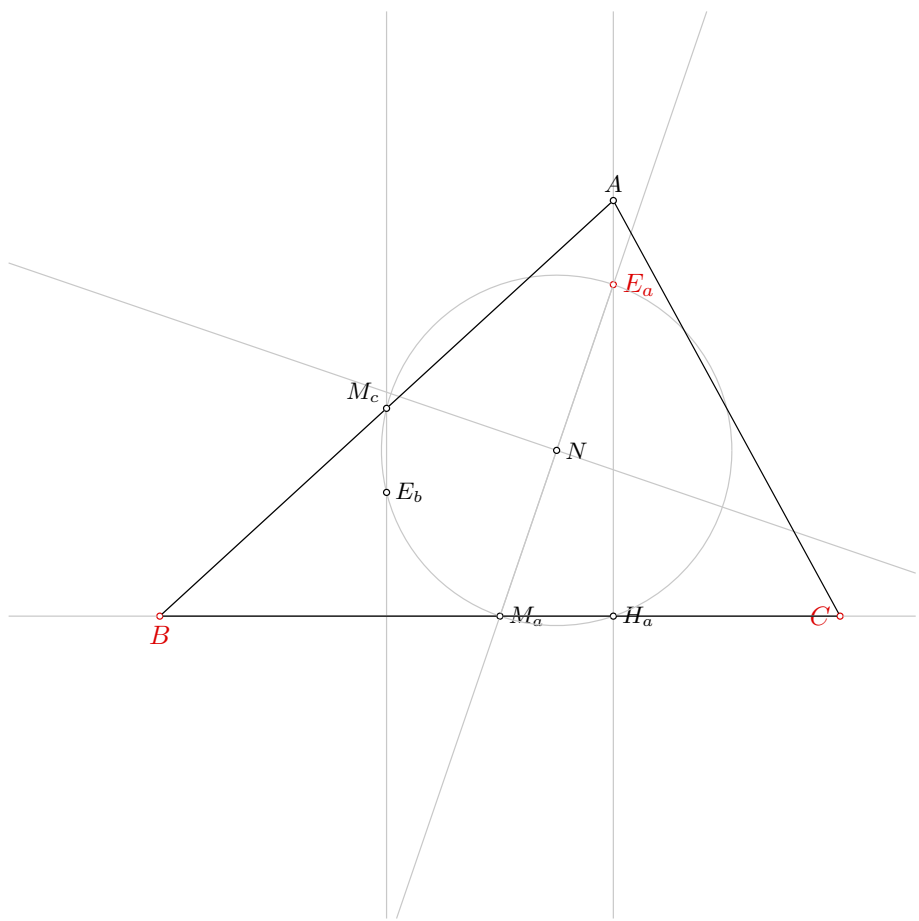

Figure 1: Illustration of the problem 0627

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_a=_E_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 36 terms.

Time Complexity: Time spent by the prover is 0.433 seconds.

NDG conditions Points M_a and E_a are not identical

Line through points B and M_a is not perpendicular to line through points M_a and C

Points A, B and C are not collinear

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{E_aBC} \neq 0$ i.e., points E_a, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{E_aBC} \neq S_{F^0_{h_a}BC}$ i.e., lines $E_aF^0_{h_a}$ and BC are not parallel (construction based assumption)

$S_{M^3_{m(E_aM_a)}E_aM_a} \neq S_{T^4_{m(E_aM_a)}E_aM_a}$ i.e., lines $M^3_{m(E_aM_a)}T^4_{m(E_aM_a)}$ and E_aM_a are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving C=C

NDG conditions are:

$S_{E_aBC} \neq 0$ i.e., points E_a, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{E_aBC} \neq S_{F^0_{h_a}BC}$ i.e., lines $E_aF^0_{h_a}$ and BC are not parallel (construction based assumption)

$S_{M^3_{m(E_aM_a)}E_aM_a} \neq S_{T^4_{m(E_aM_a)}E_aM_a}$ i.e., lines $M^3_{m(E_aM_a)}T^4_{m(E_aM_a)}$ and E_aM_a are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving $E_a{=}\_E_a$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 42 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving $E_a{=}\_E_a$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 314 terms.

Time Complexity: Time spent by the prover is 0.580 seconds.There are no ndg conditions.

Problem 628

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 628: Given a point B, a point C and a point E_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point E_b, construct a point H (rule W01); ;
2. Using the point B and the point C, construct a line a (rule W02); % DET: points B and C are not the same;
3. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
4. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
5. Using the circle $k(E_b, B)$, the line a, the point E_b and the point B, construct a point H_a (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points B and H_a must be different;
6. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
7. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H and H_c must be different;
8. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
9. Using the line h_a and the line c, construct a point A (rule W03); % NDG: lines h_a and c are not parallel % DET: lines h_a and c are not the same.

Non-degenerate conditions: lines h_a and c are not parallel; line h_c and circle $k(E_b, B)$ intersect; line a and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines h_a and c are not the same; points H_c and B are not the same; points H and H_c must be different; points H_a and H are not the same; points B and H_a must be different; points C and H are not the same; points B and C are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D29,D3,D5,D7,D8,GD01,GD02,GL03,L3,L49,L50,L51]

Solving time: 11.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point C 110 40
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_b B
cmark_l C
cmark_r E_{b}
color 0 0 0
fontsize 8


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points B and C are not the same
% Constructing a line a which passes through point B and point C
line a B C

color 200 200 200
drawline a
color 0 0 0



% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points B and H_{a} must be different
% Constructing a point P_{\_G18897} which is a foot of the point E_{b} on the line a
foot P_{\_G18897} E_{b} a
cmark_r P_{\_G18897}
color 200 200 200
drawline E_{b} P_{\_G18897}
color 0 0 0

% Constructing a point H_{a} which is an image of the point B in the symmetry to point/line P_{\_G
    18897}
sim H_{a} P_{\_G18897} B
cmark_r H_{a}


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G19135} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G19135} E_{b} h_{c}
cmark_r P_{\_G19135}
color 200 200 200
drawline E_{b} P_{\_G19135}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    19135}
sim H_{c} P_{\_G19135} H
cmark_rt H_{c}


% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0
```

```
% NDG: lines h_{a} and c are not parallel% DET: lines h_{a} and c are not the same
% Constructing a point A which belongs to line h_{a} and line c
intersec A h_{a} c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and c are not parallel; line h_{c} and circle k(E_{b},B)
    intersect; line a and circle k(E_{b},B) intersect; points B and E_{b} are not the same
% Determination conditions: lines h_{a} and c are not the same; points H_{c} and B are not the same
    ; points H and H_{c} must be different; points H_{a} and H are not the same; points B and H_{a}
     must be different; points C and H are not the same; points B and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.03 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{H_aH_cB} \neq S_{HH_cB}$ i.e., lines H_aH and H_cB are not parallel (construction based assumption)

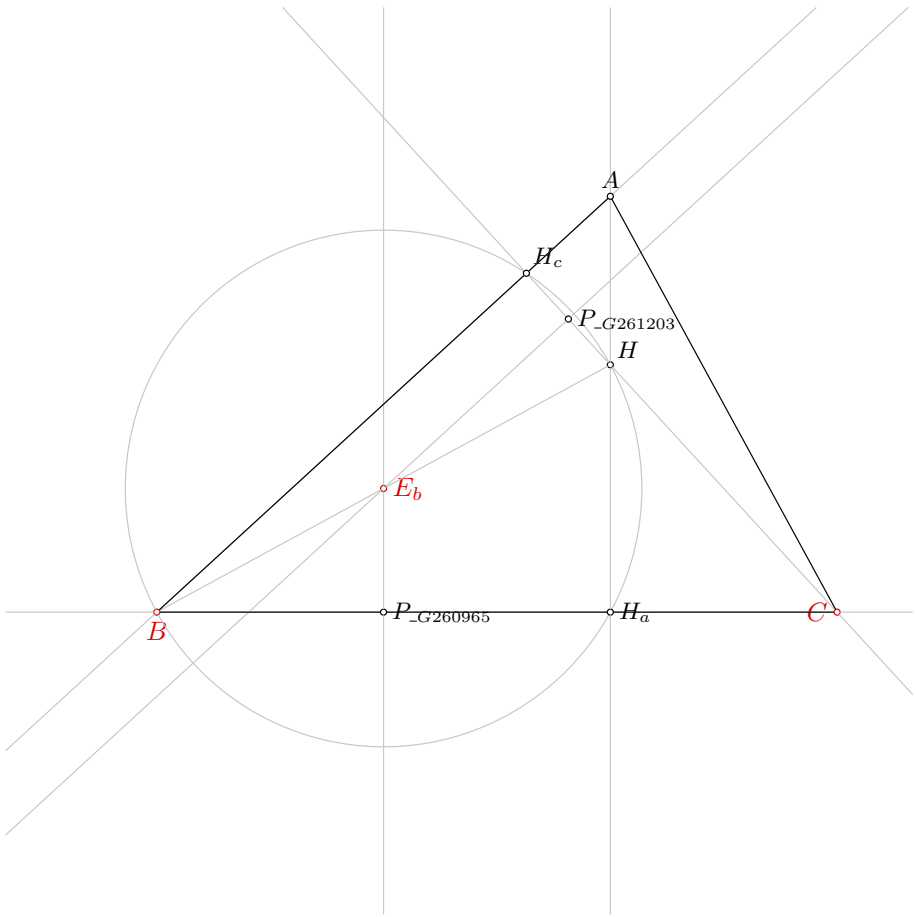

Figure 1: Illustration of the problem 0628

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a} BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving C=C

NDG conditions are:
$S_{H_aH_cB} \neq S_{HH_cB}$ i.e., lines H_aH and H_cB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a} BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.3 Proving E_b=$\_E_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving E_b=$\_E_b$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving E_b=_E_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 51 terms.

Time Complexity: Time spent by the prover is 0.250 seconds.There are no ndg conditions.

Problem 629

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 629: Given a point B, a point C and a point E_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point C, construct a point M_a (rule W01); ;
2. Using the point C and the point E_c, construct a point H (rule W01); ;
3. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
4. Using the point C and the point E_c, construct a line h_c (rule W02); % DET: points C and E_c are not the same;
5. Using the point B and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points B and M_a are not the same;
6. Using the circle $k(M_a, B)$, the line h_b, the point M_a and the point B, construct a point H_b (rule W05); % NDG: line h_b and circle $k(M_a, B)$ intersect % DET: points B and H_b must be different;
7. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
8. Using the circle $k(M_a, B)$, the line h_c, the point M_a and the point C, construct a point H_c (rule W05); % NDG: line h_c and circle $k(M_a, B)$ intersect % DET: points C and H_c must be different;
9. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
10. Using the line b and the line c, construct a point A (rule W03); % NDG: lines b and c are not parallel % DET: lines b and c are not the same.

Non-degenerate conditions: lines b and c are not parallel; line h_c and circle $k(M_a, B)$ intersect; line h_b and circle $k(M_a, B)$ intersect; points B and M_a are not the same.

Determination conditions: lines b and c are not the same; points H_c and B are not the same; points C and H_c must be different; points H_b and C are not the same; points B and H_b must be different; points C and E_c are not the same; points B and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D21,D3,D30,D6,D7,D9,GD01,GD02,GL03,GL09,L3,L37,L38,L39]

Solving time: 10.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point C 110 40
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_b B
cmark_l C
cmark_r E_{c}
color 0 0 0
fontsize 8


% Constructing a point M_{a} such that BM_{a}/BC=0.5
towards M_{a} B C 0.5
cmark_r M_{a}
color 200 200 200
drawsegment B C
color 0 0 0



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% DET: points C and E_{c} are not the same
% Constructing a line h_{c} which passes through point C and point E_{c}
line h_{c} C E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points B and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point B
circle k(M_{a},B) M_{a} B

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: line h_{b} and circle k(M_{a},B) intersect% DET: points B and H_{b} must be different
% Constructing a point P_{\_G41482} which is a foot of the point M_{a} on the line h_{b}
foot P_{\_G41482} M_{a} h_{b}
cmark_r P_{\_G41482}
color 200 200 200
drawline M_{a} P_{\_G41482}
color 0 0 0

% Constructing a point H_{b} which is an image of the point B in the symmetry to point/line P_{\_G
    41482}
sim H_{b} P_{\_G41482} B
cmark_l H_{b}


% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% NDG: line h_{c} and circle k(M_{a},B) intersect% DET: points C and H_{c} must be different
% Constructing a point P_{\_G41720} which is a foot of the point M_{a} on the line h_{c}
foot P_{\_G41720} M_{a} h_{c}
cmark_r P_{\_G41720}
color 200 200 200
drawline M_{a} P_{\_G41720}
color 0 0 0

% Constructing a point H_{c} which is an image of the point C in the symmetry to point/line P_{\_G
    41720}
sim H_{c} P_{\_G41720} C
cmark_rt H_{c}
```

```
% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: lines b and c are not parallel% DET: lines b and c are not the same
% Constructing a point A which belongs to line b and line c
intersec A b c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and c are not parallel; line h_{c} and circle k(M_{a},B)
    intersect; line h_{b} and circle k(M_{a},B) intersect; points B and M_{a} are not the same
% Determination conditions: lines b and c are not the same; points H_{c} and B are not the same;
    points C and H_{c} must be different; points H_{b} and C are not the same; points B and H_{b}
    must be different; points C and E_{c} are not the same; points B and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

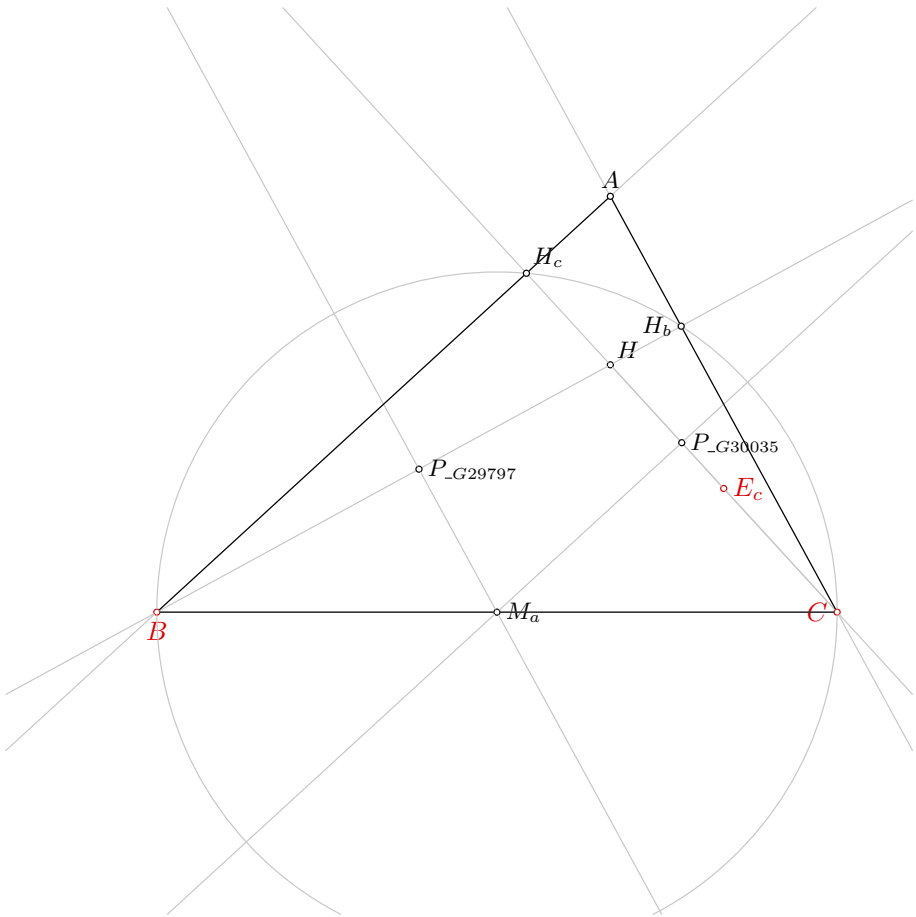

Figure 1: Illustration of the problem 0629

4.1.3 Proving E_c=_E_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 37 terms.

Time Complexity: Time spent by the prover is 4.716 seconds.

NDG conditions Points B and H are not identical

Points B, C and H are not collinear

Points E_c, B and C are not collinear

Points E_c, B and C are not collinear

Line through points H_b and C is not parallel with line through points B and H_c

Points H_b, B and C are not collinear

Points A and B are not identical

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{H_bH_cB} \neq S_{CH_cB}$ i.e., lines H_bC and H_cB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving C=C

NDG conditions are:

$S_{H_bH_cB} \neq S_{CH_cB}$ i.e., lines H_bC and H_cB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving E_c=_E_c

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving E_c=_E_c

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 97 terms.

Time Complexity: Time spent by the prover is 0.480 seconds.There are no ndg conditions.

Problem 630

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 630: Given a point B, a point C and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point C, construct a point M_a (rule W01); ;
2. Using the point B and the point C, construct a line a (rule W02); % DET: points B and C are not the same;
3. Using the point N and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points N and M_a are not the same;
4. Using the point B and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points B and M_a are not the same;
5. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
6. Using the circle $k(N, M_a)$, the line a, the point N and the point M_a, construct a point H_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points M_a and H_a must be different;
7. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;
8. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
9. Using the circle $k(M_a, B)$ and the circle $k(N, M_a)$, construct a point H_b and a point H_c (rule W07); % NDG: circles $k(M_a, B)$ and $k(N, M_a)$ intersect % DET: circles $k(M_a, B)$ and $k(N, M_a)$ are not the same;

10. Using the point B and the point H_b, construct a line h_b (rule W02); % DET: points B and H_b are not the same;

11. Using the line h_a and the line h_b, construct a point H (rule W03); % NDG: lines h_a and h_b are not parallel % DET: lines h_a and h_b are not the same;

12. Using the point N and the point H, construct a point G (rule W01); ;

13. Using the point C and the point G, construct a point M_c (rule W01); ;

14. Using the point B and the point M_c, construct a point A (rule W01); .

Non-degenerate conditions: lines h_a and h_b are not parallel; circles $k(M_a, B)$ and $k(N, M_a)$ intersect; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; line a and circle $k(N, M_a)$ intersect; points M_a and N are not the same; points B and M_a are not the same.

Determination conditions: lines h_a and h_b are not the same; points B and H_b are not the same; circles $k(M_a, B)$ and $k(N, M_a)$ are not the same; points E_a and H_a are not the same; points M_a and E_a must be different; points M_a and H_a must be different; points N and M_a are not the same; points B and C are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D20,D21,D28,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L16,L19,L20,L21,L22

Solving time: 5.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point C 110 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_l C
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point M_{a} such that BM_{a}/BC=0.5
towards M_{a} B C 0.5
cmark_r M_{a}
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points B and C are not the same
% Constructing a line a which passes through point B and point C
line a B C
```

```
color 200 200 200
drawline a
color 0 0 0


% DET: points N and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point N and point M_{a}
line m(H_{b}H_{c}) N M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0


% NDG: points B and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point B
circle k(M_{a},B) M_{a} B

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0


% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0


% NDG: line a and circle k(N,M_{a}) intersect% DET: points M_{a} and H_{a} must be different
% Constructing a point P_{\_G80192} which is a foot of the point N on the line a
foot P_{\_G80192} N a
cmark_r P_{\_G80192}
color 200 200 200
drawline N P_{\_G80192}
color 0 0 0

% Constructing a point H_{a} which is an image of the point M_{a} in the symmetry to point/line P
    _{\_G80192}
sim H_{a} P_{\_G80192} M_{a}
cmark_r H_{a}


% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}
```

```
% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: circles k(M_{a},B) and k(N,M_{a}) intersect% DET: circles k(M_{a},B) and k(N,M_{a}) are not
    the same
% Constructing points H_{b} and H_{c} which are in intersection of k(M_{a},B) and k(N,M_{a})
intersec2 H_{b} H_{c} k(M_{a},B) k(N,M_{a})
cmark_l H_{b}
cmark_rt H_{c}


% DET: points B and H_{b} are not the same
% Constructing a line h_{b} which passes through point B and point H_{b}
line h_{b} B H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines h_{a} and h_{b} are not parallel% DET: lines h_{a} and h_{b} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{b}
intersec H h_{a} h_{b}
cmark_rt H



% Constructing a line L_{\_G80694} which passes through point N and point H
line L_{\_G80694} N H

color 200 200 200
drawline L_{\_G80694}
color 0 0 0


% Constructing a point P_{\_G80795} with coordinates (0,0)
point P_{\_G80795} 0 0
cmark_r P_{\_G80795}

% Constructing a point P_{\_G80719} such that NP_{\_G80719}/NP_{\_G80795}=-1
towards P_{\_G80719} N P_{\_G80795} -1
cmark_r P_{\_G80719}
color 200 200 200
drawsegment P_{\_G80795} P_{\_G80719}
color 0 0 0
```

```
% Constructing a point P_{\_G80764} such that NP_{\_G80764}/NP_{\_G80795}=3
towards P_{\_G80764} N P_{\_G80795} 3
cmark_r P_{\_G80764}
color 200 200 200
drawsegment N P_{\_G80764}
color 0 0 0

% Constructing a line L_{\_G80725} which passes through point H and point P_{\_G80764}
line L_{\_G80725} H P_{\_G80764}

color 200 200 200
drawline L_{\_G80725}
color 0 0 0


% Constructing a line L_{\_G80688} which contains the point P_{\_G80719} and is parallel to the
    line L_{\_G80725}
parallel L_{\_G80688} P_{\_G80719} L_{\_G80725}

color 200 200 200
drawline L_{\_G80688}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G80688} and line L_{\_G80694}
intersec G L_{\_G80688} L_{\_G80694}
cmark_t G



% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0



% Constructing a point A such that BA/BM_{c}=2
towards A B M_{c} 2
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{b} are not parallel; circles k(M_{a},B) and k(N,M_{
    a}) intersect; line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect; line a and circle k(N,M_{a})
     intersect; points M_{a} and N are not the same; points B and M_{a} are not the same
```

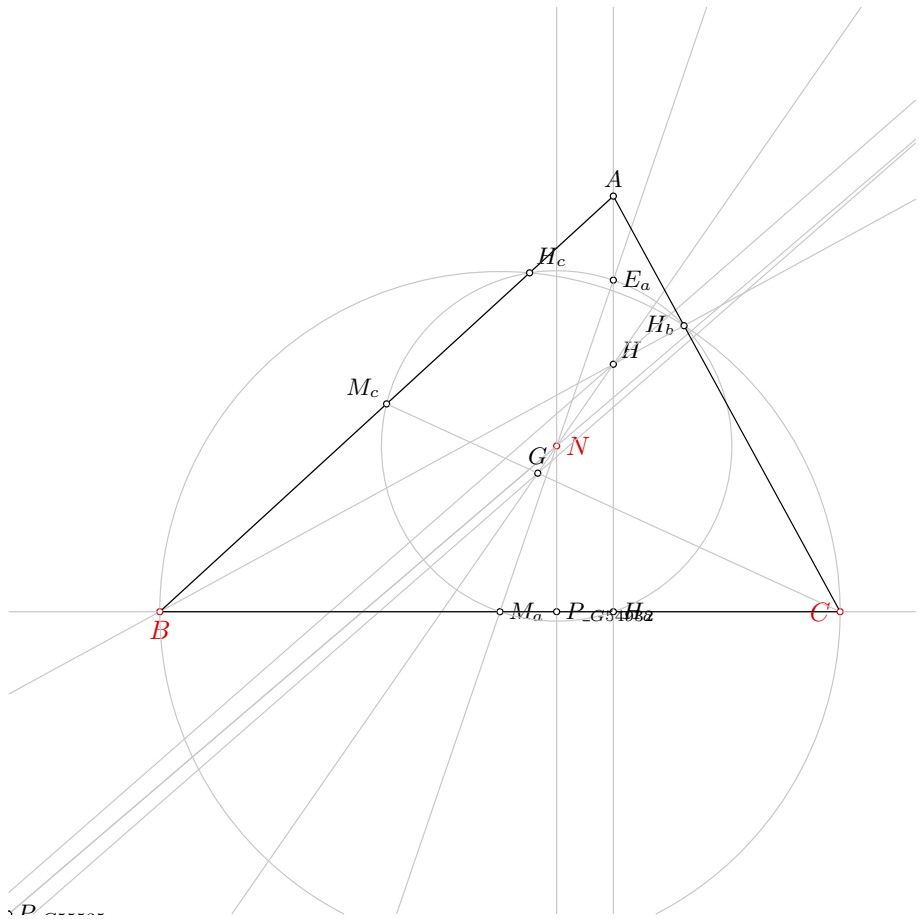

Figure 1: Illustration of the problem 0630

```
% Determination conditions: lines h_{a} and h_{b} are not the same; points B and H_{b} are not the
    same; circles k(M_{a},B) and k(N,M_{a}) are not the same; points E_{a} and H_{a} are not the
    same; points M_{a} and E_{a} must be different; points M_{a} and H_{a} must be different;
    points N and M_{a} are not the same; points B and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving $C{=}C$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving $N{=}\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving $B{=}B$

NDG conditions are:

$S_{E_aBH_b} \neq S_{H_aBH_b}$ i.e., lines E_aH_a and BH_b are not parallel (construction based assumption)

$S_{P\_G57464NH} \neq S_{P^0_{L\_G57433}NH}$ i.e., lines $P\_G57464P^0_{L\_G57433}$ and NH are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving $C{=}C$

NDG conditions are:

$S_{E_aBH_b} \neq S_{H_aBH_b}$ i.e., lines E_aH_a and BH_b are not parallel (construction based assumption)

$S_{P\_G61801NH} \neq S_{P^0_{L\_G61770}NH}$ i.e., lines $P\_G61801P^0_{L\_G61770}$ and NH are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.3 Proving $N{=}\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.3 Proving $N{=}\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 631

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 631: Given a point B, a point E_a and a point E_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point E_b, construct a point H (rule W01); ;
2. Using the point E_a and the point H, construct a point A (rule W01); ;
3. Using the point B and the point A, construct a line c (rule W02); % DET: points B and A are not the same;
4. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
5. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
6. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
7. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
8. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H and H_a must be different;
9. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
10. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; line h_a and circle $k(E_b, B)$ intersect; line c and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines h_c and a are not the same; points H_a and B are not the same; points H and H_a must be different; points H_c and H are not the same; points B and H_c must be different; points E_a and H are not the same; points B and A are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 11.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{a} 80 83.86
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{a}
cmark_r E_{b}
color 0 0 0
fontsize 8


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0


% DET: points B and A are not the same
% Constructing a line c which passes through point B and point A
line c B A

color 200 200 200
drawline c
color 0 0 0
```

```
% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G108061} which is a foot of the point E_{b} on the line c
foot P_{\_G108061} E_{b} c
cmark_r P_{\_G108061}
color 200 200 200
drawline E_{b} P_{\_G108061}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    108061}
sim H_{c} P_{\_G108061} B
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G108299} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G108299} E_{b} h_{a}
cmark_r P_{\_G108299}
color 200 200 200
drawline E_{b} P_{\_G108299}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    108299}
sim H_{a} P_{\_G108299} H
cmark_r H_{a}
```

```
% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; line h_{a} and circle k(E_{b},B)
    intersect; line c and circle k(E_{b},B) intersect; points B and E_{b} are not the same
% Determination conditions: lines h_{c} and a are not the same; points H_{a} and B are not the same
    ; points H and H_{a} must be different; points H_{c} and H are not the same; points B and H_{c}
     must be different; points E_{a} and H are not the same; points B and A are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

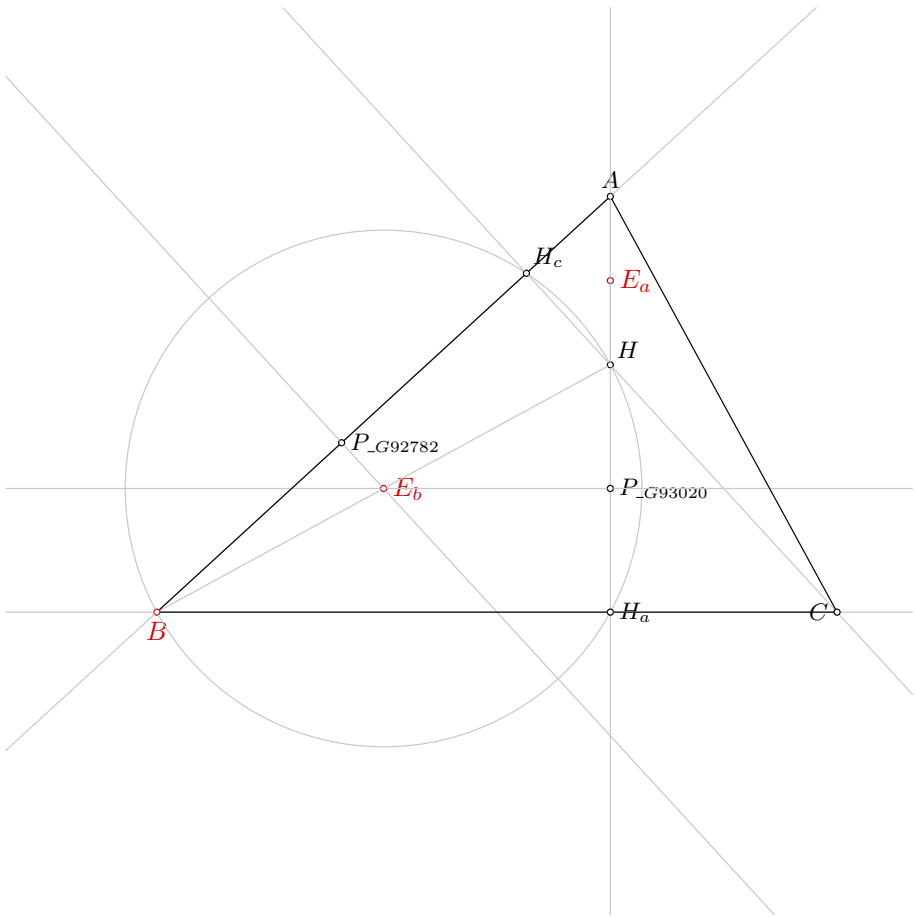

Figure 1: Illustration of the problem 0631

4.2 GCLC - Area method

4.2.1 Proving $B{=}B$

NDG conditions are:

$S_{H_cH_aB} \neq S_{HH_aB}$ i.e., lines H_cH and H_aB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_a{=}\_E_a$

Proving failed

4.2.3 Proving $E_b{=}\_E_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_a{=}\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 2174 terms.

Time Complexity: Time spent by the prover is 25.070 seconds.There are no ndg conditions.

4.3.3 Proving $E_b{=}\_E_b$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving $E_b{=}\_E_b$

Proving failed

Problem 632

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 632: Given a point B, a point E_a and a point E_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 633

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 633: Given a point B, a point E_a and a point G, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 634

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 634: Given a point B, a point E_a and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point H, construct a point E_b (rule W01); ;
2. Using the point E_a and the point H, construct a point A (rule W01); ;
3. Using the point B and the point A, construct a line c (rule W02); % DET: points B and A are not the same;
4. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
5. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
6. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
7. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
8. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H and H_a must be different;
9. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
10. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; line h_a and circle $k(E_b, B)$ intersect; line c and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines h_c and a are not the same; points H_a and B are not the same; points H and H_a must be different; points H_c and H are not the same; points B and H_c must be different; points E_a and H are not the same; points B and A are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 10.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{a} 80 83.86
point H 80 72.73

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{a}
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point E_{b} such that BE_{b}/BH=0.5
towards E_{b} B H 0.5
cmark_r E_{b}
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0


% DET: points B and A are not the same
% Constructing a line c which passes through point B and point A
line c B A

color 200 200 200
drawline c
color 0 0 0
```

```
% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G139107} which is a foot of the point E_{b} on the line c
foot P_{\_G139107} E_{b} c
cmark_r P_{\_G139107}
color 200 200 200
drawline E_{b} P_{\_G139107}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    139107}
sim H_{c} P_{\_G139107} B
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G139345} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G139345} E_{b} h_{a}
cmark_r P_{\_G139345}
color 200 200 200
drawline E_{b} P_{\_G139345}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    139345}
sim H_{a} P_{\_G139345} H
cmark_r H_{a}
```

```
% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; line h_{a} and circle k(E_{b},B)
    intersect; line c and circle k(E_{b},B) intersect; points B and E_{b} are not the same
% Determination conditions: lines h_{c} and a are not the same; points H_{a} and B are not the same
    ; points H and H_{a} must be different; points H_{c} and H are not the same; points B and H_{c}
     must be different; points E_{a} and H are not the same; points B and A are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving H=_H

Proving failed

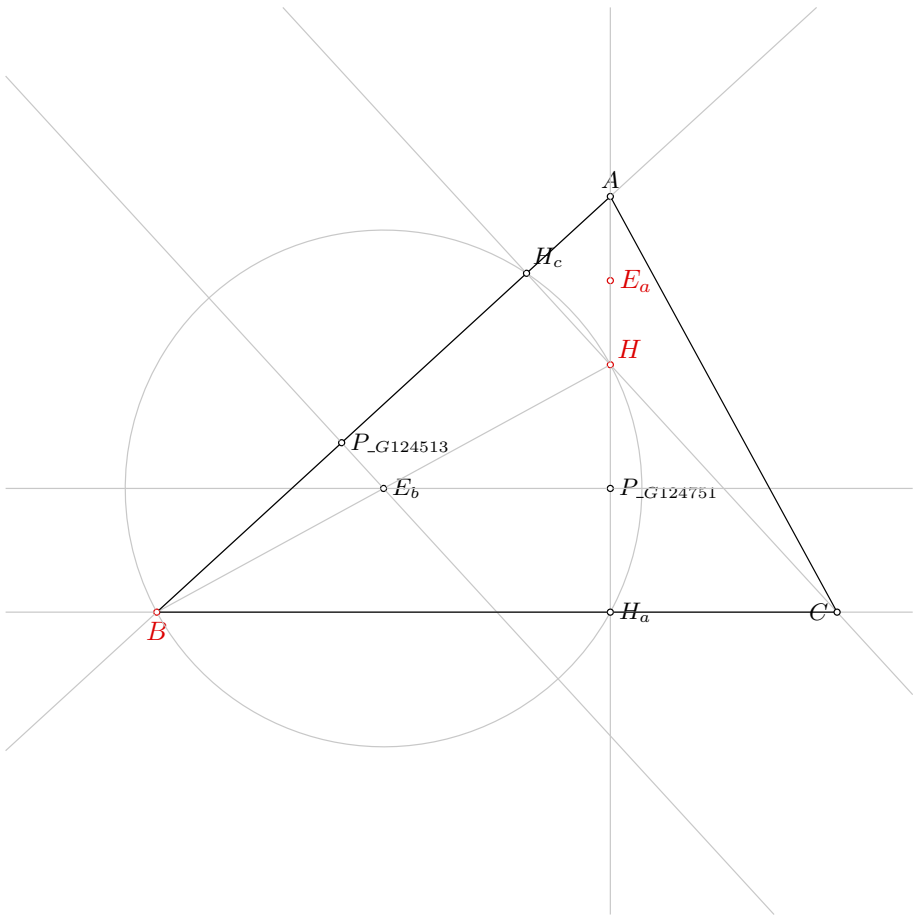

Figure 1: Illustration of the problem 0634

4.2 GCLC - Area method

4.2.1 Proving $B{=}B$

NDG conditions are:

$S_{H_cH_aB} \neq S_{HH_aB}$ i.e., lines H_cH and H_aB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_a{=}\_E_a$

Proving failed

4.2.3 Proving $H{=}\_H$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_a{=}\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 2174 terms.

Time Complexity: Time spent by the prover is 1.770 seconds.There are no ndg conditions.

4.3.3 Proving $H{=}\_H$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 315 terms.

Time Complexity: Time spent by the prover is 0.270 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving $H{=}\_H$

Proving failed

Problem 635

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 635: Given a point E_a, a point H_a and a point B, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Using the point H_a and the line h_a, construct a line a (rule W10a); ;
3. Choose freely a point B on the line a (rule WOnline2);
4. Choose freely a point A on the line h_a (rule WOnline1) ;
5. Using the point A and the point E_a, construct a point H (rule W01); ;
6. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
7. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
8. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
9. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
10. Using the line a and the line h_c, construct a point C (rule W03); % NDG: lines a and h_c are not parallel % DET: lines a and h_c are not the same.

Non-degenerate conditions: lines a and h_c are not parallel; line c and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines a and h_c are not the same; points H and H_c are not the same; points A and H_c must be different; points A and B are not the same; points E_a and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,WOnline1,WOnline2]

Lemmas used: [D10,D28,D3,D5,D7,D8,GD01,GD02,GL03,GL09,L3,L48]

Solving time: 62.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{a} 80 40
point B 20 40

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r H_{a}
cmark_b B
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Constructing a line a which is perpendicular to line h_{a} and which passes through point H_{a}
perp a H_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0




% Generating random value V[_G161621]
random V[_G161621]


% Calculating value V[_G161642] using formula V[_G161621]*20
expression V[_G161642] { V[_G161621]*20 }
```

```
% Constructing a point B which is a point for which holds H_{a}B = V[_G161642] and angle E_{a}H_{a}
    B = 90
turtle B E_{a} H_{a} 90 V[_G161642]
cmark_b B



% Choosing randomly a point A on the line E_{a}H_{a}
online A E_{a} H_{a}
cmark_t A
color 200 200 200
drawline E_{a} H_{a}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G162162} which is a foot of the point E_{a} on the line c
foot P_{\_G162162} E_{a} c
cmark_r P_{\_G162162}
color 200 200 200
drawline E_{a} P_{\_G162162}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    162162}
sim H_{c} P_{\_G162162} A
```

```
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines a and h_{c} are not parallel% DET: lines a and h_{c} are not the same
% Constructing a point C which belongs to line a and line h_{c}
intersec C a h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{c} are not parallel; line c and circle k(E_{a},A)
    intersect; points A and E_{a} are not the same
% Determination conditions: lines a and h_{c} are not the same; points H and H_{c} are not the same
    ; points A and H_{c} must be different; points A and B are not the same; points E_{a} and H_{a}
     are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 55 terms.

Time Complexity: Time spent by the prover is 0.935 seconds.

NDG conditions Points A and B are not identical

Points A and B are not identical

Line through points H_c and H_a is not perpendicular to line through points H_a and H

Line through points A and E_a is not parallel with line through points B and C

4.1.2 Proving H_a=_H_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

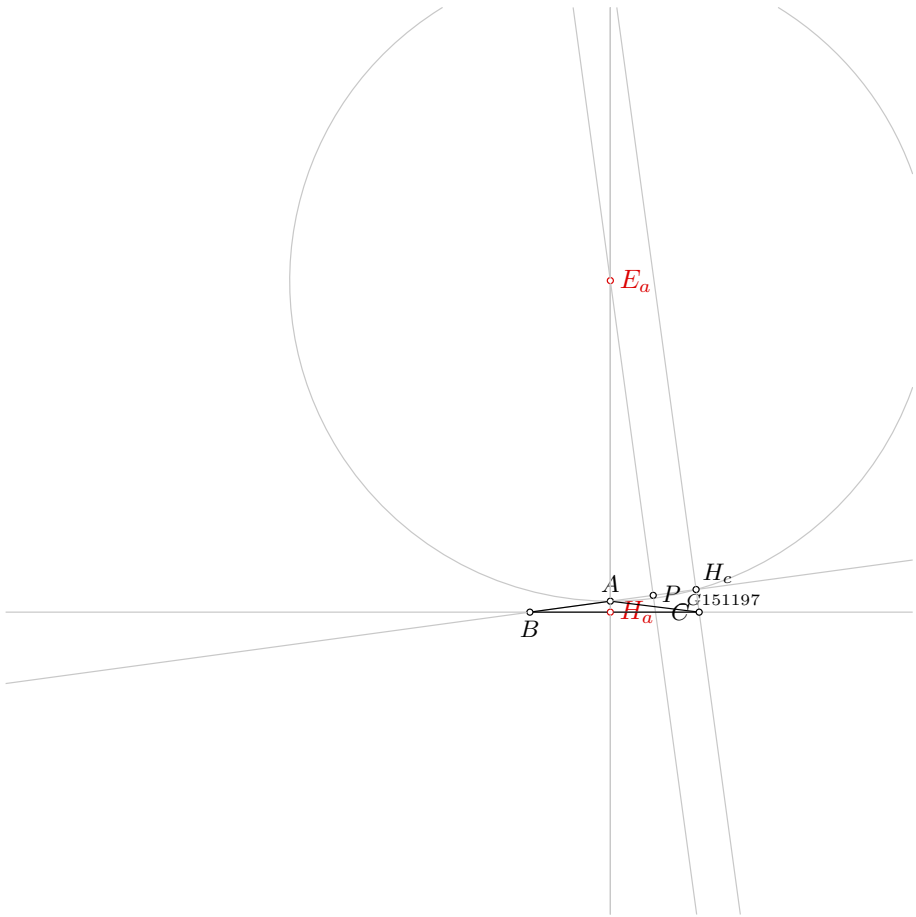

Figure 1: Illustration of the problem 0635

Time Complexity: Time spent by the prover is 0.169 seconds.

NDG conditions Points A and B are not identical

Points A and B are not identical

Line through points H_c and H_a is not perpendicular to line through points H_a and H

Line through points A and E_a is not parallel with line through points B and C

4.1.3 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.007 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving B=B

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving H_a=_H_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 16 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.3 Proving B=B

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 20 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.4.2 Proving H_a=_H_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 20 terms.

Time Complexity: Time spent by the prover is 0.060 seconds.There are no ndg conditions.

4.4.3 Proving B=B

Proving failed

Problem 636

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 636: Given a point B, a point E_a and a point H_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point H_b, construct a line h_b (rule W02); % DET: points B and H_b are not the same;
2. Using the point H_b and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_b and E_a are not the same;
3. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H_b, construct a point H (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H_b and H must be different;
4. Using the point E_a and the point H, construct a point A (rule W01); ;
5. Using the point B and the point A, construct a line c (rule W02); % DET: points B and A are not the same;
6. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
7. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
8. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
9. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same.

Non-degenerate conditions: lines b and h_c are not parallel; line c and circle $k(E_a, A)$ intersect; line h_b and circle $k(E_a, A)$ intersect; points H_b and E_a are not the same.

Determination conditions: lines b and h_c are not the same; points H and H_c are not the same; points A and H_c must be different; points H_b and A are not the same; points B and A are not the same; points H_b and H must be different; points B and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,L3,L46,L47,L48]

Solving time: 8.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{a} 80 83.86
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{a}
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points B and H_{b} are not the same
% Constructing a line h_{b} which passes through point B and point H_{b}
line h_{b} B H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{b} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{b}
circle k(E_{a},A) E_{a} H_{b}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H_{b} and H must be different
% Constructing a point P_{\_G184218} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G184218} E_{a} h_{b}
cmark_r P_{\_G184218}
color 200 200 200
drawline E_{a} P_{\_G184218}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    184218}
sim H P_{\_G184218} H_{b}
cmark_rt H



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0


% DET: points B and A are not the same
% Constructing a line c which passes through point B and point A
line c B A

color 200 200 200
drawline c
color 0 0 0



% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G184581} which is a foot of the point E_{a} on the line c
foot P_{\_G184581} E_{a} c
cmark_r P_{\_G184581}
color 200 200 200
drawline E_{a} P_{\_G184581}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    184581}
sim H_{c} P_{\_G184581} A
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
```

```
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line c and circle k(E_{a},A)
    intersect; line h_{b} and circle k(E_{a},A) intersect; points H_{b} and E_{a} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H and H_{c} are not the same
    ; points A and H_{c} must be different; points H_{b} and A are not the same; points B and A are
     not the same; points H_{b} and H must be different; points B and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{H_bHH_c} \neq S_{AHH_c}$ i.e., lines H_bA and HH_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

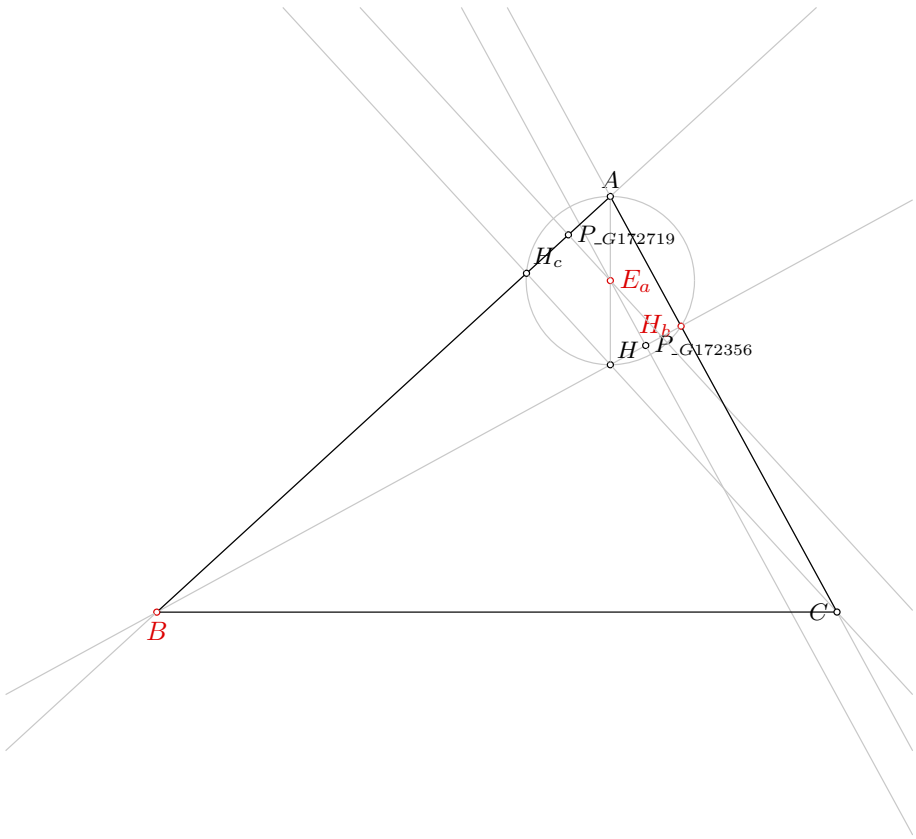

Figure 1: Illustration of the problem 0636

$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving H_b=$\_H_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Proving failed

4.3.2 Proving E_a=$\_E_a$

Proving failed

4.3.3 Proving H_b=$\_H_b$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Proving failed

4.4.2 Proving E_a=$\_E_a$

Proving failed

4.4.3 Proving H_b=$\_H_b$

Proving failed

Problem 637

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 637: Given a point B, a point E_a and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point H_c, construct a line c (rule W02); % DET: points B and H_c are not the same;
2. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
3. Using the circle $k(E_a, A)$, the line c, the point E_a and the point H_c, construct a point A (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points H_c and A must be different;
4. Using the point E_a and the point A, construct a point H (rule W01); ;
5. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
6. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
7. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
8. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
9. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; line c and circle $k(E_a, A)$ intersect; points H_c and E_a are not the same.

Determination conditions: lines h_c and b are not the same; points A and H_b are not the same; points H and H_b must be different; points H_c and H are not the same; points B and H are not the same; points H_c and A must be different; points B and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,L3,L46,L47,L48]

Solving time: 8.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{a} 80 83.86
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{a}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points B and H_{c} are not the same
% Constructing a line c which passes through point B and point H_{c}
line c B H_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points H_{c} and A must be different
% Constructing a point P_{\_G207349} which is a foot of the point E_{a} on the line c
foot P_{\_G207349} E_{a} c
cmark_r P_{\_G207349}
color 200 200 200
drawline E_{a} P_{\_G207349}
color 0 0 0
```

```
% Constructing a point A which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    207349}
sim A P_{\_G207349} H_{c}
cmark_t A



% Constructing a point H such that E_{a}H/E_{a}A=-1
towards H E_{a} A -1
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0



% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G207712} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G207712} E_{a} h_{b}
cmark_r P_{\_G207712}
color 200 200 200
drawline E_{a} P_{\_G207712}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    207712}
sim H_{b} P_{\_G207712} H
cmark_l H_{b}


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
```

```
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; line c and circle k(E_{a},A) intersect; points H_{c} and E_{a} are not the same
% Determination conditions: lines h_{c} and b are not the same; points A and H_{b} are not the same
    ; points H and H_{b} must be different; points H_{c} and H are not the same; points B and H are
     not the same; points H_{c} and A must be different; points B and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving H_c=_H_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 1176 terms.

Time Complexity: Time spent by the prover is 7.805 seconds.

NDG conditions Points B, H_c and E_a are not collinear

Points B, H_c and E_a are not collinear

Points B and H are not identical

Points B and H are not identical

Line through points H_b and A is not parallel with line through points H_c and H

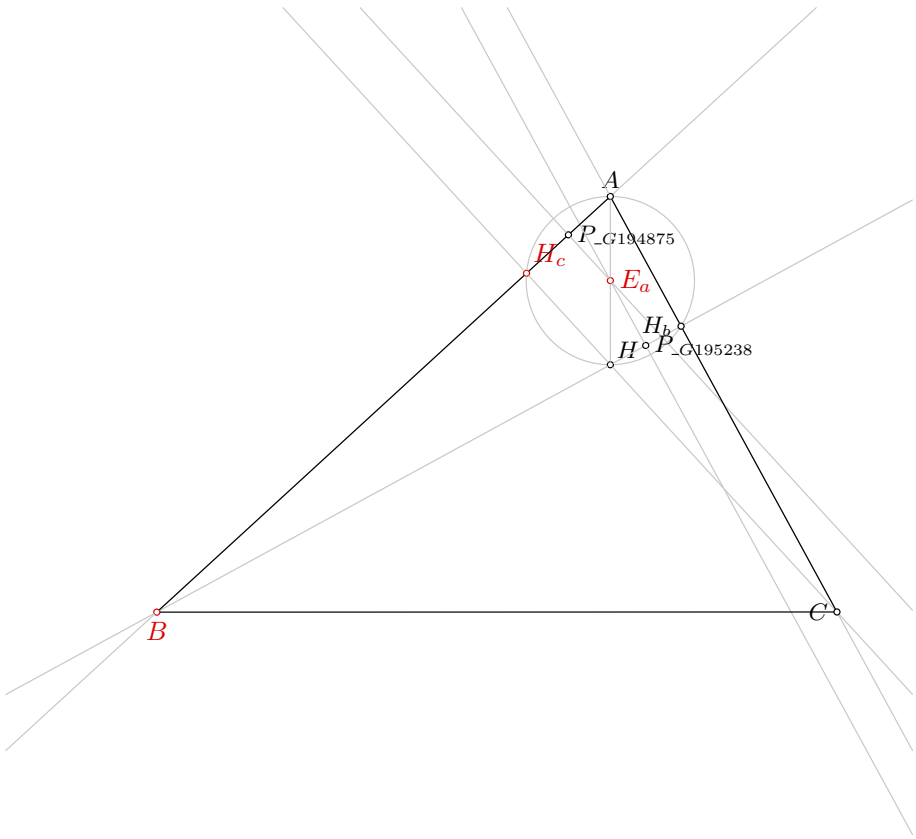

Figure 1: Illustration of the problem 0637

Line through points B and E_a is not parallel with line through points H_c and H

Points A and B are not identical

Points A and B are not identical

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{H_cAH_b} \neq S_{HAH_b}$ i.e., lines H_cH and AH_b are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^2_{\_h_c}} \neq S_{BCF^2_{\_h_c}}$ i.e., lines AB and $CF^2_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving H_c=$\_H_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Proving failed

4.3.2 Proving E_a=$\_E_a$

Proving failed

4.3.3 Proving H_c=$\_H_c$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Proving failed

4.4.2 Proving E_a=$\_E_a$

Proving failed

4.4.3 Proving H_c=$\_H_c$

Proving failed

Problem 638

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 638: Given a point B, a point E_a and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 639

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 639: Given a point B, a point E_a and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point M_a, construct a point C (rule W01); ;
2. Using the point B and the point M_a, construct a line a (rule W02); % DET: points B and M_a are not the same;
3. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
4. Using the point E_a and the line a, construct a line h_a (rule W10b); ;
5. Using the line h_a and the line a, construct a point H_a (rule W03); % NDG: lines h_a and a are not parallel % DET: lines h_a and a are not the same;
6. Using the point B and the point H_a, construct a line $m(BH_a)$ (rule W14); % DET: points B and H_a are not the same;
7. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;
8. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;
9. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
10. Using the circle $k(N, M_a)$ and the line $m(BH_a)$, construct a point M_c and a point E_b (rule W04); % NDG: line $m(BH_a)$ and circle $k(N, M_a)$ intersect;

11. Using the point M_c and the point B, construct a point A (rule W01); .

Non-degenerate conditions: line $m(BH_a)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel; lines h_a and a are not parallel.

Determination conditions: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points B and H_a are not the same; lines h_a and a are not the same; points E_a and M_a are not the same; points B and M_a are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14]

Lemmas used: [D20,D21,D28,D3,D32,D5,D8,GD01,GD02,GL01,GL03,GL04,GL09,L18,L20,L21,L22,L23,L38,L

Solving time: 2.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{a} 80 83.86
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{a}
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point C such that BC/BM_{a}=2
towards C B M_{a} 2
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points B and M_{a} are not the same
% Constructing a line a which passes through point B and point M_{a}
line a B M_{a}

color 200 200 200
drawline a
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
```

```
color 0 0 0



% Constructing a line h_{a} which is perpendicular to line a and which passes through point E_{a}
perp h_{a} E_{a} a

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{a} and a are not parallel% DET: lines h_{a} and a are not the same
% Constructing a point H_{a} which belongs to line h_{a} and line a
intersec H_{a} h_{a} a
cmark_r H_{a}


% DET: points B and H_{a} are not the same
% Constructing bisector m(BH_{a}) of the segment BH_{a}
med m(BH_{a}) B H_{a}

color 200 200 200
drawline m(BH_{a})
color 0 0 0

color 200 200 200
drawsegment B H_{a}
color 0 0 0


% DET: points E_{a} and M_{a} are not the same
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0


% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(BH_{a}) and circle k(N,M_{a}) intersect
% Constructing points M_{c} and E_{b} which are in intersection of k(N,M_{a}) and m(BH_{a})
intersec2 M_{c} E_{b} k(N,M_{a}) m(BH_{a})
cmark_lt M_{c}
cmark_r E_{b}



% Constructing a point A such that M_{c}A/M_{c}B=-1
towards A M_{c} B -1
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(BH_{a}) and circle k(N,M_{a}) intersect; points E_{a} and N are
     not the same; lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel; lines h_{a} and a are
    not parallel
% Determination conditions: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the same; points E_{a}
    and M_{a} are not the same; points B and H_{a} are not the same; lines h_{a} and a are not the
    same; points E_{a} and M_{a} are not the same; points B and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

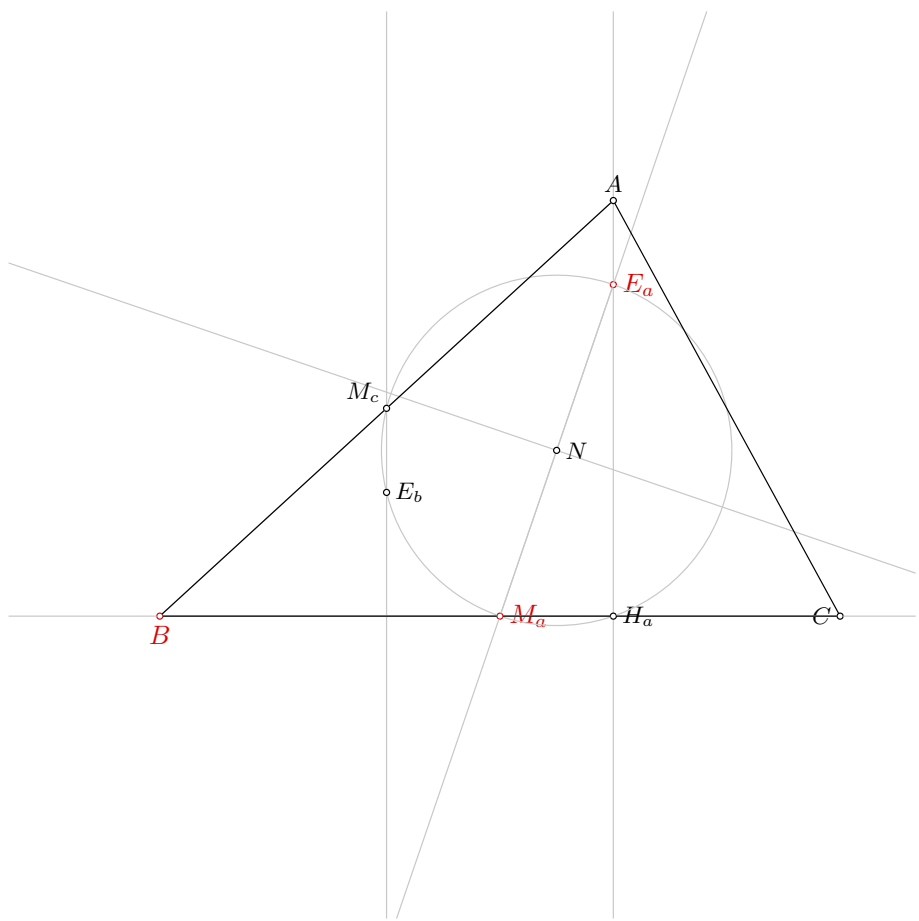

Figure 1: Illustration of the problem 0639

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{E_aBM_a} \neq 0$ i.e., points E_a, B and M_a are not collinear (foot is not the point itself; construction based assumption)

$S_{E_aBM_a} \neq S_{F^0_{h_a}BM_a}$ i.e., lines $E_aF^0_{h_a}$ and BM_a are not parallel (construction based assumption)

$S_{M^3_{m(E_aM_a)}E_aM_a} \neq S_{T^4_{m(E_aM_a)}E_aM_a}$ i.e., lines $M^3_{m(E_aM_a)}T^4_{m(E_aM_a)}$ and E_aM_a are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=_E_a

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_a=_E_a

Proving failed

4.3.3 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 13 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving $M_a{=}\_M_a$

Proving failed

Problem 640

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 640: Given a point B, a point E_a and a point M_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 641

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 641: Given a point B, a point E_a and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point M_c, construct a point A (rule W01); ;
2. Using the point E_a and the point A, construct a point H (rule W01); ;
3. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
4. Using the point E_a and the point A, construct a line h_a (rule W02); % DET: points E_a and A are not the same;
5. Using the point B and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points B and M_c are not the same;
6. Using the circle $k(M_c, A)$, the line h_b, the point M_c and the point B, construct a point H_b (rule W05); % NDG: line h_b and circle $k(M_c, A)$ intersect % DET: points B and H_b must be different;
7. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
8. Using the circle $k(M_c, A)$, the line h_a, the point M_c and the point A, construct a point H_a (rule W05); % NDG: line h_a and circle $k(M_c, A)$ intersect % DET: points A and H_a must be different;
9. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
10. Using the line b and the line a, construct a point C (rule W03); % NDG: lines b and a are not parallel % DET: lines b and a are not the same.

Non-degenerate conditions: lines b and a are not parallel; line h_a and circle $k(M_c, A)$ intersect; line h_b and circle $k(M_c, A)$ intersect; points B and M_c are not the same.

Determination conditions: lines b and a are not the same; points H_a and B are not the same; points A and H_a must be different; points H_b and A are not the same; points B and H_b must be different; points E_a and A are not the same; points B and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D20,D28,D3,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L40,L41,L42]

Solving time: 10.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{a} 80 83.86
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{a}
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point A such that BA/BM_{c}=2
towards A B M_{c} 2
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0



% Constructing a point H such that E_{a}H/E_{a}A=-1
towards H E_{a} A -1
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% DET: points E_{a} and A are not the same
% Constructing a line h_{a} which passes through point E_{a} and point A
line h_{a} E_{a} A

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points B and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point B
circle k(M_{c},A) M_{c} B

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: line h_{b} and circle k(M_{c},A) intersect% DET: points B and H_{b} must be different
% Constructing a point P_{\_G257178} which is a foot of the point M_{c} on the line h_{b}
foot P_{\_G257178} M_{c} h_{b}
cmark_r P_{\_G257178}
color 200 200 200
drawline M_{c} P_{\_G257178}
color 0 0 0

% Constructing a point H_{b} which is an image of the point B in the symmetry to point/line P_{\_G
    257178}
sim H_{b} P_{\_G257178} B
cmark_l H_{b}


% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: line h_{a} and circle k(M_{c},A) intersect% DET: points A and H_{a} must be different
% Constructing a point P_{\_G257416} which is a foot of the point M_{c} on the line h_{a}
foot P_{\_G257416} M_{c} h_{a}
cmark_r P_{\_G257416}
color 200 200 200
drawline M_{c} P_{\_G257416}
color 0 0 0

% Constructing a point H_{a} which is an image of the point A in the symmetry to point/line P_{\_G
    257416}
sim H_{a} P_{\_G257416} A
cmark_r H_{a}
```

```
% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: lines b and a are not parallel% DET: lines b and a are not the same
% Constructing a point C which belongs to line b and line a
intersec C b a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and a are not parallel; line h_{a} and circle k(M_{c},A)
    intersect; line h_{b} and circle k(M_{c},A) intersect; points B and M_{c} are not the same
% Determination conditions: lines b and a are not the same; points H_{a} and B are not the same;
    points A and H_{a} must be different; points H_{b} and A are not the same; points B and H_{b}
    must be different; points E_{a} and A are not the same; points B and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.038 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

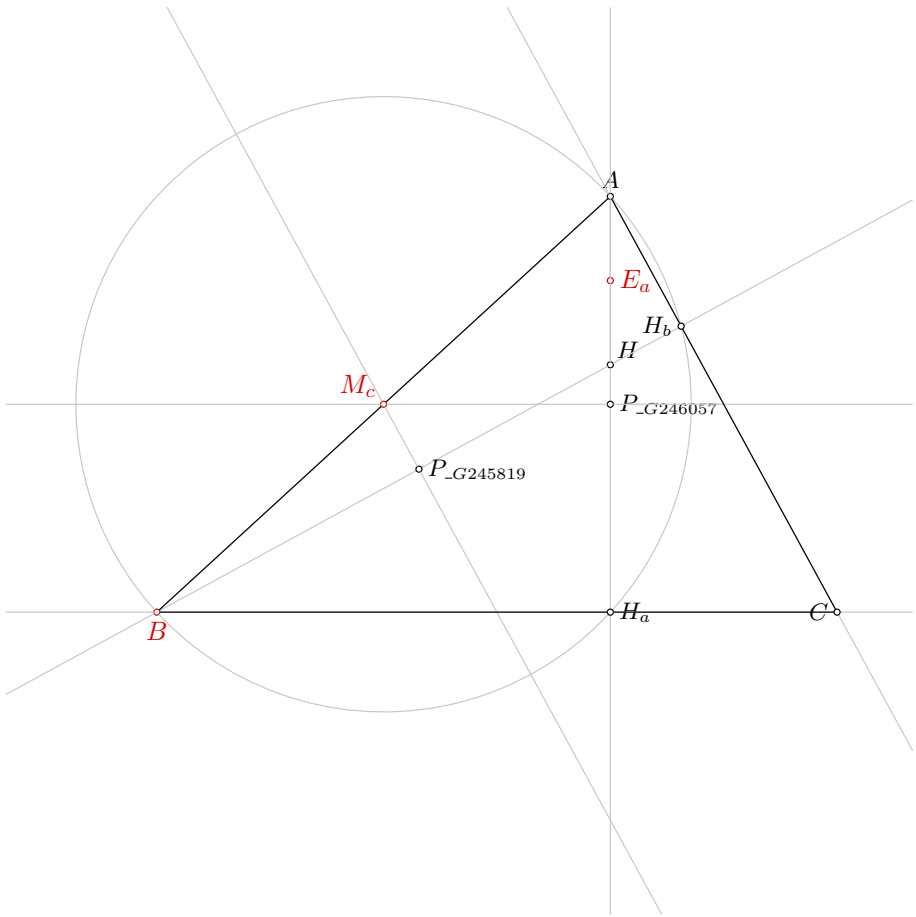

Figure 1: Illustration of the problem 0641

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{H_bH_aB} \neq S_{AH_aB}$ i.e., lines H_bA and H_aB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving M_c=$\_M_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving E_a=$\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 331 terms.

Time Complexity: Time spent by the prover is 1.040 seconds.There are no ndg conditions.

4.3.3 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving E_a=$\_E_a$

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 642

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 642: Given a point B, a point E_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and N are not the same;

2. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;

3. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point E_a, construct a point M_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_a and M_a must be different;

4. Using the point M_a and the point B, construct a point C (rule W01); ;

5. Using the point B and the point M_a, construct a line a (rule W02); % DET: points B and M_a are not the same;

6. Using the circle $k(N, M_a)$, the line a, the point N and the point M_a, construct a point H_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points M_a and H_a must be different;

7. Using the point H_a and the point E_a, construct a line h_a (rule W02); % DET: points H_a and E_a are not the same;

8. Using the point B and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points B and M_a are not the same;

9. Using the circle $k(N, M_a)$ and the circle $k(M_a, B)$, construct a point H_b and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_a, B)$ intersect % DET: circles $k(N, M_a)$ and $k(M_a, B)$ are not the same;

10. Using the point B and the point H_b, construct a line h_b (rule W02); % DET: points B and H_b are not the same;

11. Using the line h_a and the line h_b, construct a point H (rule W03); % NDG: lines h_a and h_b are not parallel % DET: lines h_a and h_b are not the same;

12. Using the point E_a and the point H, construct a point A (rule W01); .

Non-degenerate conditions: lines h_a and h_b are not parallel; circles $k(N, M_a)$ and $k(M_a, B)$ intersect; points B and M_a are not the same; line a and circle $k(N, M_a)$ intersect; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: lines h_a and h_b are not the same; points B and H_b are not the same; circles $k(N, M_a)$ and $k(M_a, B)$ are not the same; points H_a and E_a are not the same; points M_a and H_a must be different; points B and M_a are not the same; points E_a and M_a must be different; points E_a and N are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D21,D28,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L19,L20,L21,L22,L38,L39

Solving time: 4.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{a} 80 83.86
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{a}
cmark_r N
color 0 0 0
fontsize 8

% DET: points E_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point N
line m(H_{b}H_{c}) E_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
```

```
color 0 0 0


% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{a} and M_{a} must be
    different
% Constructing a point M_{a} which is an image of the point E_{a} in the symmetry to point/line N
sim M_{a} N E_{a}
cmark_r M_{a}



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points B and M_{a} are not the same
% Constructing a line a which passes through point B and point M_{a}
line a B M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(N,M_{a}) intersect% DET: points M_{a} and H_{a} must be different
% Constructing a point P_{\_G40062} which is a foot of the point N on the line a
foot P_{\_G40062} N a
cmark_r P_{\_G40062}
color 200 200 200
drawline N P_{\_G40062}
color 0 0 0

% Constructing a point H_{a} which is an image of the point M_{a} in the symmetry to point/line P
    _{\_G40062}
sim H_{a} P_{\_G40062} M_{a}
cmark_r H_{a}


% DET: points H_{a} and E_{a} are not the same
% Constructing a line h_{a} which passes through point H_{a} and point E_{a}
line h_{a} H_{a} E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points B and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point B
```

```
circle k(M_{a},B) M_{a} B

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{a},B) intersect% DET: circles k(N,M_{a}) and k(M_{a},B) are not
    the same
% Constructing points H_{b} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{a},B)
intersec2 H_{b} H_{c} k(N,M_{a}) k(M_{a},B)
cmark_l H_{b}
cmark_rt H_{c}


% DET: points B and H_{b} are not the same
% Constructing a line h_{b} which passes through point B and point H_{b}
line h_{b} B H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines h_{a} and h_{b} are not parallel% DET: lines h_{a} and h_{b} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{b}
intersec H h_{a} h_{b}
cmark_rt H



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{b} are not parallel; circles k(N,M_{a}) and k(M_{a
    },B) intersect; points B and M_{a} are not the same; line a and circle k(N,M_{a}) intersect;
    line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect; points E_{a} and N are not the same
% Determination conditions: lines h_{a} and h_{b} are not the same; points B and H_{b} are not the
    same; circles k(N,M_{a}) and k(M_{a},B) are not the same; points H_{a} and E_{a} are not the
    same; points M_{a} and H_{a} must be different; points B and M_{a} are not the same; points E_{
    a} and M_{a} must be different; points E_{a} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

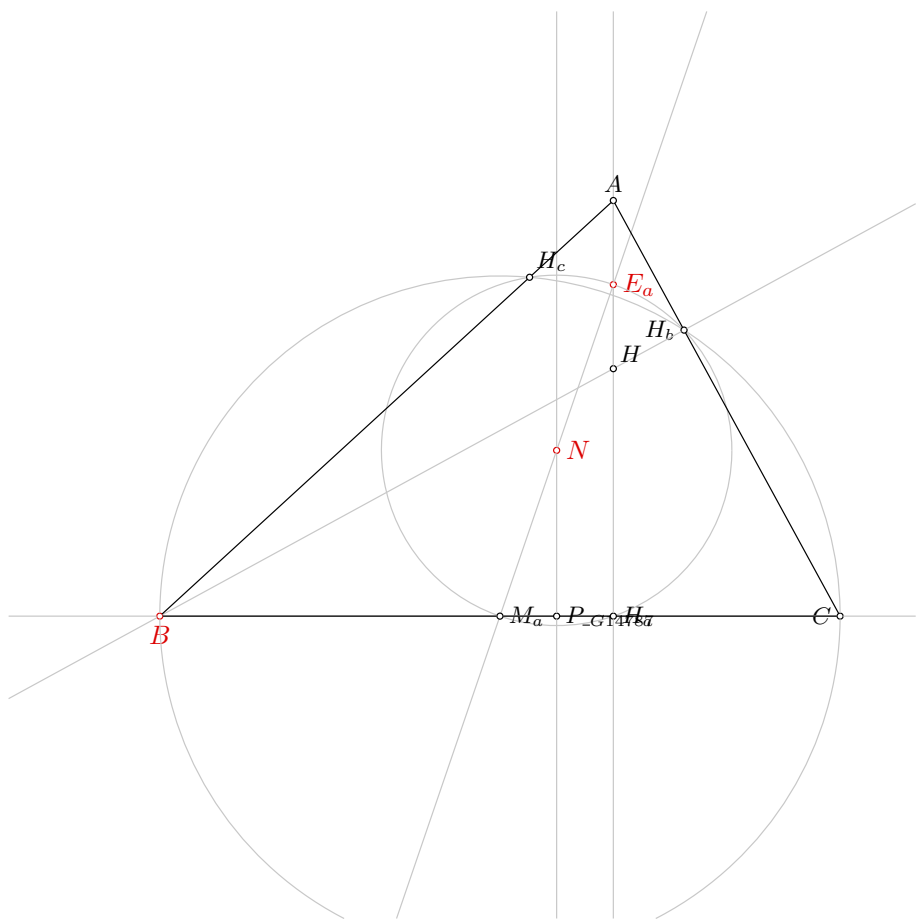

Figure 1: Illustration of the problem 0642

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving $B{=}B$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving $E_a{=}\_E_a$

Proving failed

4.1.3 Proving $N{=}\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving $B{=}B$

NDG conditions are:

$S_{H_aBH_b} \neq S_{E_aBH_b}$ i.e., lines H_aE_a and BH_b are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_a{=}\_E_a$

Proving failed

4.2.3 Proving $N{=}\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $B{=}B$

Proving failed

4.3.2 Proving $E_a{=}\_E_a$

Proving failed

4.3.3 Proving $N = \_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $B = B$

Proving failed

4.4.2 Proving $E_a = \_E_a$

Proving failed

4.4.3 Proving $N = \_N$

Proving failed

Problem 643

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 643: Given a point B, a point E_a and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 644

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 644: Given a point B, a point E_a and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 645

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 645: Given a point B, a point E_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 646

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 646: Given a point B, a point E_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 647

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 647: Given a point B, a point E_b and a point E_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point E_b, construct a point H (rule W01); ;
2. Using the point E_c and the point H, construct a point C (rule W01); ;
3. Using the point B and the point C, construct a line a (rule W02); % DET: points B and C are not the same;
4. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
5. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
6. Using the circle $k(E_b, B)$, the line a, the point E_b and the point B, construct a point H_a (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points B and H_a must be different;
7. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
8. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H and H_c must be different;
9. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
10. Using the line h_a and the line c, construct a point A (rule W03); % NDG: lines h_a and c are not parallel % DET: lines h_a and c are not the same.

Non-degenerate conditions: lines h_a and c are not parallel; line h_c and circle $k(E_b, B)$ intersect; line a and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines h_a and c are not the same; points H_c and B are not the same; points H and H_c must be different; points H_a and H are not the same; points B and H_a must be different; points E_c and H are not the same; points B and C are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D29,D3,D30,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 12.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{b} 50 56.36
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{b}
cmark_r E_{c}
color 0 0 0
fontsize 8


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points B and C are not the same
% Constructing a line a which passes through point B and point C
line a B C

color 200 200 200
drawline a
color 0 0 0
```

```
% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points B and H_{a} must be different
% Constructing a point P_{\_G77886} which is a foot of the point E_{b} on the line a
foot P_{\_G77886} E_{b} a
cmark_r P_{\_G77886}
color 200 200 200
drawline E_{b} P_{\_G77886}
color 0 0 0

% Constructing a point H_{a} which is an image of the point B in the symmetry to point/line P_{\_G
    77886}
sim H_{a} P_{\_G77886} B
cmark_r H_{a}


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G78124} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G78124} E_{b} h_{c}
cmark_r P_{\_G78124}
color 200 200 200
drawline E_{b} P_{\_G78124}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    78124}
sim H_{c} P_{\_G78124} H
cmark_rt H_{c}
```

```
% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{a} and c are not parallel% DET: lines h_{a} and c are not the same
% Constructing a point A which belongs to line h_{a} and line c
intersec A h_{a} c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and c are not parallel; line h_{c} and circle k(E_{b},B)
    intersect; line a and circle k(E_{b},B) intersect; points B and E_{b} are not the same
% Determination conditions: lines h_{a} and c are not the same; points H_{c} and B are not the same
    ; points H and H_{c} must be different; points H_{a} and H are not the same; points B and H_{a}
     must be different; points E_{c} and H are not the same; points B and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

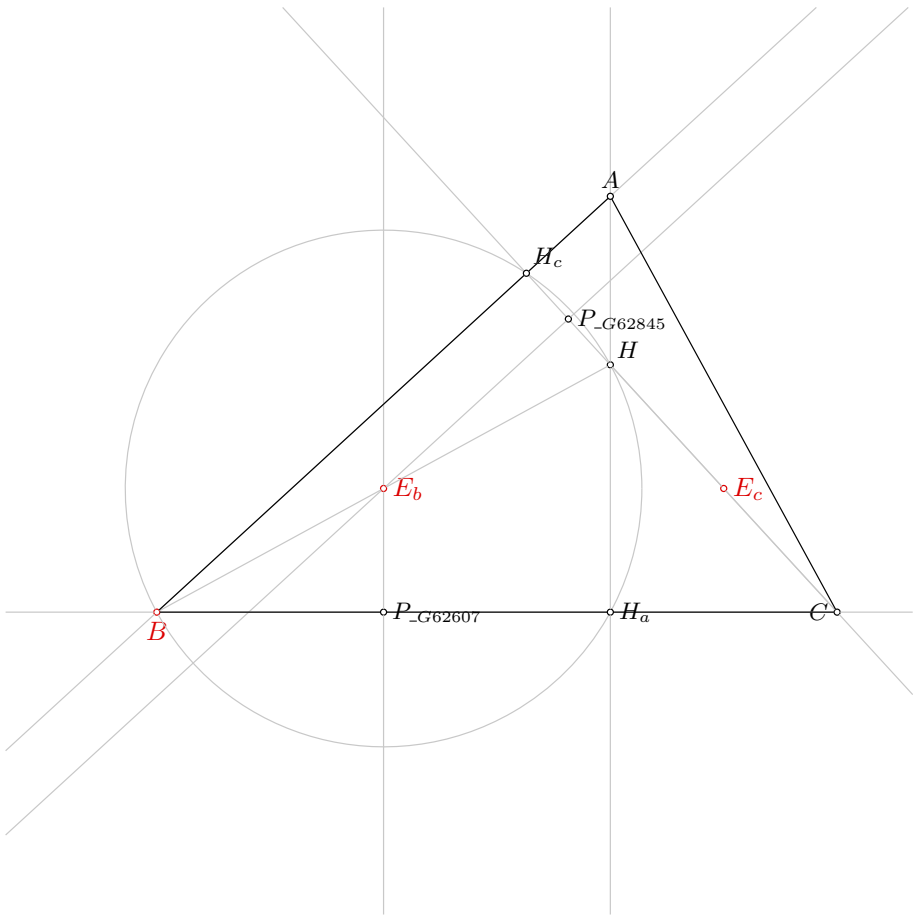

Figure 1: Illustration of the problem 0647

4.2 GCLC - Area method

4.2.1 Proving $B{=}B$

NDG conditions are:

$S_{H_aH_cB} \neq S_{HH_cB}$ i.e., lines H_aH and H_cB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_b{=}\_E_b$

Proving failed

4.2.3 Proving $E_c{=}\_E_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_b{=}\_E_b$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 4794 terms.

Time Complexity: Time spent by the prover is 13.460 seconds.There are no ndg conditions.

4.3.3 Proving $E_c{=}\_E_c$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 2170 terms.

Time Complexity: Time spent by the prover is 14.490 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_b{=}\_E_b$

Proving failed

4.4.3 Proving $E_c{=}\_E_c$

Proving failed

Problem 648

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 648: Given a point B, a point E_b and a point G, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point E_b, construct a point H (rule W01); ;
2. Using the point B and the point G, construct a point M_b (rule W01); ;
3. Using the point G and the point H, construct a point N (rule W01); ;
4. Using the point G and the point H, construct a point O (rule W01); ;
5. Using the point B and the point E_b, construct a line h_b (rule W02); % DET: points B and E_b are not the same;
6. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
7. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
9. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same; points B and O are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points B and E_b are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L16,L20,L23,L56,L58]

Solving time: 9.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{b} 50 56.36
point G 70 58.33

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{b}
cmark_t G
color 0 0 0
fontsize 8


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point M_{b} such that BM_{b}/BG=1.5
towards M_{b} B G 1.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0



% Constructing a point N such that GN/GH=0.25
towards N G H 0.25
cmark_r N
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
```

```
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points B and E_{b} are not the same
% Constructing a line h_{b} which passes through point B and point E_{b}
line h_{b} B E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G104487} which is a foot of the point N on the line h_{b}
foot P_{\_G104487} N h_{b}
cmark_r P_{\_G104487}
color 200 200 200
drawline N P_{\_G104487}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G104487}
sim H_{b} P_{\_G104487} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
```

```
drawline b
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; line h_{b} and circle k(N,M_{a})
    intersect; points E_{b} and N are not the same; points B and O are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points B and E_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=$\_E_b$

Proving failed

4.1.3 Proving G=$\_G$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

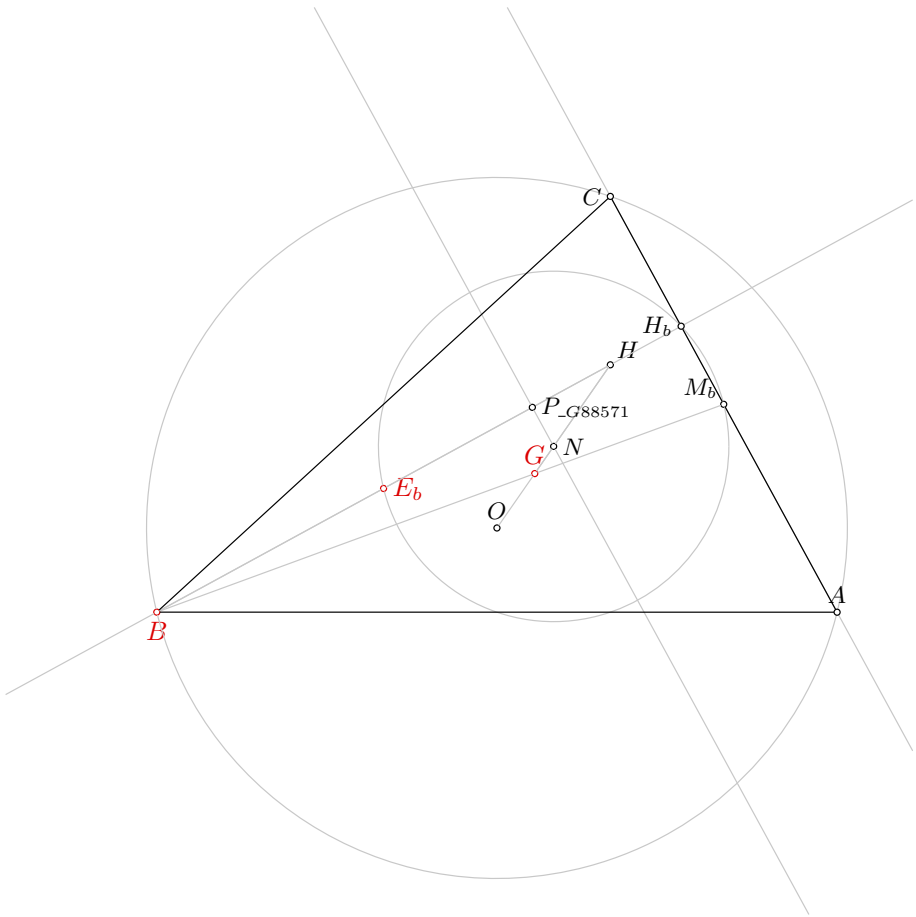

Figure 1: Illustration of the problem 0648

$S_{AB\_M_b} \neq S_{\_M_aB\_M_b}$ i.e., lines A_M_a and B_M_b are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving G=$\_G$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_b=$\_E_b$

Proving failed

4.3.3 Proving G=$\_G$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving E_b=$\_E_b$

Proving failed

4.4.3 Proving G=$\_G$

Proving failed

Problem 649

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 649: Given a point E_b, a point H and a point B, construct the triangle ABC.

2 Status

Problem is redundant.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H, construct a point B (rule W01); ;
2. Choose freely a point A (rule free);
3. Using the point A and the point H, construct a point E_a (rule W01); ;
4. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
5. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
6. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
7. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
8. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
9. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
10. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;

11. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; line c and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines h_c and b are not the same; points H_b and A are not the same; points H and H_b must be different; points H_c and H are not the same; points A and H_c must be different; points E_b and H are not the same; points A and B are not the same.

Rules used: [W01,W02,W03,W05,W06,free]

Lemmas used: [D10,D28,D29,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 10.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H 80 72.73
point B 20 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H
cmark_b B
color 0 0 0
fontsize 8


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0
```

```
% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G129688} which is a foot of the point E_{a} on the line c
foot P_{\_G129688} E_{a} c
cmark_r P_{\_G129688}
color 200 200 200
drawline E_{a} P_{\_G129688}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    129688}
sim H_{c} P_{\_G129688} A
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
```

```
% Constructing a point P_{\_G129926} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G129926} E_{a} h_{b}
cmark_r P_{\_G129926}
color 200 200 200
drawline E_{a} P_{\_G129926}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    129926}
sim H_{b} P_{\_G129926} H
cmark_l H_{b}


% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; line c and circle k(E_{a},A) intersect; points A and E_{a} are not the same
% Determination conditions: lines h_{c} and b are not the same; points H_{b} and A are not the same
    ; points H and H_{b} must be different; points H_{c} and H are not the same; points A and H_{c}
     must be different; points E_{b} and H are not the same; points A and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

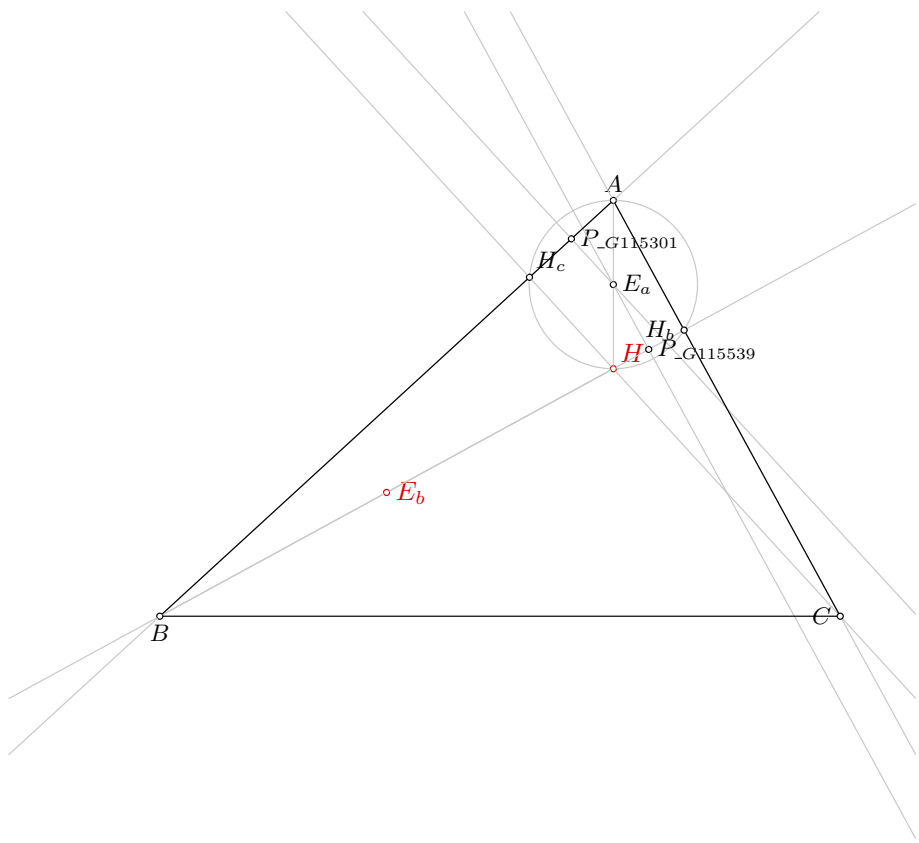

Figure 1: Illustration of the problem 0649

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2 terms.

Time Complexity: Time spent by the prover is 0.022 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving B=B

NDG conditions are:

$S_{H_cH_bA} \neq S_{HH_bA}$ i.e., lines H_cH and H_bA are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 974 terms.

Time Complexity: Time spent by the prover is 1.210 seconds.There are no ndg conditions.

4.3.2 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 167 terms.

Time Complexity: Time spent by the prover is 0.160 seconds.There are no ndg conditions.

4.3.3 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 650

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 650: Given a point E_b, a point H_a and a point B, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;
2. Choose freely a point B on the circle $k(E_b, B)$ (rule WOncircle);
3. Using the point B and the point E_b, construct a point H (rule W01); ;
4. Using the point B and the point H_a, construct a line a (rule W02); % DET: points B and H_a are not the same;
5. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
6. Choose freely a point A on the line h_a (rule WOnline1) ;
7. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
8. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
9. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
10. Using the line a and the line h_c, construct a point C (rule W03); % NDG: lines a and h_c are not parallel % DET: lines a and h_c are not the same.

Non-degenerate conditions: lines a and h_c are not parallel; line c and circle $k(E_b, B)$ intersect; points H_a and E_b are not the same.

Determination conditions: lines a and h_c are not the same; points H and H_c are not the same; points B and H_c must be different; points A and B are not the same; points H_a and H are not the same; points B and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06,WOncircle1,WOnline1]

Lemmas used: [D10,D29,D3,D5,D7,GD01,GD02,GL03,L3,L50,L51]

Solving time: 683.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{a} 80 40
point B 20 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r H_{a}
cmark_b B
color 0 0 0
fontsize 8

% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0




% Choosing randomly a point B on the circle with center E_{b} through point H_{a}
oncircle B E_{b} H_{a}
cmark_b B
color 200 200 200
drawcircle E_{b} H_{a}
color 0 0 0



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0
```

```
% DET: points B and H_{a} are not the same
% Constructing a line a which passes through point B and point H_{a}
line a B H_{a}

color 200 200 200
drawline a
color 0 0 0



% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% Choosing randomly a point A on the line H_{a}H
online A H_{a} H
cmark_t A
color 200 200 200
drawline H_{a} H
color 0 0 0


% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G153175} which is a foot of the point E_{b} on the line c
foot P_{\_G153175} E_{b} c
cmark_r P_{\_G153175}
color 200 200 200
drawline E_{b} P_{\_G153175}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    153175}
sim H_{c} P_{\_G153175} B
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
```

```
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines a and h_{c} are not parallel% DET: lines a and h_{c} are not the same
% Constructing a point C which belongs to line a and line h_{c}
intersec C a h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{c} are not parallel; line c and circle k(E_{b},B)
    intersect; points H_{a} and E_{b} are not the same
% Determination conditions: lines a and h_{c} are not the same; points H and H_{c} are not the same
    ; points B and H_{c} must be different; points A and B are not the same; points H_{a} and H are
     not the same; points B and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2 terms.

Time Complexity: Time spent by the prover is 0.023 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

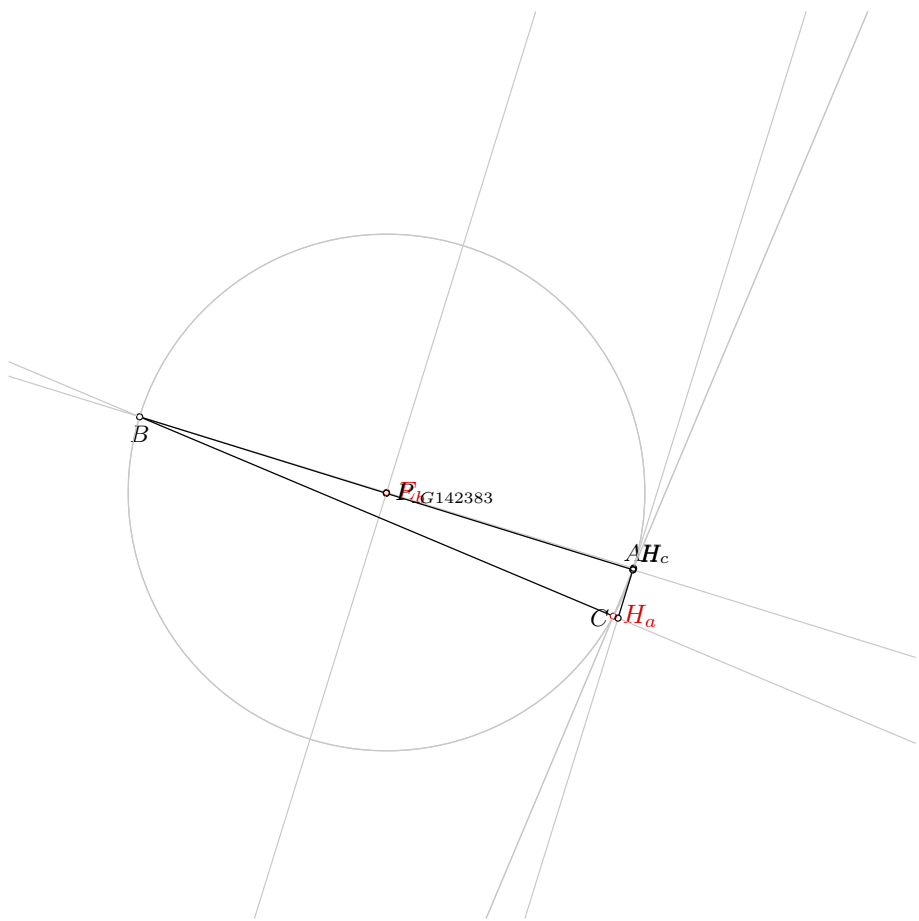

Figure 1: Illustration of the problem 0650

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving B=B

NDG conditions are:

$S_{BHH_c} \neq S_{H_aHH_c}$ i.e., lines BH_a and HH_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{BAF^1_{\_h_a}} \neq S_{CAF^1_{\_h_a}}$ i.e., lines BC and $AF^1_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 651

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 651: Given a point E_b, a point H_b and a point B, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Choose freely a point B on the line h_b (rule WOnline1) ;
3. Using the point B and the point E_b, construct a point H (rule W01); ;
4. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
5. Using the point H_b and the line h_b, construct a line b (rule W10a); ;
6. Choose freely a point A on the line b (rule WOnline2);
7. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
8. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
9. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
10. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same.

Non-degenerate conditions: lines b and h_c are not parallel; line c and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines b and h_c are not the same; points H and H_c are not the same; points B and H_c must be different; points A and B are not the same; points E_b and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,WOnline1,WOnline2]

Lemmas used: [D10,D29,D3,D6,D7,D9,GD01,GD02,GL03,GL09,L3,L51]

Solving time: 174.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{b} 89.36 77.83
point B 20 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_l H_{b}
cmark_b B
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0




% Choosing randomly a point B on the line E_{b}H_{b}
online B E_{b} H_{b}
cmark_b B
color 200 200 200
drawline E_{b} H_{b}
color 0 0 0



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0
```

```
% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0




% Constructing a line b which is perpendicular to line h_{b} and which passes through point H_{b}
perp b H_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0




% Generating random value V[_G175698]
random V[_G175698]


% Calculating value V[_G175719] using formula V[_G175698]*20
expression V[_G175719] { V[_G175698]*20 }


% Constructing a point A which is a point for which holds H_{b}A = V[_G175719] and angle BH_{b}A =
    90
turtle A B H_{b} 90 V[_G175719]
cmark_t A


% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G175991} which is a foot of the point E_{b} on the line c
foot P_{\_G175991} E_{b} c
cmark_r P_{\_G175991}
color 200 200 200
drawline E_{b} P_{\_G175991}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    175991}
sim H_{c} P_{\_G175991} B
```

```
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line c and circle k(E_{b},B)
    intersect; points B and E_{b} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H and H_{c} are not the same
    ; points B and H_{c} must be different; points A and B are not the same; points E_{b} and H_{b}
     are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 55 terms.

Time Complexity: Time spent by the prover is 0.986 seconds.

NDG conditions Points A and B are not identical

Point E_b is not on circle with center H_b and point from it B

Line through points B and H_c is not perpendicular to line through points H_c and E_b

Points A, C and E_b are not collinear

4.1.2 Proving H_b=_H_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

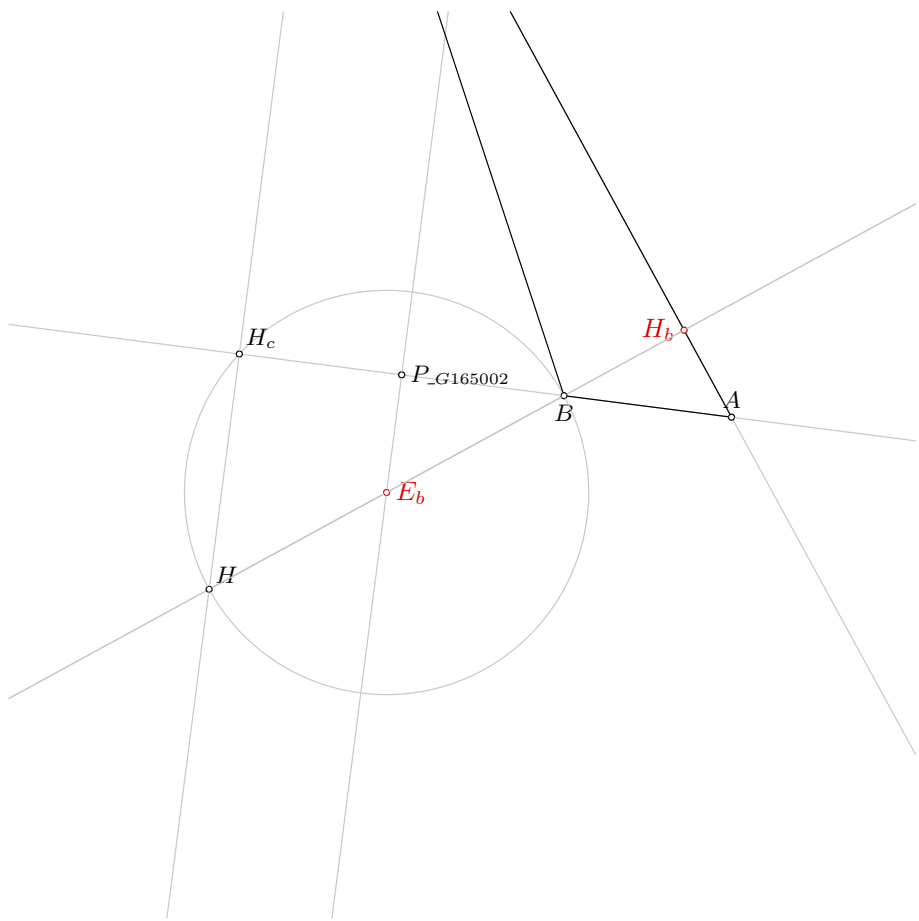

Figure 1: Illustration of the problem 0651

Time Complexity: Time spent by the prover is 0.174 seconds.

NDG conditions Points A and B are not identical

Point E_b is not on circle with center H_b and point from it B

Line through points B and H_c is not perpendicular to line through points H_c and E_b

Points A, C and E_b are not collinear

4.1.3 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.015 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_b=$\_E_b$

Proving failed

4.2.2 Proving H_b=$\_H_b$

Proving failed

4.2.3 Proving B=B

NDG conditions are:

$S_{H_bHH_c} \neq S_{T_b^1HH_c}$ i.e., lines $H_bT_b^1$ and HH_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{CBF^3_{\_h_b}}$ i.e., lines AC and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=$\_E_b$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving H_b=$\_H_b$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 16 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.3 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 20 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving H_b=_H_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 20 terms.

Time Complexity: Time spent by the prover is 0.060 seconds.There are no ndg conditions.

4.4.3 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 652

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 652: Given a point E_b, a point H_c and a point B, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
2. Choose freely a point B on the circle $k(E_b, B)$ (rule WOncircle);
3. Using the point B and the point E_b, construct a point H (rule W01); ;
4. Using the point B and the point H_c, construct a line c (rule W02); % DET: points B and H_c are not the same;
5. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
6. Choose freely a point A on the line c (rule WOnline1) ;
7. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
8. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H and H_a must be different;
9. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
10. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; line h_a and circle $k(E_b, B)$ intersect; points H_c and E_b are not the same.

Determination conditions: lines h_c and a are not the same; points H_a and B are not the same; points H and H_a must be different; points A and H are not the same; points H_c and H are not the same; points B and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06,WOncircle1,WOnline1]

Lemmas used: [D10,D29,D3,D5,D7,D8,GD01,GD02,GL03,L3,L49,L50,L51]

Solving time: 687.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{c} 68.91 84.83
point B 20 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H_{c}
cmark_b B
color 0 0 0
fontsize 8

% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0




% Choosing randomly a point B on the circle with center E_{b} through point H_{c}
oncircle B E_{b} H_{c}
cmark_b B
color 200 200 200
drawcircle E_{b} H_{c}
color 0 0 0



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0
```

```
% DET: points B and H_{c} are not the same
% Constructing a line c which passes through point B and point H_{c}
line c B H_{c}

color 200 200 200
drawline c
color 0 0 0



% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% Choosing randomly a point A on the line BH_{c}
online A B H_{c}
cmark_t A
color 200 200 200
drawline B H_{c}
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G199847} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G199847} E_{b} h_{a}
cmark_r P_{\_G199847}
color 200 200 200
drawline E_{b} P_{\_G199847}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    199847}
sim H_{a} P_{\_G199847} H
cmark_r H_{a}


% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
```

```
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; line h_{a} and circle k(E_{b},B)
    intersect; points H_{c} and E_{b} are not the same
% Determination conditions: lines h_{c} and a are not the same; points H_{a} and B are not the same
    ; points H and H_{a} must be different; points A and H are not the same; points H_{c} and H are
     not the same; points B and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_c=_H_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2241 terms.

Time Complexity: Time spent by the prover is 15.129 seconds.

NDG conditions Points H_c, B and E_b are not collinear

Points A and H are not identical

Line through points A and H is not parallel with line through points H_c and E_b

Line through points B and H_a is not parallel with line through points H_c and H

Points E_b and H are not identical

Points A and B are not identical

Points A, B and E_b are not collinear

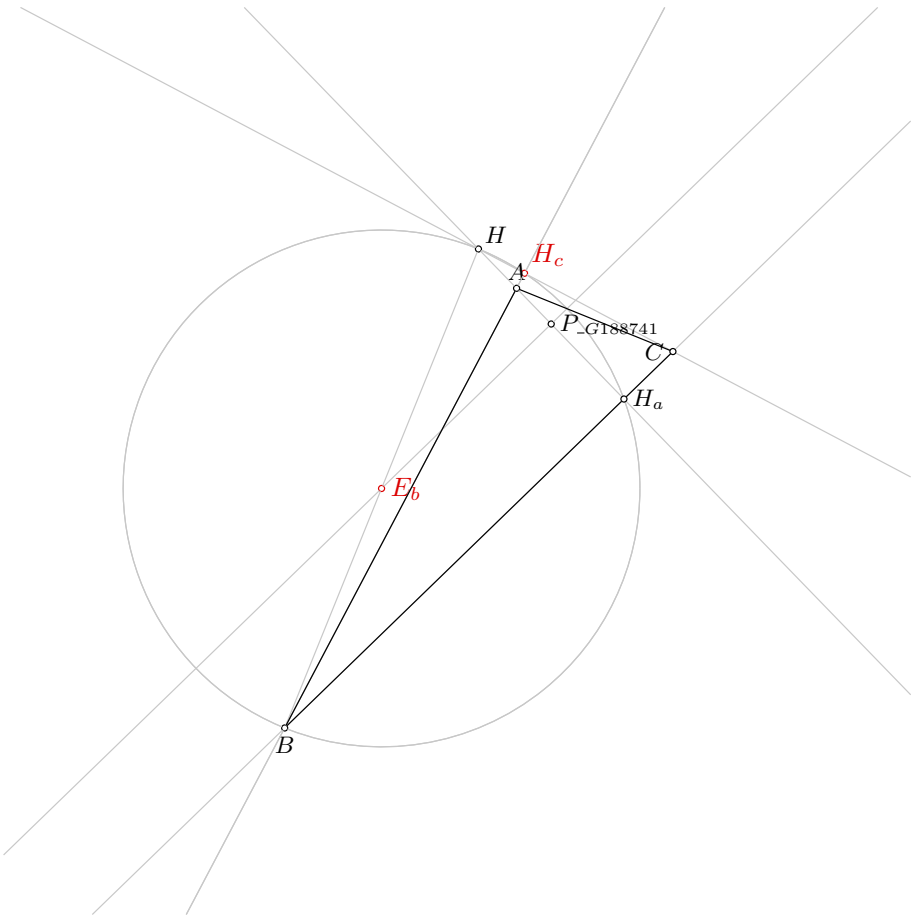

Figure 1: Illustration of the problem 0652

4.1.3 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2 terms.

Time Complexity: Time spent by the prover is 0.026 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_b=$\_E_b$

Proving failed

4.2.2 Proving H_c=$\_H_c$

Proving failed

4.2.3 Proving B=B

NDG conditions are:

$S_{H_cH_aB} \neq S_{HH_aB}$ i.e., lines H_cH and H_aB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^3_{\_h_c}} \neq S_{BCF^3_{\_h_c}}$ i.e., lines AB and $CF^3_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=$\_E_b$

Proving failed

4.3.2 Proving H_c=$\_H_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 280 terms.

Time Complexity: Time spent by the prover is 0.140 seconds.There are no ndg conditions.

4.3.3 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=$\_E_b$

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 653

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 653: Given a point B, a point E_b and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 654

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 654: Given a point B, a point E_b and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point E_b, construct a point H (rule W01); ;
2. Using the point B and the point M_a, construct a point C (rule W01); ;
3. Using the point B and the point M_a, construct a line a (rule W02); % DET: points B and M_a are not the same;
4. Using the point H and the point C, construct a line h_c (rule W02); % DET: points H and C are not the same;
5. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
6. Using the circle $k(E_b, B)$, the line a, the point E_b and the point B, construct a point H_a (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points B and H_a must be different;
7. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
8. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H and H_c must be different;
9. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
10. Using the line h_a and the line c, construct a point A (rule W03); % NDG: lines h_a and c are not parallel % DET: lines h_a and c are not the same.

Non-degenerate conditions: lines h_a and c are not parallel; line h_c and circle $k(E_b, B)$ intersect; line a and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines h_a and c are not the same; points H_c and B are not the same; points H and H_c must be different; points H_a and H are not the same; points B and H_a must be different; points H and C are not the same; points B and M_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D21,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL09,L3,L49,L50,L51]

Solving time: 12.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{b} 50 56.36
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{b}
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point C such that BC/BM_{a}=2
towards C B M_{a} 2
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points B and M_{a} are not the same
% Constructing a line a which passes through point B and point M_{a}
line a B M_{a}

color 200 200 200
drawline a
color 0 0 0
```

```
% DET: points H and C are not the same
% Constructing a line h_{c} which passes through point H and point C
line h_{c} H C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points B and H_{a} must be different
% Constructing a point P_{\_G224792} which is a foot of the point E_{b} on the line a
foot P_{\_G224792} E_{b} a
cmark_r P_{\_G224792}
color 200 200 200
drawline E_{b} P_{\_G224792}
color 0 0 0

% Constructing a point H_{a} which is an image of the point B in the symmetry to point/line P_{\_G
    224792}
sim H_{a} P_{\_G224792} B
cmark_r H_{a}


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G225030} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G225030} E_{b} h_{c}
cmark_r P_{\_G225030}
color 200 200 200
drawline E_{b} P_{\_G225030}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    225030}
sim H_{c} P_{\_G225030} H
cmark_rt H_{c}
```

```
% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{a} and c are not parallel% DET: lines h_{a} and c are not the same
% Constructing a point A which belongs to line h_{a} and line c
intersec A h_{a} c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and c are not parallel; line h_{c} and circle k(E_{b},B)
    intersect; line a and circle k(E_{b},B) intersect; points B and E_{b} are not the same
% Determination conditions: lines h_{a} and c are not the same; points H_{c} and B are not the same
    ; points H and H_{c} must be different; points H_{a} and H are not the same; points B and H_{a}
     must be different; points H and C are not the same; points B and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.034 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 1741 terms.

Time Complexity: Time spent by the prover is 14.964 seconds.

NDG conditions Points E_b and M_a are not identical

Points E_b and M_a are not identical

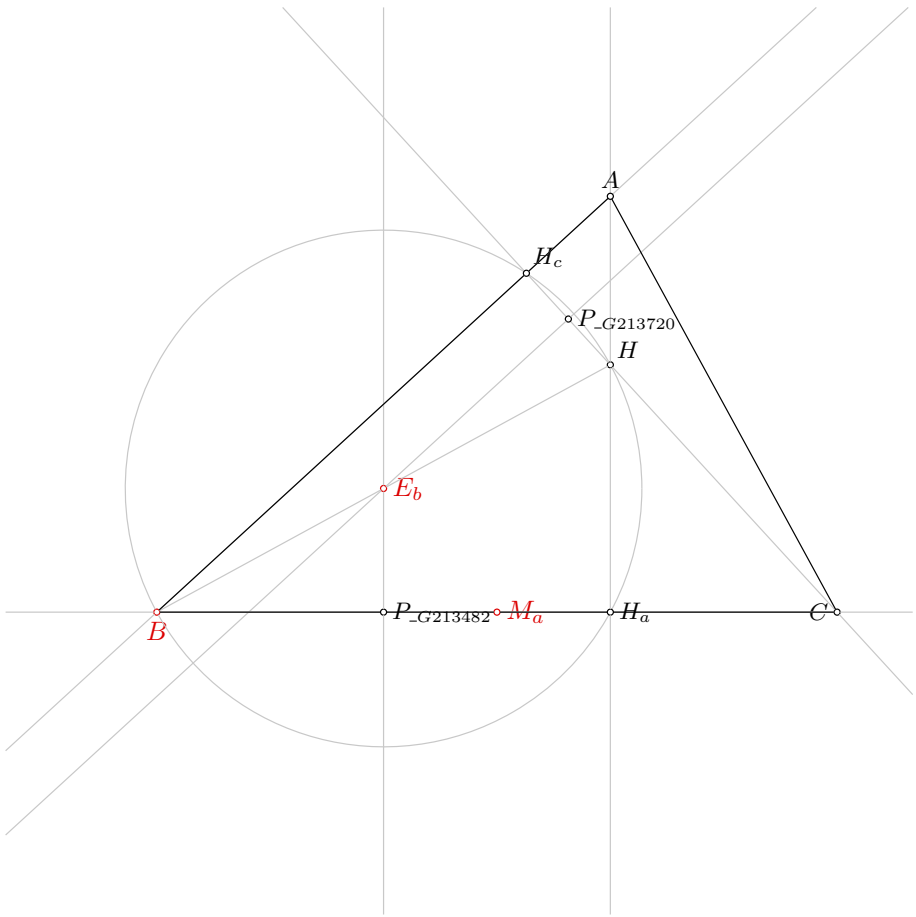

Figure 1: Illustration of the problem 0654

Points C and H are not identical

Line through points B and C is not perpendicular to line through points C and E_b

Line through points B and H_c is not parallel with line through points H and H_a

Points B, E_b and H are not collinear

Points A, B and C are not collinear

Points B, C and H are not collinear

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{H_aH_cB} \neq S_{HH_cB}$ i.e., lines H_aH and H_cB are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=_E_b

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving E_b=_E_b

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 363 terms.

Time Complexity: Time spent by the prover is 0.960 seconds.There are no ndg conditions.

4.3.3 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 8 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_b{=}\_E_b$

Proving failed

4.4.3 Proving $M_a{=}\_M_a$

Proving failed

Problem 655

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 655: Given a point B, a point E_b and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point E_b, construct a point H (rule W01); ;
2. Using the point B and the point M_b, construct a point G (rule W01); ;
3. Using the point H and the point G, construct a point N (rule W01); ;
4. Using the point H and the point G, construct a point O (rule W01); ;
5. Using the point B and the point E_b, construct a line h_b (rule W02); % DET: points B and E_b are not the same;
6. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
7. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
9. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same; points B and O are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points B and E_b are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL09,L11,L12,L16,L20,L23,L56,L58]

Solving time: 9.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{b} 50 56.36
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{b}
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a line L_{\_G248357} which passes through point B and point M_{b}
line L_{\_G248357} B M_{b}

color 200 200 200
drawline L_{\_G248357}
color 0 0 0


% Constructing a point P_{\_G248458} with coordinates (0,0)
point P_{\_G248458} 0 0
cmark_r P_{\_G248458}

% Constructing a point P_{\_G248382} such that BP_{\_G248382}/BP_{\_G248458}=2
towards P_{\_G248382} B P_{\_G248458} 2
cmark_r P_{\_G248382}
color 200 200 200
drawsegment B P_{\_G248382}
color 0 0 0
```

```
% Constructing a point P_{\_G248427} such that BP_{\_G248427}/BP_{\_G248458}=3
towards P_{\_G248427} B P_{\_G248458} 3
cmark_r P_{\_G248427}
color 200 200 200
drawsegment B P_{\_G248427}
color 0 0 0

% Constructing a line L_{\_G248388} which passes through point M_{b} and point P_{\_G248427}
line L_{\_G248388} M_{b} P_{\_G248427}

color 200 200 200
drawline L_{\_G248388}
color 0 0 0


% Constructing a line L_{\_G248351} which contains the point P_{\_G248382} and is parallel to the
    line L_{\_G248388}
parallel L_{\_G248351} P_{\_G248382} L_{\_G248388}

color 200 200 200
drawline L_{\_G248351}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G248351} and line L_{\_G248357}
intersec G L_{\_G248351} L_{\_G248357}
cmark_t G



% Constructing a point N such that HN/HG=0.75
towards N H G 0.75
cmark_r N
color 200 200 200
drawsegment H G
color 0 0 0



% Constructing a point O such that HO/HG=1.5
towards O H G 1.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points B and E_{b} are not the same
% Constructing a line h_{b} which passes through point B and point E_{b}
line h_{b} B E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G249428} which is a foot of the point N on the line h_{b}
foot P_{\_G249428} N h_{b}
cmark_r P_{\_G249428}
color 200 200 200
drawline N P_{\_G249428}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G249428}
sim H_{b} P_{\_G249428} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

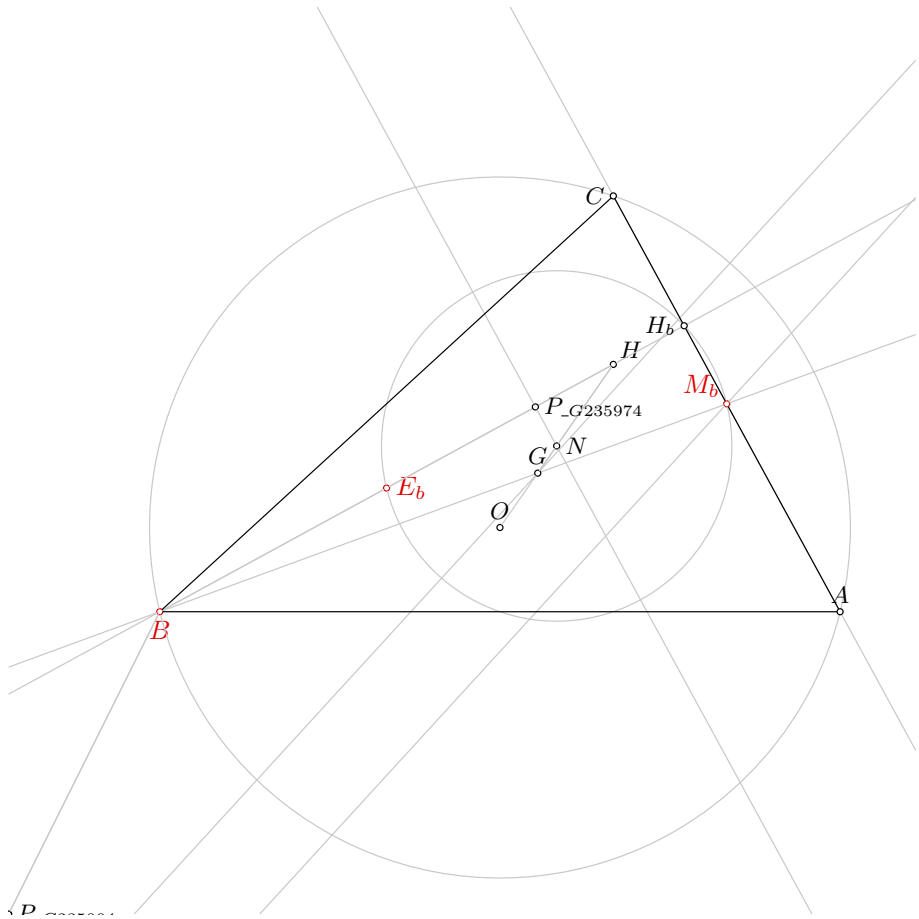

Figure 1: Illustration of the problem 0655

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; line h_{b} and circle k(N,M_{a})
    intersect; points E_{b} and N are not the same; points B and O are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points B and E_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=$\_E_b$

Proving failed

4.1.3 Proving M_b=$\_M_b$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{P_{\_G236373}BM_b} \neq S_{P^0_{L_{\_G236342}}BM_b}$ i.e., lines $P_{\_G236373}P^0_{L_{\_G236342}}$ and BM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving M_b=$\_M_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving E_b=$\_E_b$

Proving failed

4.3.3 Proving M_b=$\_M_b$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 656

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 656: Given a point B, a point E_b and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point E_b, construct a point H (rule W01); ;
2. Using the point B and the point M_c, construct a point A (rule W01); ;
3. Using the point B and the point M_c, construct a line c (rule W02); % DET: points B and M_c are not the same;
4. Using the point H and the point A, construct a line h_a (rule W02); % DET: points H and A are not the same;
5. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
6. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
7. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
8. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H and H_a must be different;
9. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
10. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; line h_a and circle $k(E_b, B)$ intersect; line c and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines h_c and a are not the same; points H_a and B are not the same; points H and H_a must be different; points H_c and H are not the same; points B and H_c must be different; points H and A are not the same; points B and M_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D20,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 12.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{b} 50 56.36
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{b}
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point A such that BA/BM_{c}=2
towards A B M_{c} 2
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points B and M_{c} are not the same
% Constructing a line c which passes through point B and point M_{c}
line c B M_{c}

color 200 200 200
drawline c
color 0 0 0
```

```
% DET: points H and A are not the same
% Constructing a line h_{a} which passes through point H and point A
line h_{a} H A

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G20797} which is a foot of the point E_{b} on the line c
foot P_{\_G20797} E_{b} c
cmark_r P_{\_G20797}
color 200 200 200
drawline E_{b} P_{\_G20797}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    20797}
sim H_{c} P_{\_G20797} B
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G21035} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G21035} E_{b} h_{a}
cmark_r P_{\_G21035}
color 200 200 200
drawline E_{b} P_{\_G21035}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    21035}
sim H_{a} P_{\_G21035} H
cmark_r H_{a}
```

```
% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; line h_{a} and circle k(E_{b},B)
    intersect; line c and circle k(E_{b},B) intersect; points B and E_{b} are not the same
% Determination conditions: lines h_{c} and a are not the same; points H_{a} and B are not the same
    ; points H and H_{a} must be different; points H_{c} and H are not the same; points B and H_{c}
     must be different; points H and A are not the same; points B and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.035 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

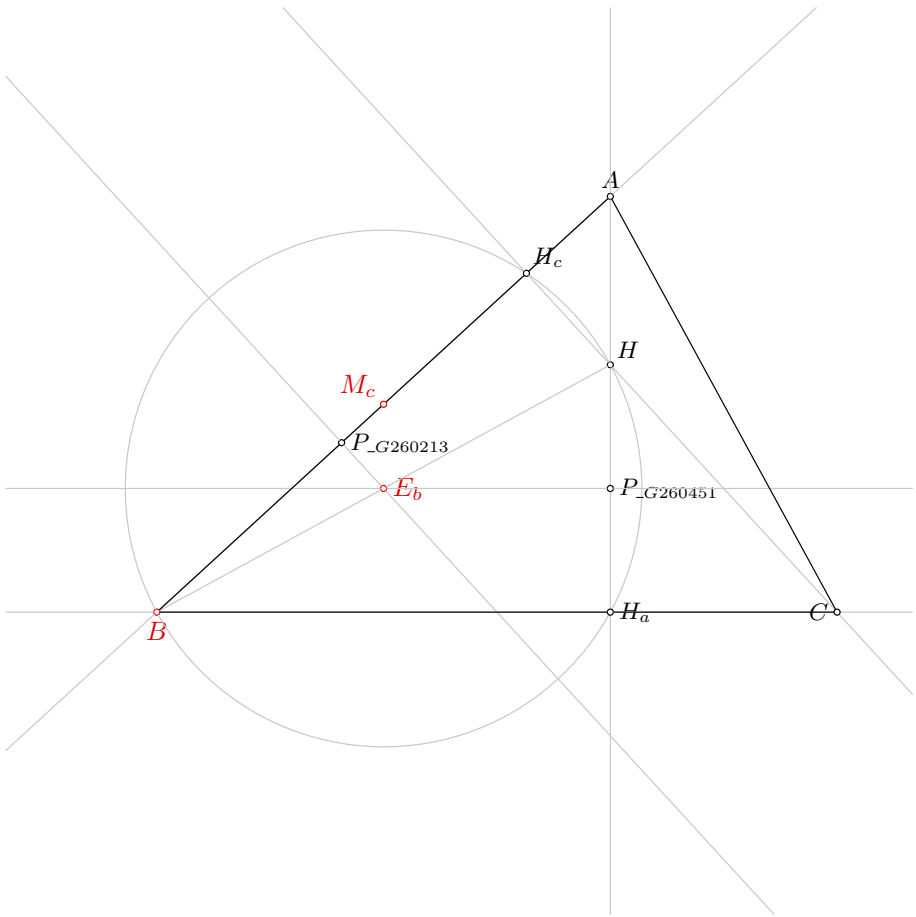

Figure 1: Illustration of the problem 0656

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{H_cH_aB} \neq S_{HH_aB}$ i.e., lines H_cH and H_aB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving M_c=$\_M_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving E_b=$\_E_b$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 363 terms.

Time Complexity: Time spent by the prover is 1.000 seconds.There are no ndg conditions.

4.3.3 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 8 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving E_b=$\_E_b$

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 657

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 657: Given a point B, a point E_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point E_b, construct a point H (rule W01); ;
2. Using the point N and the point H, construct a point O (rule W01); ;
3. Using the point N and the point H, construct a point G (rule W01); ;
4. Using the point B and the point G, construct a point M_b (rule W01); ;
5. Using the point B and the point E_b, construct a line h_b (rule W02); % DET: points B and E_b are not the same;
6. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
7. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
9. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same; points B and O are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points B and E_b are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L16,L20,L23,L56]

Solving time: 9.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{b} 50 56.36
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{b}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point O such that NO/NH=-1
towards O N H -1
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G56414} which passes through point N and point H
line L_{\_G56414} N H

color 200 200 200
drawline L_{\_G56414}
color 0 0 0


% Constructing a point P_{\_G56515} with coordinates (0,0)
point P_{\_G56515} 0 0
```

```
cmark_r P_{\_G56515}

% Constructing a point P_{\_G56439} such that NP_{\_G56439}/NP_{\_G56515}=-1
towards P_{\_G56439} N P_{\_G56515} -1
cmark_r P_{\_G56439}
color 200 200 200
drawsegment P_{\_G56515} P_{\_G56439}
color 0 0 0

% Constructing a point P_{\_G56484} such that NP_{\_G56484}/NP_{\_G56515}=3
towards P_{\_G56484} N P_{\_G56515} 3
cmark_r P_{\_G56484}
color 200 200 200
drawsegment N P_{\_G56484}
color 0 0 0

% Constructing a line L_{\_G56445} which passes through point H and point P_{\_G56484}
line L_{\_G56445} H P_{\_G56484}

color 200 200 200
drawline L_{\_G56445}
color 0 0 0


% Constructing a line L_{\_G56408} which contains the point P_{\_G56439} and is parallel to the
    line L_{\_G56445}
parallel L_{\_G56408} P_{\_G56439} L_{\_G56445}

color 200 200 200
drawline L_{\_G56408}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G56408} and line L_{\_G56414}
intersec G L_{\_G56408} L_{\_G56414}
cmark_t G



% Constructing a point M_{b} such that BM_{b}/BG=1.5
towards M_{b} B G 1.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points B and E_{b} are not the same
% Constructing a line h_{b} which passes through point B and point E_{b}
line h_{b} B E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G57410} which is a foot of the point N on the line h_{b}
foot P_{\_G57410} N h_{b}
cmark_r P_{\_G57410}
color 200 200 200
drawline N P_{\_G57410}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G57410}
sim H_{b} P_{\_G57410} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

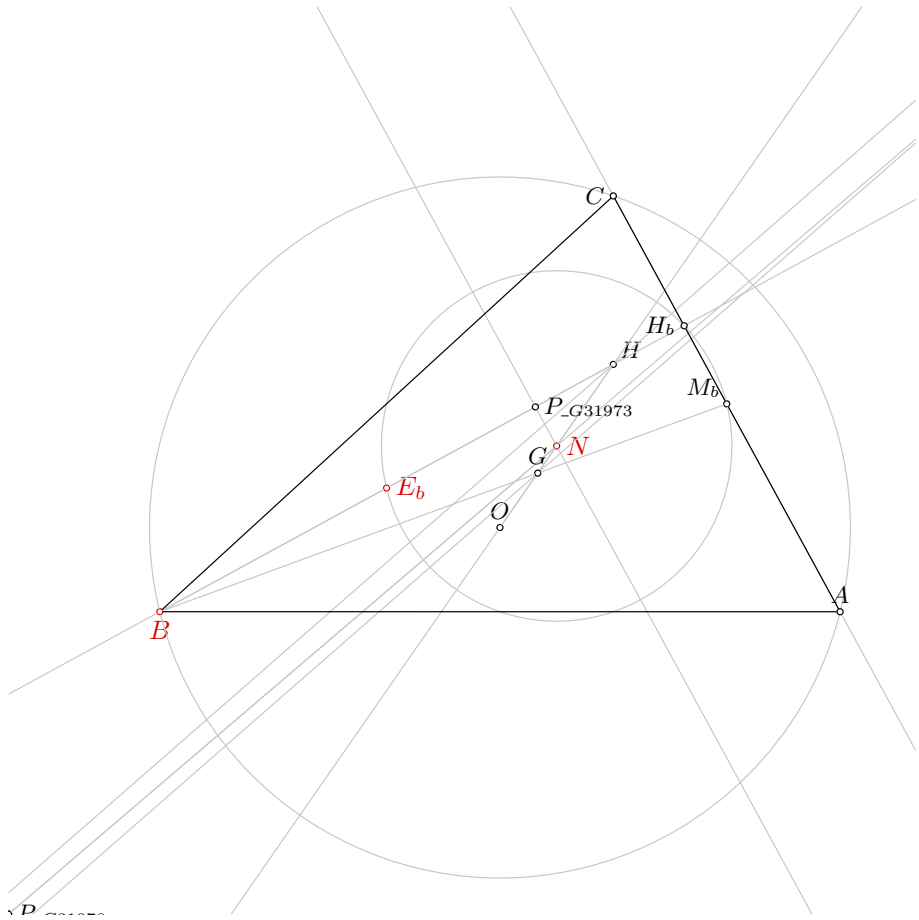

Figure 1: Illustration of the problem 0657

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; line h_{b} and circle k(N,M_{a})
    intersect; points E_{b} and N are not the same; points B and O are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points B and E_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=$\_E_b$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{P_{\_G32449}NH} \neq S_{P^0_{L_{\_G32418}}NH}$ i.e., lines $P_{\_G32449}P^0_{L_{\_G32418}}$ and NH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^4_{\_m_b}} \neq S_{F^3_{\_m_a}\_M_bF^4_{\_m_b}}$ i.e., lines $\_M_aF^3_{\_m_a}$ and $\_M_bF^4_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving E_b=$\_E_b$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4.2 Proving $E_b{=}\_E_b$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 658

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 658: Given a point B, a point E_b and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point E_b, construct a point H (rule W01); ;
2. Using the point O and the point H, construct a point N (rule W01); ;
3. Using the point O and the point H, construct a point G (rule W01); ;
4. Using the point B and the point G, construct a point M_b (rule W01); ;
5. Using the point B and the point E_b, construct a line h_b (rule W02); % DET: points B and E_b are not the same;
6. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
7. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
9. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same; points B and O are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points B and E_b are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L20,L23,L56,L58]

Solving time: 9.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{b} 50 56.36
point O 65 51.14

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{b}
cmark_t O
color 0 0 0
fontsize 8


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point N such that ON/OH=0.5
towards N O H 0.5
cmark_r N
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a line L_{\_G85769} which passes through point O and point H
line L_{\_G85769} O H

color 200 200 200
drawline L_{\_G85769}
color 0 0 0


% Constructing a point P_{\_G85870} with coordinates (0,0)
point P_{\_G85870} 0 0
```

```
cmark_r P_{\_G85870}

% Constructing a point P_{\_G85794} such that OP_{\_G85794}/OP_{\_G85870}=1
towards P_{\_G85794} O P_{\_G85870} 1
cmark_r P_{\_G85794}
color 200 200 200
drawsegment O P_{\_G85794}
color 0 0 0

% Constructing a point P_{\_G85839} such that OP_{\_G85839}/OP_{\_G85870}=3
towards P_{\_G85839} O P_{\_G85870} 3
cmark_r P_{\_G85839}
color 200 200 200
drawsegment O P_{\_G85839}
color 0 0 0

% Constructing a line L_{\_G85800} which passes through point H and point P_{\_G85839}
line L_{\_G85800} H P_{\_G85839}

color 200 200 200
drawline L_{\_G85800}
color 0 0 0


% Constructing a line L_{\_G85763} which contains the point P_{\_G85794} and is parallel to the
    line L_{\_G85800}
parallel L_{\_G85763} P_{\_G85794} L_{\_G85800}

color 200 200 200
drawline L_{\_G85763}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G85763} and line L_{\_G85769}
intersec G L_{\_G85763} L_{\_G85769}
cmark_t G



% Constructing a point M_{b} such that BM_{b}/BG=1.5
towards M_{b} B G 1.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points B and E_{b} are not the same
% Constructing a line h_{b} which passes through point B and point E_{b}
line h_{b} B E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G86757} which is a foot of the point N on the line h_{b}
foot P_{\_G86757} N h_{b}
cmark_r P_{\_G86757}
color 200 200 200
drawline N P_{\_G86757}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G86757}
sim H_{b} P_{\_G86757} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

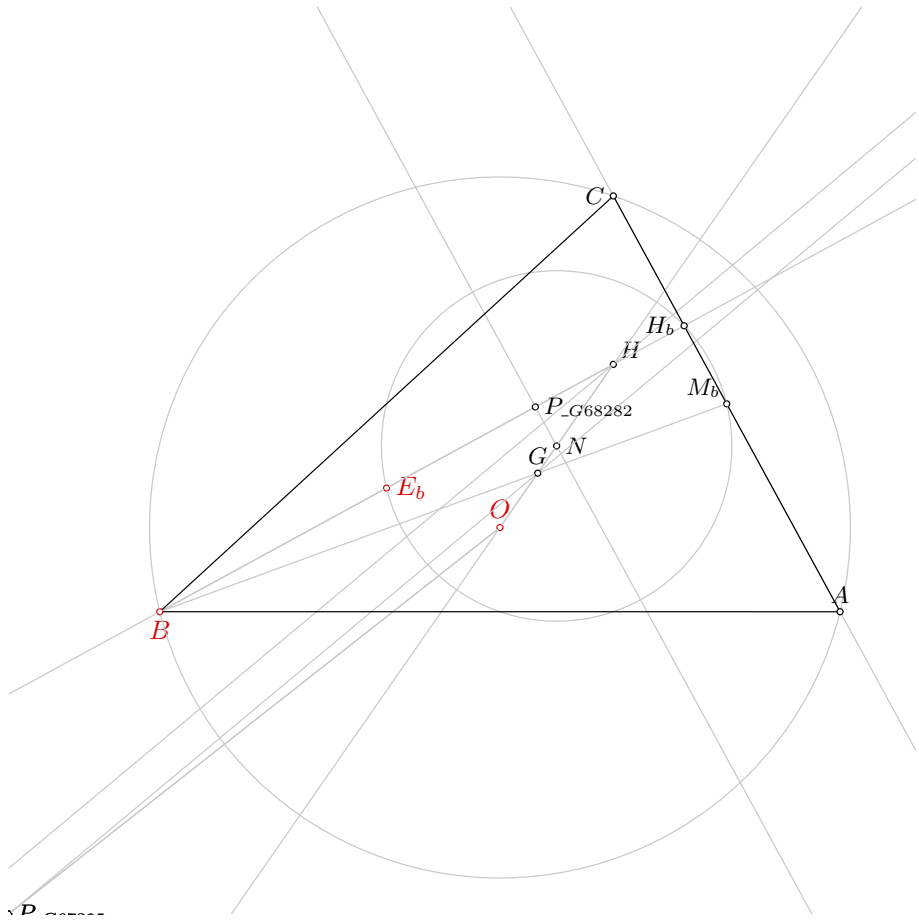

Figure 1: Illustration of the problem 0658

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; line h_{b} and circle k(N,M_{a})
    intersect; points E_{b} and N are not the same; points B and O are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points B and E_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=$\_E_b$

Proving failed

4.1.3 Proving O=$\_O$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2435 terms.

Time Complexity: Time spent by the prover is 8.008 seconds.

NDG conditions Points H, O and $P_{\_G82740}$ are not collinear

Points H_b, E_b and $P_{\_G83034}$ are not collinear

Points M_b and H_b are not identical

Points M_b and B are not identical

Points A, B and C are not collinear

Points C, E_b and H are not collinear

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{P_{\_G68764}OH} \neq S_{P^0_{L_{\_G68733}}OH}$ i.e., lines $P_{\_G68764}P^0_{L_{\_G68733}}$ and OH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^4_{\_m_b}} \neq S_{F^3_{\_m_a}\_M_bF^4_{\_m_b}}$ i.e., lines $\_M_aF^3_{\_m_a}$ and $\_M_bF^4_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving E_b=_E_b

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 659

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 659: Given a point B, a point E_b and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 660

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 660: Given a point B, a point E_b and a point T_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point E_b, construct a point H (rule W01); ;
2. Using the point B and the point E_b, construct a line h_b (rule W02); % DET: points B and E_b are not the same;
3. Using the point B and the point T_b, construct a line s_b (rule W02); % DET: points B and T_b are not the same;
4. Using the point T_b and the line h_b, construct a line b (rule W10a); ;
5. Using the point E_b, the point B, the point T_b, the line s_b and the line h_b, construct a line BO (rule W17); % NDG: points B and T_b are not the same; points E_b and B are not the same % DET: points B and T_b are not the same;
6. Using the point E_b and the line BO, construct a line $m(H_aH_c)$ (rule W16); ;
7. Using the line $m(H_aH_c)$ and the line b, construct a point M_b (rule W03); % NDG: lines $m(H_aH_c)$ and b are not parallel % DET: lines $m(H_aH_c)$ and b are not the same;
8. Using the point M_b and the point B, construct a point G (rule W01); ;
9. Using the point H and the point G, construct a point O (rule W01); ;
10. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
11. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; lines $m(H_aH_c)$ and b are not parallel; points B and T_b are not the same; points E_b and B are not the same.

Determination conditions: lines $m(H_aH_c)$ and b are not the same; points B and T_b are not the same; points B and T_b are not the same; points B and E_b are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W16,W17]

Lemmas used: [D22,D24,D26,D29,D3,D9,GD01,GD02,GL01,GL03,GL04,GL09,GL17,L105,L11,L12,L44,L45,L5

Solving time: 27.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{b} 50 56.36
point T_{b} 94.25 68.88

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{b}
cmark_t T_{b}
color 0 0 0
fontsize 8


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points B and E_{b} are not the same
% Constructing a line h_{b} which passes through point B and point E_{b}
line h_{b} B E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% DET: points B and T_{b} are not the same
% Constructing a line s_{b} which passes through point B and point T_{b}
line s_{b} B T_{b}

color 200 200 200
drawline s_{b}
color 0 0 0
```

```
% Constructing a line b which is perpendicular to line h_{b} and which passes through point T_{b}
perp b T_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and T_{b} are not the same; points E_{b} and B are not the same% DET: points B and
    T_{b} are not the same
% Constructing an angle V[_G120609] which is equal to the angle E_{b}BT_{b}
angle_o V[_G120609] E_{b} B T_{b}


% Calculating value angle[_G120688] using formula 1/pow(2,0)*V[_G120609]+0/pow(2,0)*180
expression angle[_G120688] { 1/pow(2,0)*V[_G120609]+0/pow(2,0)*180 }


% Constructing a point P_{\_G120685} which is an image of the point T_{b} in a rotation around the
    point B for the angle 1/pow(2,0)*V[_G120609]+0/pow(2,0)*180
rotate P_{\_G120685} B angle[_G120688] T_{b}
cmark_r P_{\_G120685}
color 200 200 200
drawarc_p B T_{b} angle[_G120688]
color 0 0 0

% Constructing a line BO which passes through point B and point P_{\_G120685}
line BO B P_{\_G120685}

color 200 200 200
drawline BO
color 0 0 0



% Constructing a line m(H_{a}H_{c}) which contains the point E_{b} and is parallel to the line BO
parallel m(H_{a}H_{c}) E_{b} BO

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: lines m(H_{a}H_{c}) and b are not parallel% DET: lines m(H_{a}H_{c}) and b are not the same
% Constructing a point M_{b} which belongs to line m(H_{a}H_{c}) and line b
intersec M_{b} m(H_{a}H_{c}) b
cmark_lt M_{b}



% Constructing a line L_{\_G121210} which passes through point M_{b} and point B
```

```
line L_{\_G121210} M_{b} B

color 200 200 200
drawline L_{\_G121210}
color 0 0 0


% Constructing a point P_{\_G121311} with coordinates (0,0)
point P_{\_G121311} 0 0
cmark_r P_{\_G121311}

% Constructing a point P_{\_G121235} such that M_{b}P_{\_G121235}/M_{b}P_{\_G121311}=1
towards P_{\_G121235} M_{b} P_{\_G121311} 1
cmark_r P_{\_G121235}
color 200 200 200
drawsegment M_{b} P_{\_G121235}
color 0 0 0

% Constructing a point P_{\_G121280} such that M_{b}P_{\_G121280}/M_{b}P_{\_G121311}=3
towards P_{\_G121280} M_{b} P_{\_G121311} 3
cmark_r P_{\_G121280}
color 200 200 200
drawsegment M_{b} P_{\_G121280}
color 0 0 0

% Constructing a line L_{\_G121241} which passes through point B and point P_{\_G121280}
line L_{\_G121241} B P_{\_G121280}

color 200 200 200
drawline L_{\_G121241}
color 0 0 0


% Constructing a line L_{\_G121204} which contains the point P_{\_G121235} and is parallel to the
    line L_{\_G121241}
parallel L_{\_G121204} P_{\_G121235} L_{\_G121241}

color 200 200 200
drawline L_{\_G121204}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G121204} and line L_{\_G121210}
intersec G L_{\_G121204} L_{\_G121210}
cmark_t G



% Constructing a point O such that HO/HG=1.5
towards O H G 1.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0
```

```
% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    lines m(H_{a}H_{c}) and b are not parallel; points B and T_{b} are not the same; points E_{b}
    and B are not the same
% Determination conditions: lines m(H_{a}H_{c}) and b are not the same; points B and T_{b} are not
    the same; points B and T_{b} are not the same; points B and E_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 103 terms.

Time Complexity: Time spent by the prover is 4.026 seconds.

NDG conditions Points A and B are not identical

Points T_b and E_b are not identical

Points B, $P\_{G115198}$ and H are not collinear

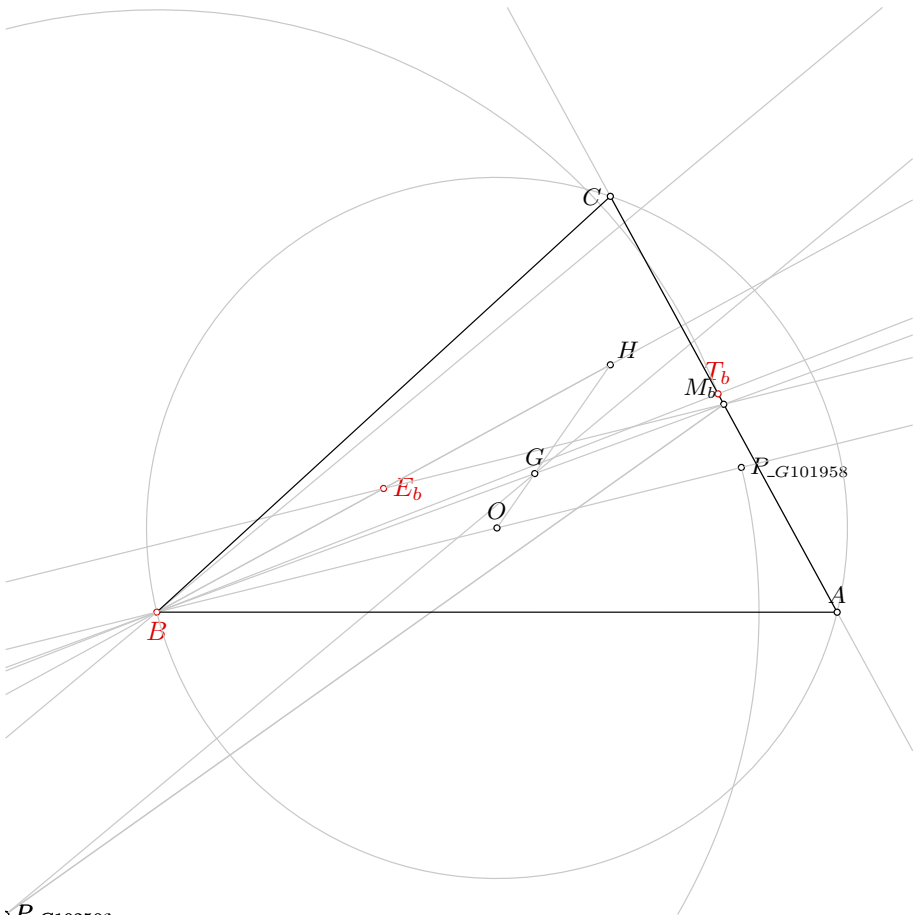

Figure 1: Illustration of the problem 0660

Points M_b, $P_{\_G115596}$ and B are not collinear

Points $P_{\_G115596}$ and B are not identical

Points A, B and C are not collinear

4.1.3 Proving T_b=$\_T_b$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{T_bBE_b} \neq 0$ i.e., points T_b, B and E_b are not collinear (foot is not the point itself; construction based assumption)

$S_{E_bT_bF_b^0} \neq S_{P^1_{m(H_aH_c)}T_bF_b^0}$ i.e., lines $E_bP^1_{m(H_aH_c)}$ and $T_bF_b^0$ are not parallel (construction based assumption)

$S_{P_{\_G104383}M_bB} \neq S_{P^2_{L_{\_G104352}}M_bB}$ i.e., lines $P_{\_G104383}P^2_{L_{\_G104352}}$ and M_bB are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving T_b=$\_T_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_b=$\_E_b$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 3720 terms.

Time Complexity: Time spent by the prover is 8.080 seconds.There are no ndg conditions.

4.3.3 Proving T_b=$\_T_b$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 8 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving $E_b{=}\_E_b$

Proving failed

4.4.3 Proving $T_b{=}\_T_b$

Proving failed

Problem 661

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 661: Given a point B, a point E_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 662

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 662: Given a point B, a point E_c and a point G, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 663

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 663: Given a point B, a point E_c and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point H, construct a point E_b (rule W01); ;
2. Using the point E_c and the point H, construct a point C (rule W01); ;
3. Using the point B and the point C, construct a line a (rule W02); % DET: points B and C are not the same;
4. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
5. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
6. Using the circle $k(E_b, B)$, the line a, the point E_b and the point B, construct a point H_a (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points B and H_a must be different;
7. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
8. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H and H_c must be different;
9. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
10. Using the line h_a and the line c, construct a point A (rule W03); % NDG: lines h_a and c are not parallel % DET: lines h_a and c are not the same.

Non-degenerate conditions: lines h_a and c are not parallel; line h_c and circle $k(E_b, B)$ intersect; line a and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines h_a and c are not the same; points H_c and B are not the same; points H and H_c must be different; points H_a and H are not the same; points B and H_a must be different; points E_c and H are not the same; points B and C are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D29,D3,D30,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 10.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{c} 95 56.36
point H 80 72.73

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{c}
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point E_{b} such that BE_{b}/BH=0.5
towards E_{b} B H 0.5
cmark_r E_{b}
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points B and C are not the same
% Constructing a line a which passes through point B and point C
line a B C

color 200 200 200
drawline a
color 0 0 0
```

```
% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points B and H_{a} must be different
% Constructing a point P_{\_G154117} which is a foot of the point E_{b} on the line a
foot P_{\_G154117} E_{b} a
cmark_r P_{\_G154117}
color 200 200 200
drawline E_{b} P_{\_G154117}
color 0 0 0

% Constructing a point H_{a} which is an image of the point B in the symmetry to point/line P_{\_G
    154117}
sim H_{a} P_{\_G154117} B
cmark_r H_{a}


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G154355} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G154355} E_{b} h_{c}
cmark_r P_{\_G154355}
color 200 200 200
drawline E_{b} P_{\_G154355}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    154355}
sim H_{c} P_{\_G154355} H
cmark_rt H_{c}
```

```
% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{a} and c are not parallel% DET: lines h_{a} and c are not the same
% Constructing a point A which belongs to line h_{a} and line c
intersec A h_{a} c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and c are not parallel; line h_{c} and circle k(E_{b},B)
    intersect; line a and circle k(E_{b},B) intersect; points B and E_{b} are not the same
% Determination conditions: lines h_{a} and c are not the same; points H_{c} and B are not the same
    ; points H and H_{c} must be different; points H_{a} and H are not the same; points B and H_{a}
     must be different; points E_{c} and H are not the same; points B and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H=_H

Proving failed

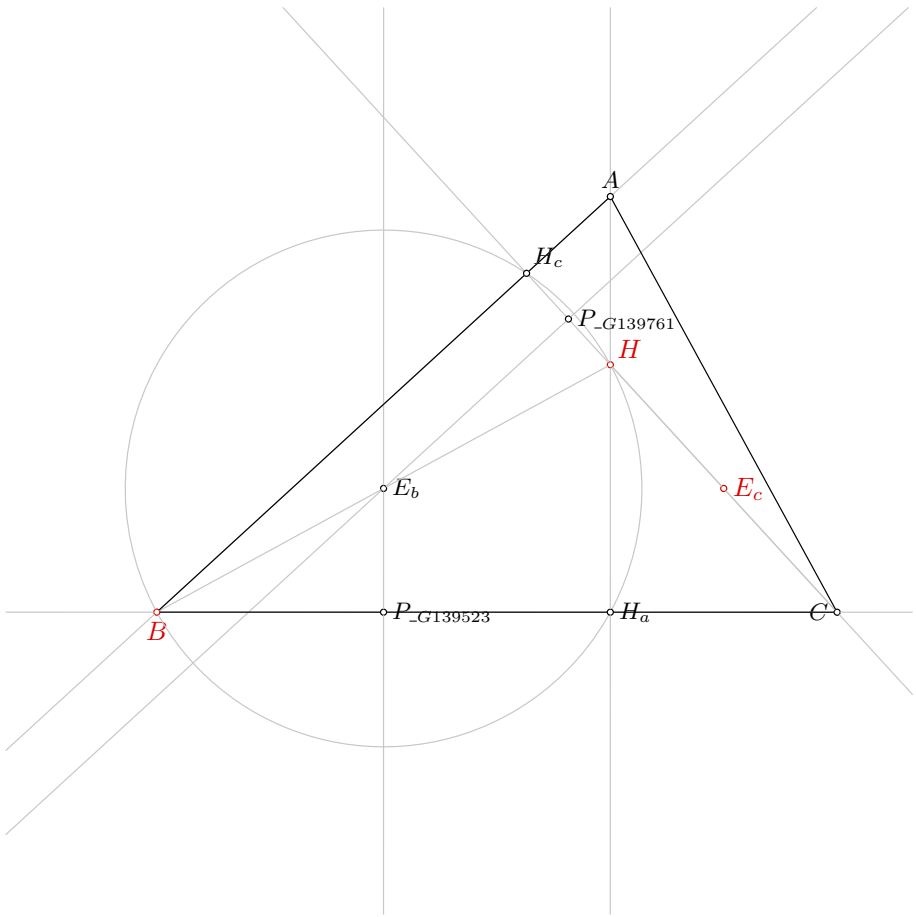

Figure 1: Illustration of the problem 0663

4.2 GCLC - Area method

4.2.1 Proving $B{=}B$

NDG conditions are:

$S_{H_aH_cB} \neq S_{HH_cB}$ i.e., lines H_aH and H_cB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_c{=}\_E_c$

Proving failed

4.2.3 Proving $H{=}\_H$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_c{=}\_E_c$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 2174 terms.

Time Complexity: Time spent by the prover is 1.680 seconds.There are no ndg conditions.

4.3.3 Proving $H{=}\_H$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 315 terms.

Time Complexity: Time spent by the prover is 0.270 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_c{=}\_E_c$

Proving failed

4.4.3 Proving $H{=}\_H$

Proving failed

Problem 664

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 664: Given a point B, a point E_c and a point H_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point H_a, construct a line a (rule W02); % DET: points B and H_a are not the same;
2. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;
3. Using the circle $k(E_c, C)$, the line a, the point E_c and the point H_a, construct a point C (rule W05); % NDG: line a and circle $k(E_c, C)$ intersect % DET: points H_a and C must be different;
4. Using the point E_c and the point C, construct a point H (rule W01); ;
5. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
6. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
7. Using the circle $k(E_c, C)$, the line h_b, the point E_c and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_c, C)$ intersect % DET: points H and H_b must be different;
8. Using the point C and the point H_b, construct a line b (rule W02); % DET: points C and H_b are not the same;
9. Using the line h_a and the line b, construct a point A (rule W03); % NDG: lines h_a and b are not parallel % DET: lines h_a and b are not the same.

Non-degenerate conditions: lines h_a and b are not parallel; line h_b and circle $k(E_c, C)$ intersect; line a and circle $k(E_c, C)$ intersect; points H_a and E_c are not the same.

Determination conditions: lines h_a and b are not the same; points C and H_b are not the same; points H and H_b must be different; points H_a and H are not the same; points B and H are not the same; points H_a and C must be different; points B and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,L52,L53,L54]

Solving time: 8.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{c} 95 56.36
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{c}
cmark_r H_{a}
color 0 0 0
fontsize 8

% DET: points B and H_{a} are not the same
% Constructing a line a which passes through point B and point H_{a}
line a B H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line a and circle k(E_{c},C) intersect% DET: points H_{a} and C must be different
% Constructing a point P_{\_G177504} which is a foot of the point E_{c} on the line a
foot P_{\_G177504} E_{c} a
cmark_r P_{\_G177504}
color 200 200 200
drawline E_{c} P_{\_G177504}
color 0 0 0
```

```
% Constructing a point C which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    177504}
sim C P_{\_G177504} H_{a}
cmark_l C



% Constructing a point H such that E_{c}H/E_{c}C=-1
towards H E_{c} C -1
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0



% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{b} and circle k(E_{c},C) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G177867} which is a foot of the point E_{c} on the line h_{b}
foot P_{\_G177867} E_{c} h_{b}
cmark_r P_{\_G177867}
color 200 200 200
drawline E_{c} P_{\_G177867}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    177867}
sim H_{b} P_{\_G177867} H
cmark_l H_{b}


% DET: points C and H_{b} are not the same
% Constructing a line b which passes through point C and point H_{b}
line b C H_{b}

color 200 200 200
drawline b
```

```
color 0 0 0



% NDG: lines h_{a} and b are not parallel% DET: lines h_{a} and b are not the same
% Constructing a point A which belongs to line h_{a} and line b
intersec A h_{a} b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and b are not parallel; line h_{b} and circle k(E_{c},C)
    intersect; line a and circle k(E_{c},C) intersect; points H_{a} and E_{c} are not the same
% Determination conditions: lines h_{a} and b are not the same; points C and H_{b} are not the same
    ; points H and H_{b} must be different; points H_{a} and H are not the same; points B and H are
     not the same; points H_{a} and C must be different; points B and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H_a=_H_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 1176 terms.

Time Complexity: Time spent by the prover is 6.569 seconds.

NDG conditions Points B and H_a are not identical

Points B and H_a are not identical

Points B and H are not identical

Points B and H are not identical

Line through points H_b and C is not parallel with line through points H and H_a

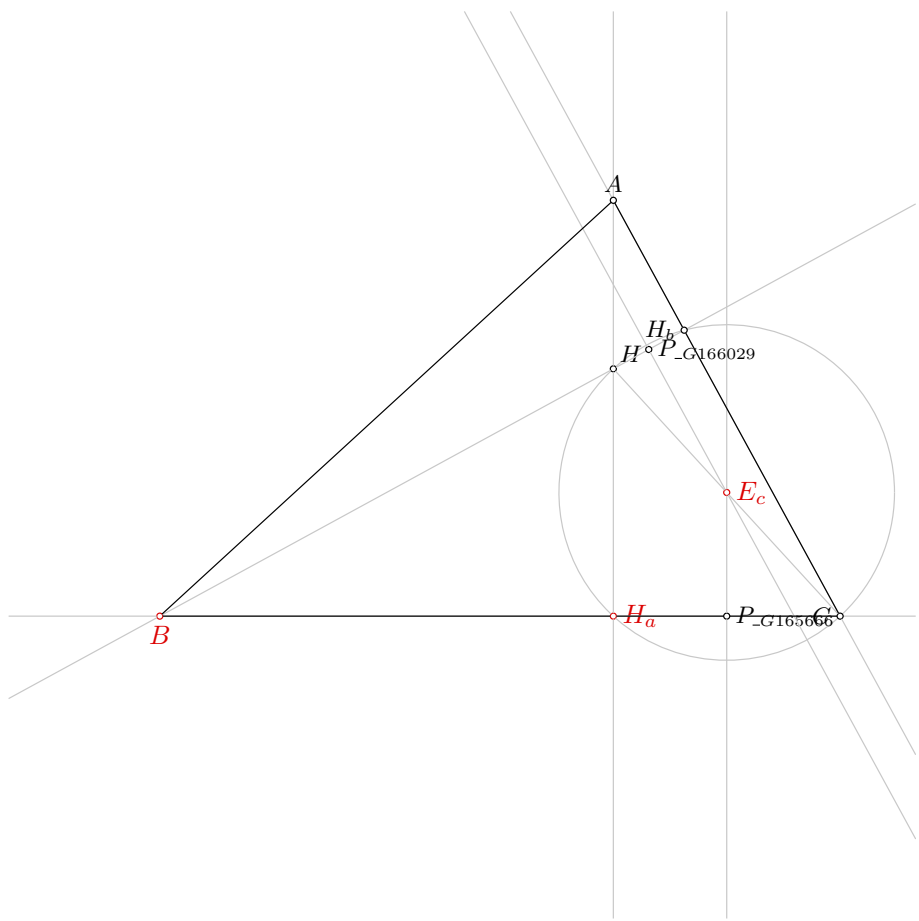

Figure 1: Illustration of the problem 0664

Line through points E_c and B is not parallel with line through points H and H_a

Points B and C are not identical

Points E_c, B and C are not collinear

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{H_aCH_b} \neq S_{HCH_b}$ i.e., lines H_aH and CH_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving H_a=$\_H_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Proving failed

4.3.2 Proving E_c=$\_E_c$

Proving failed

4.3.3 Proving H_a=$\_H_a$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Proving failed

4.4.2 Proving E_c=$\_E_c$

Proving failed

4.4.3 Proving H_a=$\_H_a$

Proving failed

Problem 665

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 665: Given a point B, a point E_c and a point H_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point H_b, construct a line h_b (rule W02); % DET: points B and H_b are not the same;
2. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
3. Using the circle $k(E_c, C)$, the line h_b, the point E_c and the point H_b, construct a point H (rule W05); % NDG: line h_b and circle $k(E_c, C)$ intersect % DET: points H_b and H must be different;
4. Using the point E_c and the point H, construct a point C (rule W01); ;
5. Using the point B and the point C, construct a line a (rule W02); % DET: points B and C are not the same;
6. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
7. Using the circle $k(E_c, C)$, the line a, the point E_c and the point C, construct a point H_a (rule W05); % NDG: line a and circle $k(E_c, C)$ intersect % DET: points C and H_a must be different;
8. Using the point H and the point H_a, construct a line h_a (rule W02); % DET: points H and H_a are not the same;
9. Using the line b and the line h_a, construct a point A (rule W03); % NDG: lines b and h_a are not parallel % DET: lines b and h_a are not the same.

Non-degenerate conditions: lines b and h_a are not parallel; line a and circle $k(E_c, C)$ intersect; line h_b and circle $k(E_c, C)$ intersect; points H_b and E_c are not the same.

Determination conditions: lines b and h_a are not the same; points H and H_a are not the same; points C and H_a must be different; points H_b and C are not the same; points B and C are not the same; points H_b and H must be different; points B and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,L52,L53,L54]

Solving time: 8.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{c} 95 56.36
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{c}
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points B and H_{b} are not the same
% Constructing a line h_{b} which passes through point B and point H_{b}
line h_{b} B H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line h_{b} and circle k(E_{c},C) intersect% DET: points H_{b} and H must be different
% Constructing a point P_{\_G200167} which is a foot of the point E_{c} on the line h_{b}
foot P_{\_G200167} E_{c} h_{b}
cmark_r P_{\_G200167}
color 200 200 200
drawline E_{c} P_{\_G200167}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    200167}
sim H P_{\_G200167} H_{b}
cmark_rt H


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points B and C are not the same
% Constructing a line a which passes through point B and point C
line a B C

color 200 200 200
drawline a
color 0 0 0



% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% NDG: line a and circle k(E_{c},C) intersect% DET: points C and H_{a} must be different
% Constructing a point P_{\_G200530} which is a foot of the point E_{c} on the line a
foot P_{\_G200530} E_{c} a
cmark_r P_{\_G200530}
color 200 200 200
drawline E_{c} P_{\_G200530}
color 0 0 0

% Constructing a point H_{a} which is an image of the point C in the symmetry to point/line P_{\_G
    200530}
sim H_{a} P_{\_G200530} C
cmark_r H_{a}


% DET: points H and H_{a} are not the same
% Constructing a line h_{a} which passes through point H and point H_{a}
line h_{a} H H_{a}

color 200 200 200
drawline h_{a}
```

```
color 0 0 0



% NDG: lines b and h_{a} are not parallel% DET: lines b and h_{a} are not the same
% Constructing a point A which belongs to line b and line h_{a}
intersec A b h_{a}
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{a} are not parallel; line a and circle k(E_{c},C)
    intersect; line h_{b} and circle k(E_{c},C) intersect; points H_{b} and E_{c} are not the same
% Determination conditions: lines b and h_{a} are not the same; points H and H_{a} are not the same
    ; points C and H_{a} must be different; points H_{b} and C are not the same; points B and C are
     not the same; points H_{b} and H must be different; points B and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{H_bHH_a} \neq S_{CHH_a}$ i.e., lines H_bC and HH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

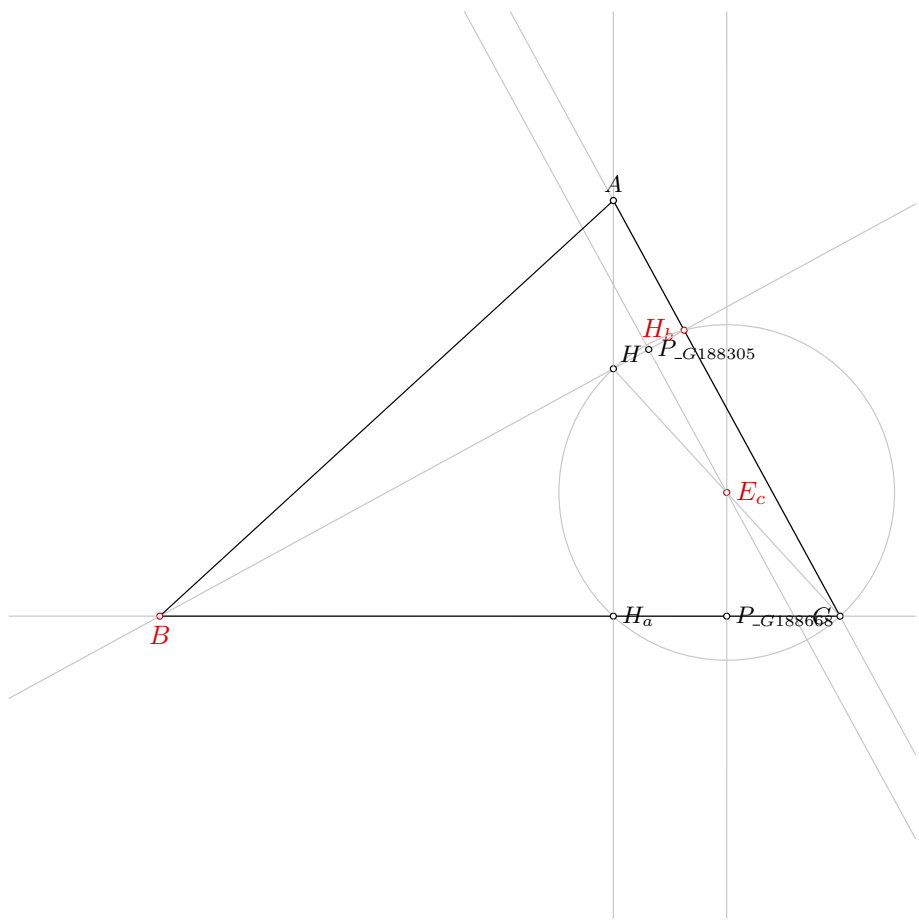

Figure 1: Illustration of the problem 0665

$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 666

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 666: Given a point E_c, a point H_c and a point B, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Using the point H_c and the line h_c, construct a line c (rule W10a); ;
3. Choose freely a point B on the line c (rule WOnline2);
4. Using the point B and the point H_c, construct a line $m(BH_c)$ (rule W14); % DET: points B and H_c are not the same;
5. Using the point E_c and the point H_c, construct a line $m(E_cH_c)$ (rule W14); % DET: points E_c and H_c are not the same;
6. Choose freely a point A on the line c (rule WOnline1) ;
7. Using the point A and the point B, construct a point M_c (rule W01); ;
8. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
9. Using the line $m(E_cH_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not the same;
10. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
11. Using the circle $k(N, M_a)$ and the line $m(BH_c)$, construct a point M_a and a point E_b (rule W04); % NDG: line $m(BH_c)$ and circle $k(N, M_a)$ intersect;

12. Using the point B and the point M_a, construct a point C (rule W01); .

Non-degenerate conditions: line $m(BH_c)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same; lines $m(E_cH_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points E_c and H_c are not the same; points B and H_c are not the same; points E_c and H_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W14,WOnline1,WOnline2]

Lemmas used: [D10,D20,D21,D30,D32,D7,GD02,GL01,GL03,GL09,L19,L20,L21,L23,L24,L3,L39,L41,L42,L51,

Solving time: 54.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{c} 68.91 84.83
point B 20 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H_{c}
cmark_b B
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0




% Constructing a line c which is perpendicular to line h_{c} and which passes through point H_{c}
perp c H_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0




% Generating random value V[_G224437]
random V[_G224437]
```

```
% Calculating value V[_G224458] using formula V[_G224437]*20
expression V[_G224458] { V[_G224437]*20 }


% Constructing a point B which is a point for which holds H_{c}B = V[_G224458] and angle E_{c}H_{c}
    B = 90
turtle B E_{c} H_{c} 90 V[_G224458]
cmark_b B


% DET: points B and H_{c} are not the same
% Constructing bisector m(BH_{c}) of the segment BH_{c}
med m(BH_{c}) B H_{c}

color 200 200 200
drawline m(BH_{c})
color 0 0 0

color 200 200 200
drawsegment B H_{c}
color 0 0 0


% DET: points E_{c} and H_{c} are not the same
% Constructing bisector m(E_{c}H_{c}) of the segment E_{c}H_{c}
med m(E_{c}H_{c}) E_{c} H_{c}

color 200 200 200
drawline m(E_{c}H_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} H_{c}
color 0 0 0



% Choosing randomly a point A on the line BH_{c}
online A B H_{c}
cmark_t A
color 200 200 200
drawline B H_{c}
color 0 0 0



% Constructing a point M_{c} such that AM_{c}/AB=0.5
towards M_{c} A B 0.5
cmark_lt M_{c}
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
```

```
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}H_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}H_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}H_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(BH_{c}) and circle k(N,M_{a}) intersect
% Constructing points M_{a} and E_{b} which are in intersection of k(N,M_{a}) and m(BH_{c})
intersec2 M_{a} E_{b} k(N,M_{a}) m(BH_{c})
cmark_r M_{a}
cmark_r E_{b}



% Constructing a point C such that BC/BM_{a}=2
towards C B M_{a} 2
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(BH_{c}) and circle k(N,M_{a}) intersect; points E_{c} and N are
     not the same; lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not parallel
% Determination conditions: lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and M_{c} are not the same; points E_{c} and H_{c} are not the same; points B and H_{c} are not
     the same; points E_{c} and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

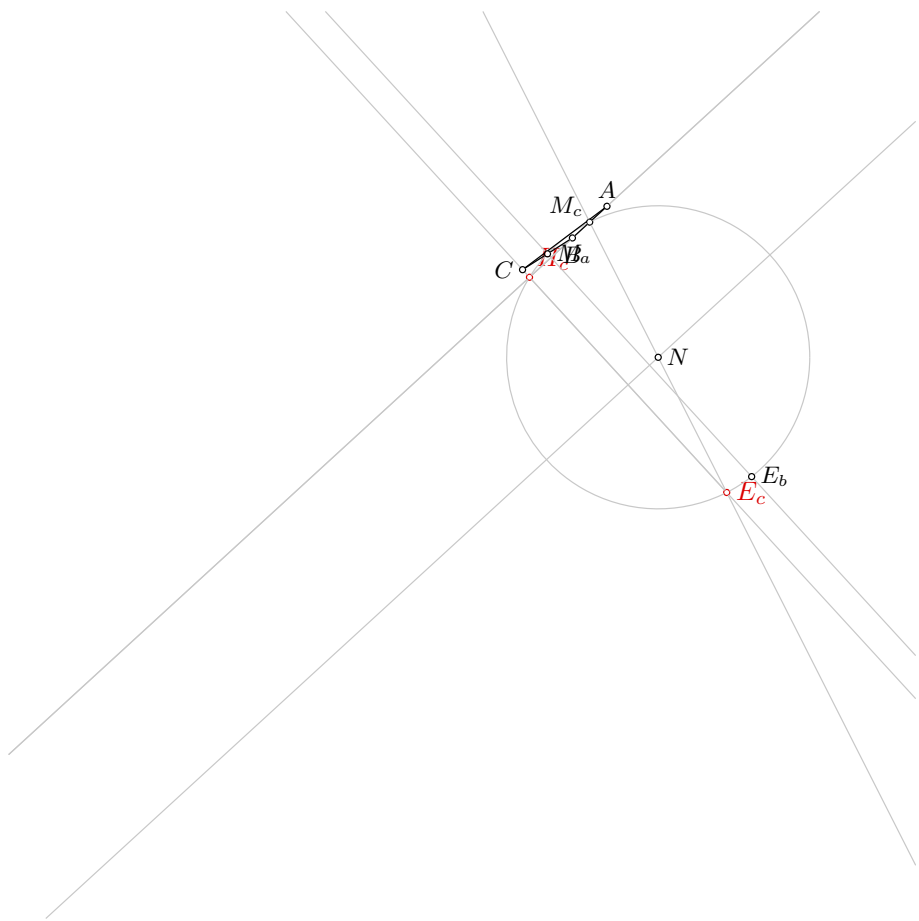

Figure 1: Illustration of the problem 0666

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 59 terms.

Time Complexity: Time spent by the prover is 0.669 seconds.

NDG conditions Points A and B are not identical

Points A, B and C are not collinear

Point M_c is not the midpoint of segment with endpoints B and C

4.1.2 Proving H_c=_H_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 4 terms.

Time Complexity: Time spent by the prover is 0.119 seconds.

NDG conditions Points A and B are not identical

4.1.3 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.007 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving B=B

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving $B{=}B$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $E_c{=}\_E_c$

Proving failed

4.4.2 Proving $H_c{=}\_H_c$

Proving failed

4.4.3 Proving $B{=}B$

Proving failed

Problem 667

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 667: Given a point B, a point E_c and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 668

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 668: Given a point B, a point E_c and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point M_a, construct a point C (rule W01); ;
2. Using the point E_c and the point C, construct a point H (rule W01); ;
3. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
4. Using the point E_c and the point C, construct a line h_c (rule W02); % DET: points E_c and C are not the same;
5. Using the point B and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points B and M_a are not the same;
6. Using the circle $k(M_a, B)$, the line h_b, the point M_a and the point B, construct a point H_b (rule W05); % NDG: line h_b and circle $k(M_a, B)$ intersect % DET: points B and H_b must be different;
7. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
8. Using the circle $k(M_a, B)$, the line h_c, the point M_a and the point C, construct a point H_c (rule W05); % NDG: line h_c and circle $k(M_a, B)$ intersect % DET: points C and H_c must be different;
9. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
10. Using the line b and the line c, construct a point A (rule W03); % NDG: lines b and c are not parallel % DET: lines b and c are not the same.

Non-degenerate conditions: lines b and c are not parallel; line h_c and circle $k(M_a, B)$ intersect; line h_b and circle $k(M_a, B)$ intersect; points B and M_a are not the same.

Determination conditions: lines b and c are not the same; points H_c and B are not the same; points C and H_c must be different; points H_b and C are not the same; points B and H_b must be different; points E_c and C are not the same; points B and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D21,D3,D30,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L37,L38,L39]

Solving time: 10.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{c} 95 56.36
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{c}
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point C such that BC/BM_{a}=2
towards C B M_{a} 2
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0



% Constructing a point H such that E_{c}H/E_{c}C=-1
towards H E_{c} C -1
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% DET: points E_{c} and C are not the same
% Constructing a line h_{c} which passes through point E_{c} and point C
line h_{c} E_{c} C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points B and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point B
circle k(M_{a},B) M_{a} B

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: line h_{b} and circle k(M_{a},B) intersect% DET: points B and H_{b} must be different
% Constructing a point P_{\_G251377} which is a foot of the point M_{a} on the line h_{b}
foot P_{\_G251377} M_{a} h_{b}
cmark_r P_{\_G251377}
color 200 200 200
drawline M_{a} P_{\_G251377}
color 0 0 0

% Constructing a point H_{b} which is an image of the point B in the symmetry to point/line P_{\_G
    251377}
sim H_{b} P_{\_G251377} B
cmark_l H_{b}


% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% NDG: line h_{c} and circle k(M_{a},B) intersect% DET: points C and H_{c} must be different
% Constructing a point P_{\_G251615} which is a foot of the point M_{a} on the line h_{c}
foot P_{\_G251615} M_{a} h_{c}
cmark_r P_{\_G251615}
color 200 200 200
drawline M_{a} P_{\_G251615}
color 0 0 0

% Constructing a point H_{c} which is an image of the point C in the symmetry to point/line P_{\_G
    251615}
sim H_{c} P_{\_G251615} C
cmark_rt H_{c}
```

```
% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: lines b and c are not parallel% DET: lines b and c are not the same
% Constructing a point A which belongs to line b and line c
intersec A b c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and c are not parallel; line h_{c} and circle k(M_{a},B)
    intersect; line h_{b} and circle k(M_{a},B) intersect; points B and M_{a} are not the same
% Determination conditions: lines b and c are not the same; points H_{c} and B are not the same;
    points C and H_{c} must be different; points H_{b} and C are not the same; points B and H_{b}
    must be different; points E_{c} and C are not the same; points B and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

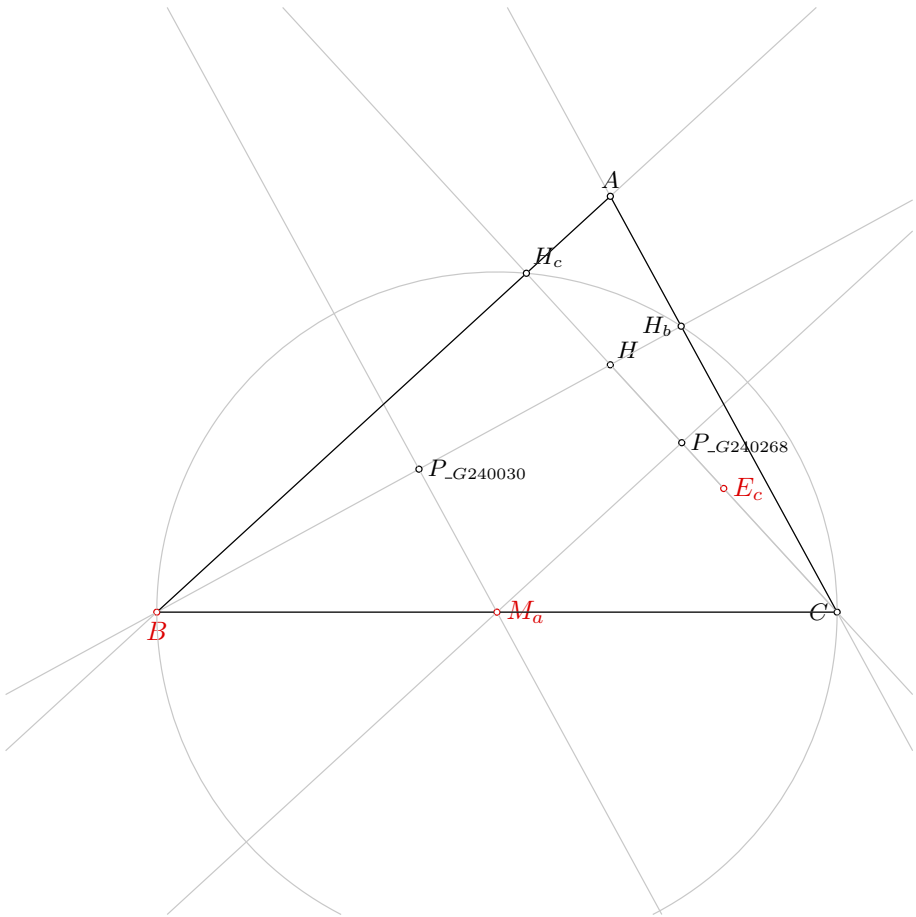

Figure 1: Illustration of the problem 0668

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving $B{=}B$

NDG conditions are:

$S_{H_bH_cB} \neq S_{CH_cB}$ i.e., lines H_bC and H_cB are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_c{=}\_E_c$

Proving failed

4.2.3 Proving $M_a{=}\_M_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_c{=}\_E_c$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 331 terms.

Time Complexity: Time spent by the prover is 1.070 seconds.There are no ndg conditions.

4.3.3 Proving $M_a{=}\_M_a$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_c{=}\_E_c$

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 669

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 669: Given a point B, a point E_c and a point M_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 670

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 670: Given a point B, a point E_c and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point M_c, construct a point A (rule W01); ;
2. Using the point B and the point M_c, construct a line c (rule W02); % DET: points B and M_c are not the same;
3. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
4. Using the point E_c and the line c, construct a line h_c (rule W10b); ;
5. Using the line h_c and the line c, construct a point H_c (rule W03); % NDG: lines h_c and c are not parallel % DET: lines h_c and c are not the same;
6. Using the point B and the point H_c, construct a line $m(BH_c)$ (rule W14); % DET: points B and H_c are not the same;
7. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;
8. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;
9. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
10. Using the circle $k(N, M_a)$ and the line $m(BH_c)$, construct a point M_a and a point E_b (rule W04); % NDG: line $m(BH_c)$ and circle $k(N, M_a)$ intersect;

11. Using the point M_a and the point B, construct a point C (rule W01); .

Non-degenerate conditions: line $m(BH_c)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel; lines h_c and c are not parallel.

Determination conditions: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points B and H_c are not the same; lines h_c and c are not the same; points E_c and M_c are not the same; points B and M_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14]

Lemmas used: [D10,D20,D21,D30,D32,D7,GD01,GD02,GL01,GL03,GL04,GL09,L18,L19,L20,L23,L24,L3,L39,I

Solving time: 2.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{c} 95 56.36
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{c}
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point A such that BA/BM_{c}=2
towards A B M_{c} 2
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points B and M_{c} are not the same
% Constructing a line c which passes through point B and point M_{c}
line c B M_{c}

color 200 200 200
drawline c
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
```

```
color 0 0 0



% Constructing a line h_{c} which is perpendicular to line c and which passes through point E_{c}
perp h_{c} E_{c} c

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines h_{c} and c are not parallel% DET: lines h_{c} and c are not the same
% Constructing a point H_{c} which belongs to line h_{c} and line c
intersec H_{c} h_{c} c
cmark_rt H_{c}


% DET: points B and H_{c} are not the same
% Constructing bisector m(BH_{c}) of the segment BH_{c}
med m(BH_{c}) B H_{c}

color 200 200 200
drawline m(BH_{c})
color 0 0 0

color 200 200 200
drawsegment B H_{c}
color 0 0 0


% DET: points E_{c} and M_{c} are not the same
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0


% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(BH_{c}) and circle k(N,M_{a}) intersect
% Constructing points M_{a} and E_{b} which are in intersection of k(N,M_{a}) and m(BH_{c})
intersec2 M_{a} E_{b} k(N,M_{a}) m(BH_{c})
cmark_r M_{a}
cmark_r E_{b}



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(BH_{c}) and circle k(N,M_{a}) intersect; points E_{c} and N are
     not the same; lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel; lines h_{c} and c are
    not parallel
% Determination conditions: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and M_{c} are not the same; points B and H_{c} are not the same; lines h_{c} and c are not the
    same; points E_{c} and M_{c} are not the same; points B and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Proving failed

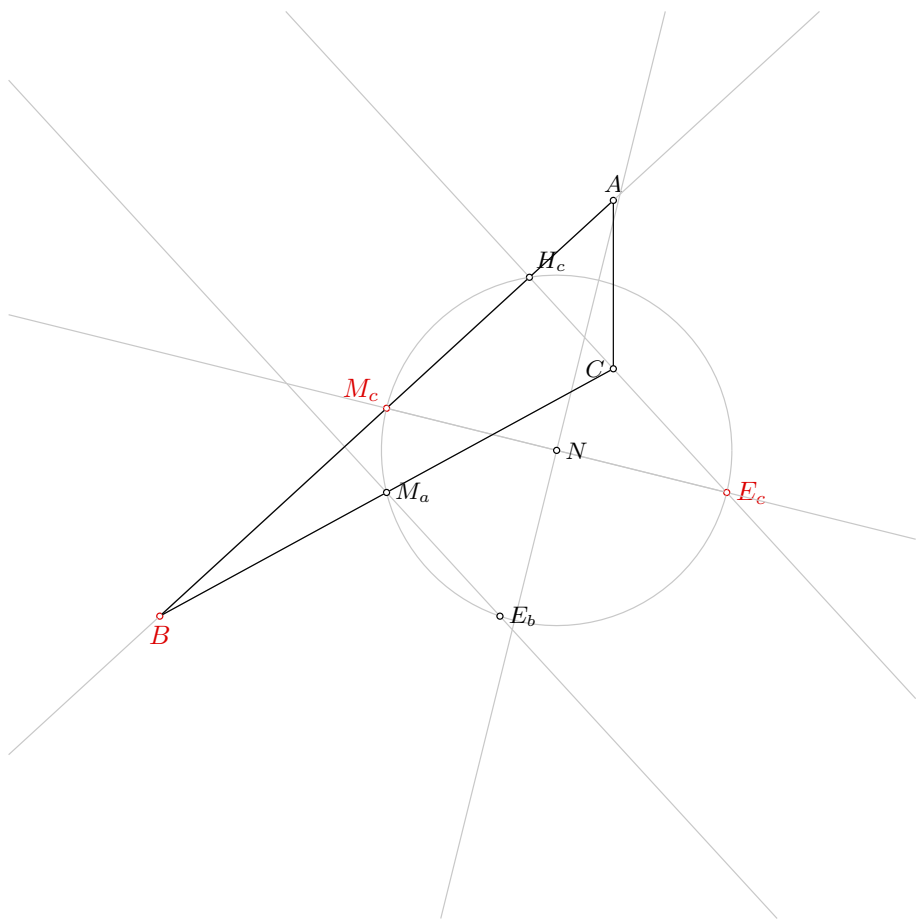

Figure 1: Illustration of the problem 0670

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{E_cBM_c} \neq 0$ i.e., points E_c, B and M_c are not collinear (foot is not the point itself; construction based assumption)

$S_{E_cBM_c} \neq S_{F^0_{h_c}BM_c}$ i.e., lines $E_cF^0_{h_c}$ and BM_c are not parallel (construction based assumption)

$S_{M^3_{m(E_cM_c)}E_cM_c} \neq S_{T^4_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^3_{m(E_cM_c)}T^4_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving M_c=_M_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 13 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 671

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 671: Given a point B, a point E_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
2. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
3. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
4. Using the point M_c and the point B, construct a point A (rule W01); ;
5. Using the point B and the point M_c, construct a line c (rule W02); % DET: points B and M_c are not the same;
6. Using the circle $k(N, M_a)$, the line c, the point N and the point M_c, construct a point H_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points M_c and H_c must be different;
7. Using the point H_c and the point E_c, construct a line h_c (rule W02); % DET: points H_c and E_c are not the same;
8. Using the point B and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points B and M_c are not the same;
9. Using the circle $k(N, M_a)$ and the circle $k(M_c, A)$, construct a point H_a and a point H_b (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_c, A)$ intersect % DET: circles $k(N, M_a)$ and $k(M_c, A)$ are not the same;

10. Using the point B and the point H_a, construct a line a (rule W02); % DET: points B and H_a are not the same;

11. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; circles $k(N, M_a)$ and $k(M_c, A)$ intersect; points B and M_c are not the same; line c and circle $k(N, M_a)$ intersect; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: lines h_c and a are not the same; points B and H_a are not the same; circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points H_c and E_c are not the same; points M_c and H_c must be different; points B and M_c are not the same; points E_c and M_c must be different; points E_c and N are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D10,D20,D30,D32,D5,D7,GD01,GD02,GL01,GL03,GL04,GL09,L18,L19,L20,L21,L24,L3,L40,L

Solving time: 4.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point E_{c} 95 56.36
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_r E_{c}
cmark_r N
color 0 0 0
fontsize 8

% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}



% Constructing a point A such that M_{c}A/M_{c}B=-1
towards A M_{c} B -1
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points B and M_{c} are not the same
% Constructing a line c which passes through point B and point M_{c}
line c B M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(N,M_{a}) intersect% DET: points M_{c} and H_{c} must be different
% Constructing a point P_{\_G61352} which is a foot of the point N on the line c
foot P_{\_G61352} N c
cmark_r P_{\_G61352}
color 200 200 200
drawline N P_{\_G61352}
color 0 0 0

% Constructing a point H_{c} which is an image of the point M_{c} in the symmetry to point/line P
    _{\_G61352}
sim H_{c} P_{\_G61352} M_{c}
cmark_rt H_{c}


% DET: points H_{c} and E_{c} are not the same
% Constructing a line h_{c} which passes through point H_{c} and point E_{c}
line h_{c} H_{c} E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points B and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point B
circle k(M_{c},A) M_{c} B
```

```
color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{c},A) intersect% DET: circles k(N,M_{a}) and k(M_{c},A) are not
    the same
% Constructing points H_{a} and H_{b} which are in intersection of k(N,M_{a}) and k(M_{c},A)
intersec2 H_{a} H_{b} k(N,M_{a}) k(M_{c},A)
cmark_r H_{a}
cmark_l H_{b}


% DET: points B and H_{a} are not the same
% Constructing a line a which passes through point B and point H_{a}
line a B H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; circles k(N,M_{a}) and k(M_{c},A)
    intersect; points B and M_{c} are not the same; line c and circle k(N,M_{a}) intersect; line m(
    H_{b}H_{a}) and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: lines h_{c} and a are not the same; points B and H_{a} are not the same
    ; circles k(N,M_{a}) and k(M_{c},A) are not the same; points H_{c} and E_{c} are not the same;
    points M_{c} and H_{c} must be different; points B and M_{c} are not the same; points E_{c} and
     M_{c} must be different; points E_{c} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

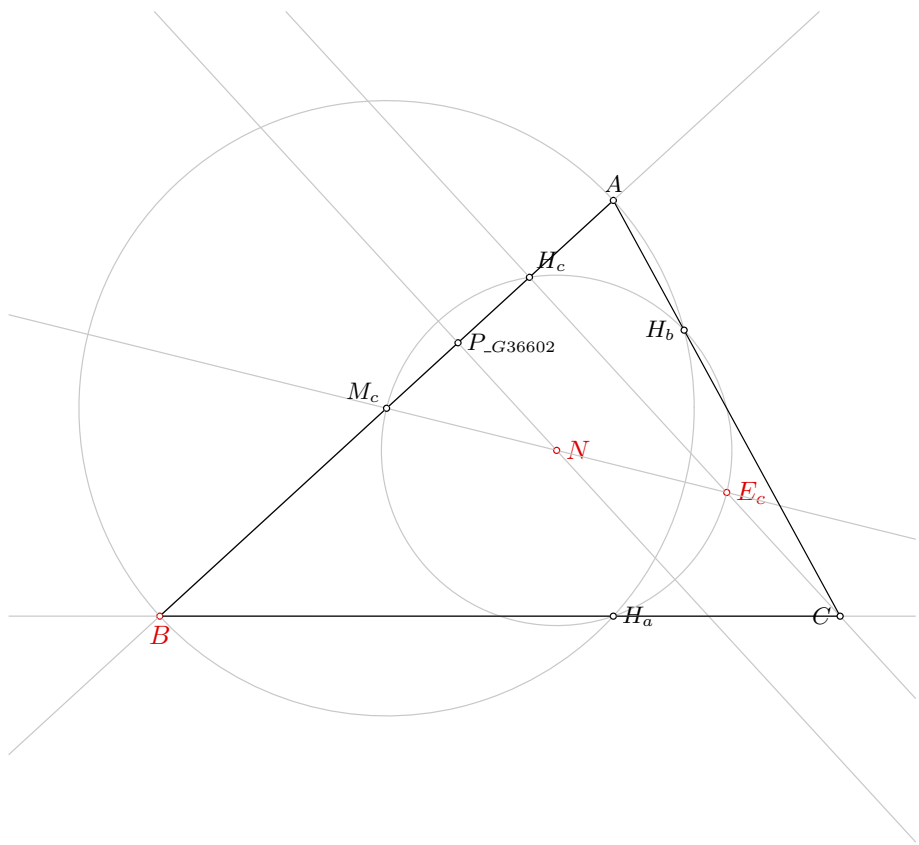

Figure 1: Illustration of the problem 0671

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=$\_E_c$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{H_cBH_a} \neq S_{E_cBH_a}$ i.e., lines H_cE_c and BH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Proving failed

4.3.2 Proving E_c=$\_E_c$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 672

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 672: Given a point B, a point E_c and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 673

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 673: Given a point B, a point E_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 674

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 674: Given a point B, a point E_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 675

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 675: Given a point B, a point E_c and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 676

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 676: Given a point B, a point G and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point G, construct a point M_b (rule W01); ;
2. Using the point G and the point N, construct a point H (rule W01); ;
3. Using the point B and the point H, construct a point E_b (rule W01); ;
4. Using the point G and the point N, construct a point O (rule W01); ;
5. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
6. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
7. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
9. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; line h_b and circle $k(N, M_a)$ intersect; points M_b and N are not the same; points B and O are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points B and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L17,L20,L23,L56]

Solving time: 9.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point G 70 58.33
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_t G
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point M_{b} such that BM_{b}/BG=1.5
towards M_{b} B G 1.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0



% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point E_{b} such that BE_{b}/BH=0.5
towards E_{b} B H 0.5
cmark_r E_{b}
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point O such that GO/GN=-2
```

```
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G110875} which is a foot of the point N on the line h_{b}
foot P_{\_G110875} N h_{b}
cmark_r P_{\_G110875}
color 200 200 200
drawline N P_{\_G110875}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G110875}
sim H_{b} P_{\_G110875} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
```

```
drawline b
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; line h_{b} and circle k(N,M_{a})
    intersect; points M_{b} and N are not the same; points B and O are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points B and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving G=$\_G$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{AB\_M_b} \neq S_{\_M_aB\_M_b}$ i.e., lines A_M_a and B_M_b are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

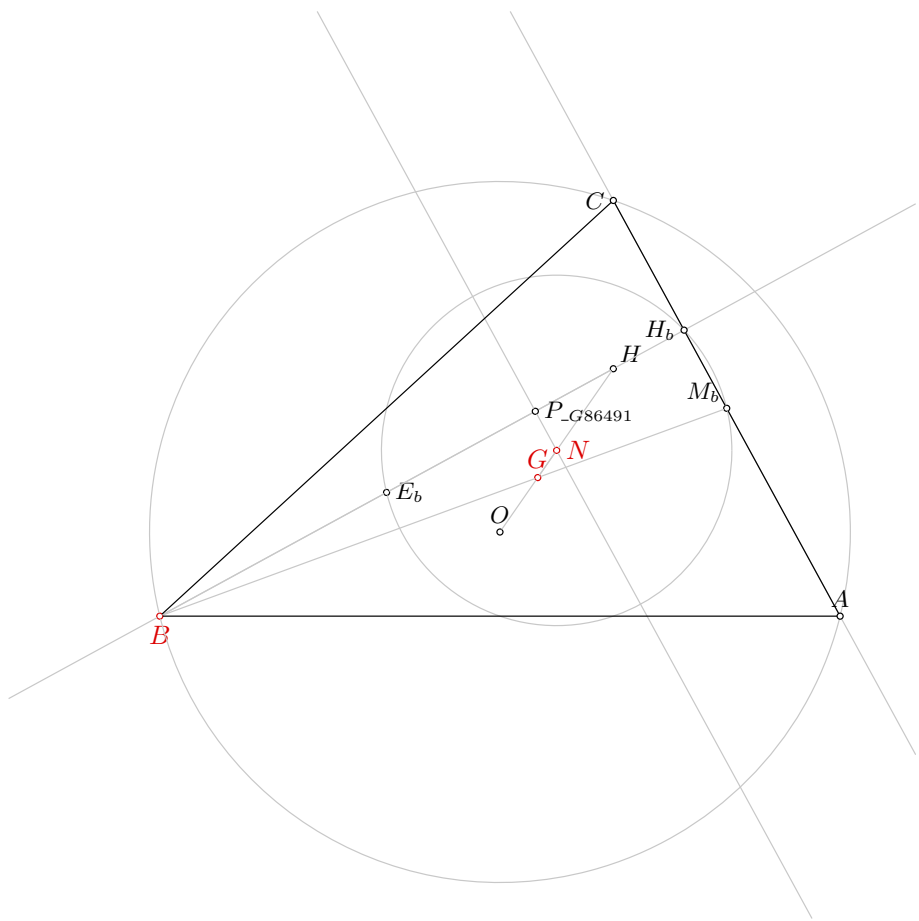

Figure 1: Illustration of the problem 0676

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 677

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 677: Given a point B, a point H and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point H, construct a point E_b (rule W01); ;
2. Using the point H and the point N, construct a point O (rule W01); ;
3. Using the point H and the point N, construct a point G (rule W01); ;
4. Using the point B and the point G, construct a point M_b (rule W01); ;
5. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
6. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
7. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
9. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same; points B and O are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points B and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL09,L11,L12,L16,L20,L23,L56]

Solving time: 9.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point H 80 72.73
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_rt H
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point E_{b} such that BE_{b}/BH=0.5
towards E_{b} B H 0.5
cmark_r E_{b}
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G145689} which passes through point H and point N
line L_{\_G145689} H N

color 200 200 200
drawline L_{\_G145689}
color 0 0 0


% Constructing a point P_{\_G145790} with coordinates (0,0)
point P_{\_G145790} 0 0
```

```
cmark_r P_{\_G145790}

% Constructing a point P_{\_G145714} such that HP_{\_G145714}/HP_{\_G145790}=4
towards P_{\_G145714} H P_{\_G145790} 4
cmark_r P_{\_G145714}
color 200 200 200
drawsegment H P_{\_G145714}
color 0 0 0

% Constructing a point P_{\_G145759} such that HP_{\_G145759}/HP_{\_G145790}=3
towards P_{\_G145759} H P_{\_G145790} 3
cmark_r P_{\_G145759}
color 200 200 200
drawsegment H P_{\_G145759}
color 0 0 0

% Constructing a line L_{\_G145720} which passes through point N and point P_{\_G145759}
line L_{\_G145720} N P_{\_G145759}

color 200 200 200
drawline L_{\_G145720}
color 0 0 0


% Constructing a line L_{\_G145683} which contains the point P_{\_G145714} and is parallel to the
    line L_{\_G145720}
parallel L_{\_G145683} P_{\_G145714} L_{\_G145720}

color 200 200 200
drawline L_{\_G145683}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G145683} and line L_{\_G145689}
intersec G L_{\_G145683} L_{\_G145689}
cmark_t G



% Constructing a point M_{b} such that BM_{b}/BG=1.5
towards M_{b} B G 1.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G146677} which is a foot of the point N on the line h_{b}
foot P_{\_G146677} N h_{b}
cmark_r P_{\_G146677}
color 200 200 200
drawline N P_{\_G146677}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G146677}
sim H_{b} P_{\_G146677} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

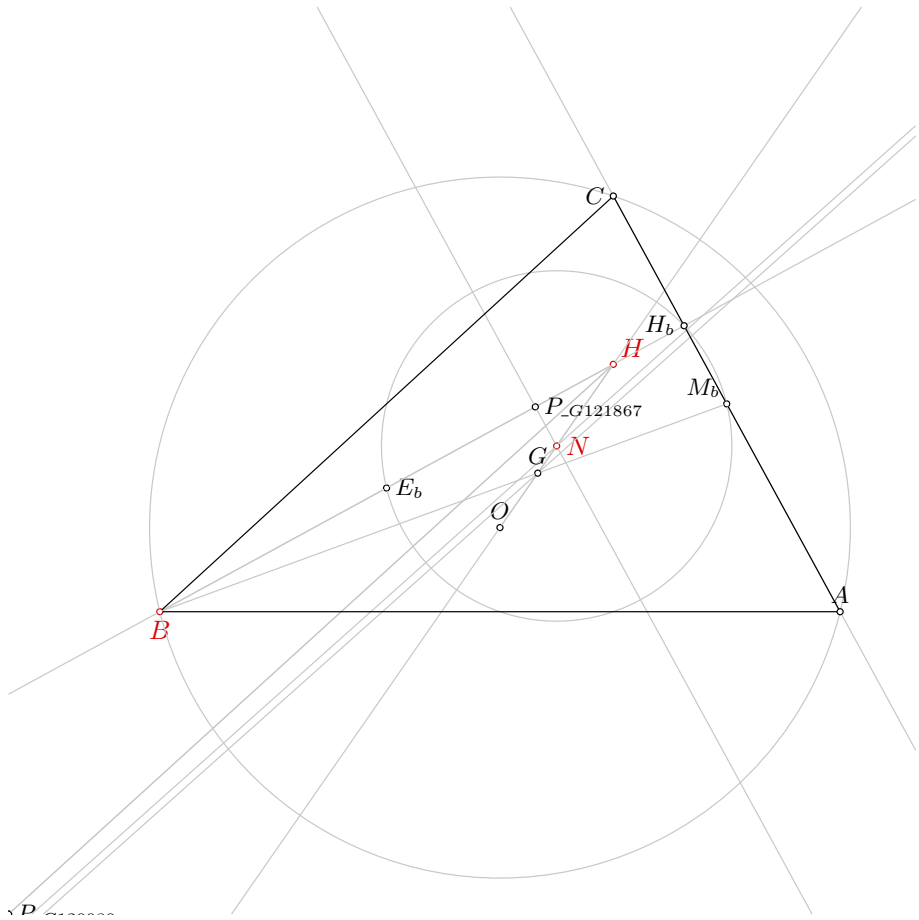

Figure 1: Illustration of the problem 0677

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; line h_{b} and circle k(N,M_{a})
    intersect; points E_{b} and N are not the same; points B and O are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points B and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H=$\_H$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{P_{\_G122352}HN} \neq S_{P^0_{L_{\_G122321}}HN}$ i.e., lines $P_{\_G122352}P^0_{L_{\_G122321}}$ and HN are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^4_{\_m_b}} \neq S_{F^3_{\_m_a}\_M_bF^4_{\_m_b}}$ i.e., lines $\_M_aF^3_{\_m_a}$ and $\_M_bF^4_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving H=$\_H$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving H=$\_H$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $H{=}\_H$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 678

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 678: Given a point B, a point H_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point H_a, construct a line a (rule W02); % DET: points B and H_a are not the same;

2. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;

3. Using the circle $k(N, M_a)$, the line a, the point N and the point H_a, construct a point M_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points H_a and M_a must be different;

4. Using the point M_a and the point B, construct a point C (rule W01); ;

5. Using the point N and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points N and M_a are not the same;

6. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;

7. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;

8. Using the point B and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points B and M_a are not the same;

9. Using the circle $k(N, M_a)$ and the circle $k(M_a, B)$, construct a point H_b and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_a, B)$ intersect % DET: circles $k(N, M_a)$ and $k(M_a, B)$ are not the same;

10. Using the point B and the point H_b, construct a line h_b (rule W02); % DET: points B and H_b are not the same;

11. Using the line h_a and the line h_b, construct a point H (rule W03); % NDG: lines h_a and h_b are not parallel % DET: lines h_a and h_b are not the same;

12. Using the point N and the point H, construct a point G (rule W01); ;

13. Using the point M_a and the point G, construct a point A (rule W01); .

Non-degenerate conditions: lines h_a and h_b are not parallel; circles $k(N, M_a)$ and $k(M_a, B)$ intersect; points B and M_a are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; line a and circle $k(N, M_a)$ intersect; points H_a and N are not the same.

Determination conditions: lines h_a and h_b are not the same; points B and H_b are not the same; circles $k(N, M_a)$ and $k(M_a, B)$ are not the same; points E_a and H_a are not the same; points M_a and E_a must be different; points N and M_a are not the same; points H_a and M_a must be different; points B and H_a are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D21,D28,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L16,L19,L20,L21,L22,L38

Solving time: 4.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point H_{a} 80 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_r H_{a}
cmark_r N
color 0 0 0
fontsize 8

% DET: points B and H_{a} are not the same
% Constructing a line a which passes through point B and point H_{a}
line a B H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line a and circle k(N,M_{a}) intersect% DET: points H_{a} and M_{a} must be different
% Constructing a point P_{\_G184600} which is a foot of the point N on the line a
foot P_{\_G184600} N a
cmark_r P_{\_G184600}
color 200 200 200
drawline N P_{\_G184600}
color 0 0 0

% Constructing a point M_{a} which is an image of the point H_{a} in the symmetry to point/line P
    _{\_G184600}
sim M_{a} P_{\_G184600} H_{a}
cmark_r M_{a}



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points N and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point N and point M_{a}
line m(H_{b}H_{c}) N M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points B and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point B
circle k(M_{a},B) M_{a} B

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{a},B) intersect% DET: circles k(N,M_{a}) and k(M_{a},B) are not
    the same
% Constructing points H_{b} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{a},B)
intersec2 H_{b} H_{c} k(N,M_{a}) k(M_{a},B)
cmark_l H_{b}
cmark_rt H_{c}


% DET: points B and H_{b} are not the same
% Constructing a line h_{b} which passes through point B and point H_{b}
line h_{b} B H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines h_{a} and h_{b} are not parallel% DET: lines h_{a} and h_{b} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{b}
intersec H h_{a} h_{b}
cmark_rt H



% Constructing a line L_{\_G185398} which passes through point N and point H
line L_{\_G185398} N H

color 200 200 200
drawline L_{\_G185398}
color 0 0 0


% Constructing a point P_{\_G185499} with coordinates (0,0)
point P_{\_G185499} 0 0
cmark_r P_{\_G185499}

% Constructing a point P_{\_G185423} such that NP_{\_G185423}/NP_{\_G185499}=-1
towards P_{\_G185423} N P_{\_G185499} -1
cmark_r P_{\_G185423}
color 200 200 200
drawsegment P_{\_G185499} P_{\_G185423}
color 0 0 0

% Constructing a point P_{\_G185468} such that NP_{\_G185468}/NP_{\_G185499}=3
towards P_{\_G185468} N P_{\_G185499} 3
```

```
cmark_r P_{\_G185468}
color 200 200 200
drawsegment N P_{\_G185468}
color 0 0 0

% Constructing a line L_{\_G185429} which passes through point H and point P_{\_G185468}
line L_{\_G185429} H P_{\_G185468}

color 200 200 200
drawline L_{\_G185429}
color 0 0 0


% Constructing a line L_{\_G185392} which contains the point P_{\_G185423} and is parallel to the
    line L_{\_G185429}
parallel L_{\_G185392} P_{\_G185423} L_{\_G185429}

color 200 200 200
drawline L_{\_G185392}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G185392} and line L_{\_G185398}
intersec G L_{\_G185392} L_{\_G185398}
cmark_t G



% Constructing a point A such that M_{a}A/M_{a}G=3
towards A M_{a} G 3
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{b} are not parallel; circles k(N,M_{a}) and k(M_{a
    },B) intersect; points B and M_{a} are not the same; line m(H_{b}H_{c}) and circle k(N,M_{a})
    intersect; line a and circle k(N,M_{a}) intersect; points H_{a} and N are not the same
% Determination conditions: lines h_{a} and h_{b} are not the same; points B and H_{b} are not the
    same; circles k(N,M_{a}) and k(M_{a},B) are not the same; points E_{a} and H_{a} are not the
    same; points M_{a} and E_{a} must be different; points N and M_{a} are not the same; points H_{
    a} and M_{a} must be different; points B and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

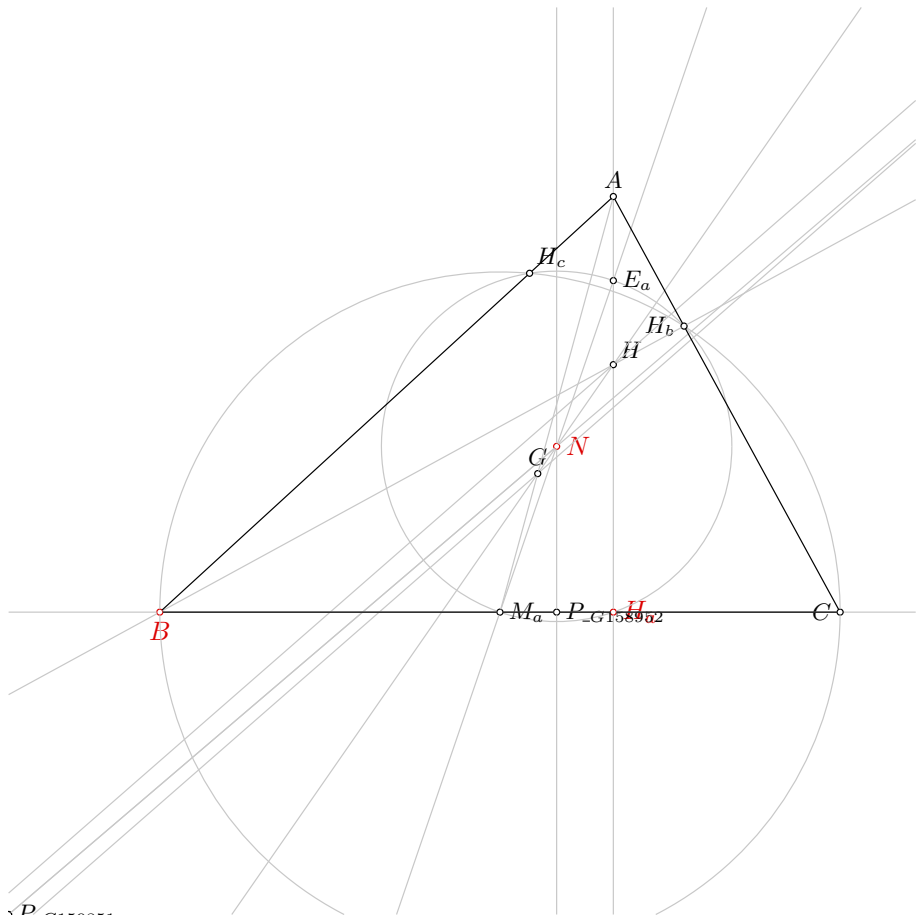

Figure 1: Illustration of the problem 0678

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.03 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H_a=$\_H_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 76 terms.

Time Complexity: Time spent by the prover is 0.741 seconds.

NDG conditions Points N and M_a are not identical

Line through points B and N is not perpendicular to line through points N and $P_{\_G176985}$

Line through points H_b and B is not parallel with line through points E_a and H_a

Points B, H_a and E_a are not collinear

Point B is not on circle with center H_a and point from it C

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{E_aBH_b} \neq S_{H_aBH_b}$ i.e., lines E_aH_a and BH_b are not parallel (construction based assumption)

$S_{P_{\_G161688}NH} \neq S_{P^0_{L_{\_G161657}}NH}$ i.e., lines $P_{\_G161688}P^0_{L_{\_G161657}}$ and NH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAF^1_{\_h_a}} \neq S_{CAF^1_{\_h_a}}$ i.e., lines BC and $AF^1_{\_h_a}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^1_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving H_a=$\_H_a$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $B{=}B$

Proving failed

4.3.2 Proving $H_a{=}\_H_a$

Proving failed

4.3.3 Proving $N{=}\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Proving failed

4.4.2 Proving $H_a{=}\_H_a$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 679

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 679: Given a point B, a point H_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point H_b, construct a line h_b (rule W02); % DET: points B and H_b are not the same;
2. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;
3. Using the circle $k(N, M_a)$, the line h_b, the point N and the point H_b, construct a point E_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points H_b and E_b must be different;
4. Using the point E_b and the point B, construct a point H (rule W01); ;
5. Using the point N and the point H, construct a point O (rule W01); ;
6. Using the point N and the point H, construct a point G (rule W01); ;
7. Using the point B and the point G, construct a point M_b (rule W01); ;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points H_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points H_b and E_b must be different; points B and H_b are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L16,L20,L23,L56]

Solving time: 3.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point H_{b} 89.36 77.83
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_l H_{b}
cmark_r N
color 0 0 0
fontsize 8

% DET: points B and H_{b} are not the same
% Constructing a line h_{b} which passes through point B and point H_{b}
line h_{b} B H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points H_{b} and E_{b} must be different
% Constructing a point P_{\_G218216} which is a foot of the point N on the line h_{b}
foot P_{\_G218216} N h_{b}
cmark_r P_{\_G218216}
color 200 200 200
drawline N P_{\_G218216}
color 0 0 0
```

```
% Constructing a point E_{b} which is an image of the point H_{b} in the symmetry to point/line P
    _{\_G218216}
sim E_{b} P_{\_G218216} H_{b}
cmark_r E_{b}



% Constructing a point H such that E_{b}H/E_{b}B=-1
towards H E_{b} B -1
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point O such that NO/NH=-1
towards O N H -1
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G218478} which passes through point N and point H
line L_{\_G218478} N H

color 200 200 200
drawline L_{\_G218478}
color 0 0 0


% Constructing a point P_{\_G218579} with coordinates (0,0)
point P_{\_G218579} 0 0
cmark_r P_{\_G218579}

% Constructing a point P_{\_G218503} such that NP_{\_G218503}/NP_{\_G218579}=-1
towards P_{\_G218503} N P_{\_G218579} -1
cmark_r P_{\_G218503}
color 200 200 200
drawsegment P_{\_G218579} P_{\_G218503}
color 0 0 0

% Constructing a point P_{\_G218548} such that NP_{\_G218548}/NP_{\_G218579}=3
towards P_{\_G218548} N P_{\_G218579} 3
cmark_r P_{\_G218548}
color 200 200 200
drawsegment N P_{\_G218548}
color 0 0 0

% Constructing a line L_{\_G218509} which passes through point H and point P_{\_G218548}
line L_{\_G218509} H P_{\_G218548}

color 200 200 200
drawline L_{\_G218509}
```

```
color 0 0 0


% Constructing a line L_{\_G218472} which contains the point P_{\_G218503} and is parallel to the
    line L_{\_G218509}
parallel L_{\_G218472} P_{\_G218503} L_{\_G218509}

color 200 200 200
drawline L_{\_G218472}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G218472} and line L_{\_G218478}
intersec G L_{\_G218472} L_{\_G218478}
cmark_t G



% Constructing a point M_{b} such that BM_{b}/BG=1.5
towards M_{b} B G 1.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
```

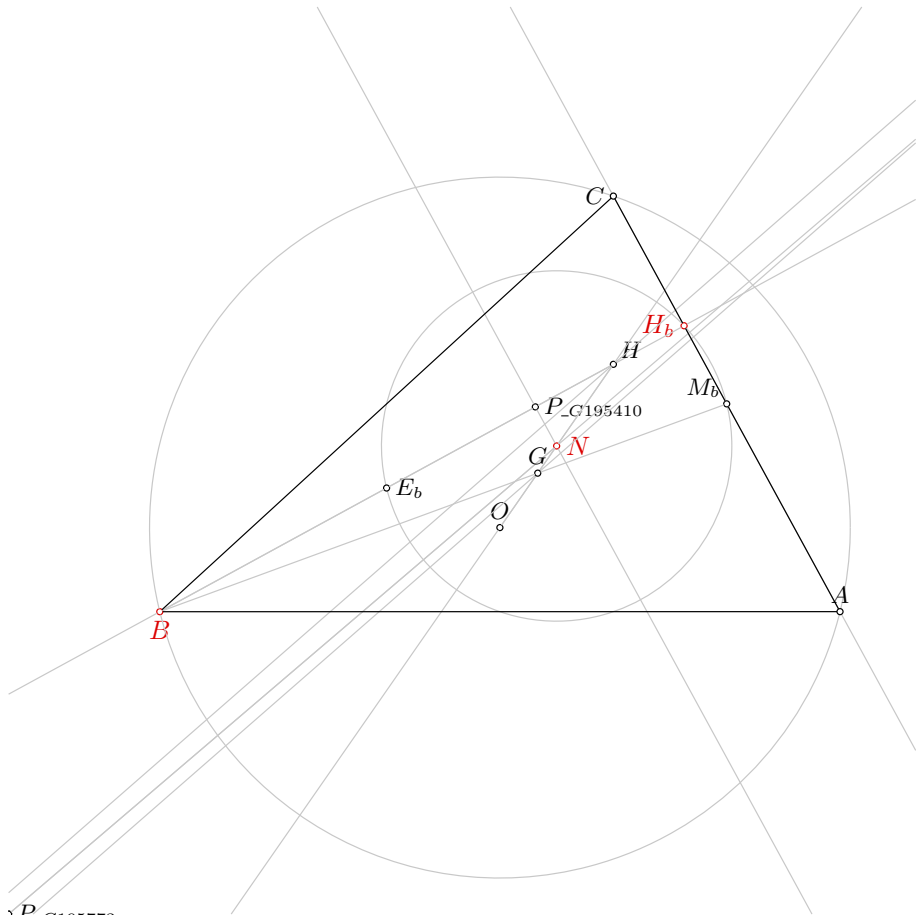

Figure 1: Illustration of the problem 0679

```
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points H_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points H_{b} and E_{b} must be
     different; points B and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H_b=$\_H_b$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{P\_G197147NH} \neq S_{P^0_{L\_G197116}NH}$ i.e., lines $P\_G197147P^0_{L\_G197116}$ and NH are not parallel (construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^4_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^4_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving H_b=$\_H_b$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Proving failed

4.3.2 Proving H_b=$\_H_b$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 680

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 680: Given a point B, a point H_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point H_c, construct a line c (rule W02); % DET: points B and H_c are not the same;

2. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;

3. Using the circle $k(N, M_a)$, the line c, the point N and the point H_c, construct a point M_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points H_c and M_c must be different;

4. Using the point M_c and the point B, construct a point A (rule W01); ;

5. Using the point N and the point M_c, construct a line $m(H_aH_b)$ (rule W02); % DET: points N and M_c are not the same;

6. Using the circle $k(N, M_a)$, the line $m(H_aH_b)$, the point N and the point M_c, construct a point E_c (rule W05a); % NDG: line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect % DET: points M_c and E_c must be different;

7. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;

8. Using the point B and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points B and M_c are not the same;

9. Using the circle $k(N, M_a)$ and the circle $k(M_c, A)$, construct a point H_a and a point H_b (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_c, A)$ intersect % DET: circles $k(N, M_a)$ and $k(M_c, A)$ are not the same;

10. Using the point B and the point H_a, construct a line a (rule W02); % DET: points B and H_a are not the same;

11. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; circles $k(N, M_a)$ and $k(M_c, A)$ intersect; points B and M_c are not the same; line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect; line c and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: lines h_c and a are not the same; points B and H_a are not the same; circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points E_c and H_c are not the same; points M_c and E_c must be different; points N and M_c are not the same; points H_c and M_c must be different; points B and H_c are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D10,D20,D30,D32,D5,D7,GD01,GD02,GL01,GL03,GL04,GL09,L18,L19,L20,L21,L24,L3,L40,L

Solving time: 4.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point H_{c} 68.91 84.83
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_rt H_{c}
cmark_r N
color 0 0 0
fontsize 8

% DET: points B and H_{c} are not the same
% Constructing a line c which passes through point B and point H_{c}
line c B H_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% NDG: line c and circle k(N,M_{a}) intersect% DET: points H_{c} and M_{c} must be different
% Constructing a point P_{\_G252842} which is a foot of the point N on the line c
foot P_{\_G252842} N c
cmark_r P_{\_G252842}
color 200 200 200
drawline N P_{\_G252842}
color 0 0 0

% Constructing a point M_{c} which is an image of the point H_{c} in the symmetry to point/line P
    _{\_G252842}
sim M_{c} P_{\_G252842} H_{c}
cmark_lt M_{c}



% Constructing a point A such that M_{c}A/M_{c}B=-1
towards A M_{c} B -1
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points N and M_{c} are not the same
% Constructing a line m(H_{a}H_{b}) which passes through point N and point M_{c}
line m(H_{a}H_{b}) N M_{c}

color 200 200 200
drawline m(H_{a}H_{b})
color 0 0 0



% NDG: line m(H_{a}H_{b}) and circle k(N,M_{a}) intersect% DET: points M_{c} and E_{c} must be
    different
% Constructing a point E_{c} which is an image of the point M_{c} in the symmetry to point/line N
sim E_{c} N M_{c}
cmark_r E_{c}


% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points B and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point B
circle k(M_{c},A) M_{c} B
```

```
color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{c},A) intersect% DET: circles k(N,M_{a}) and k(M_{c},A) are not
    the same
% Constructing points H_{a} and H_{b} which are in intersection of k(N,M_{a}) and k(M_{c},A)
intersec2 H_{a} H_{b} k(N,M_{a}) k(M_{c},A)
cmark_r H_{a}
cmark_l H_{b}


% DET: points B and H_{a} are not the same
% Constructing a line a which passes through point B and point H_{a}
line a B H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; circles k(N,M_{a}) and k(M_{c},A)
    intersect; points B and M_{c} are not the same; line m(H_{a}H_{b}) and circle k(N,M_{a})
    intersect; line c and circle k(N,M_{a}) intersect; points H_{c} and N are not the same
% Determination conditions: lines h_{c} and a are not the same; points B and H_{a} are not the same
    ; circles k(N,M_{a}) and k(M_{c},A) are not the same; points E_{c} and H_{c} are not the same;
    points M_{c} and E_{c} must be different; points N and M_{c} are not the same; points H_{c} and
     M_{c} must be different; points B and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving $B{=}B$

Status: Theorem has been proved.

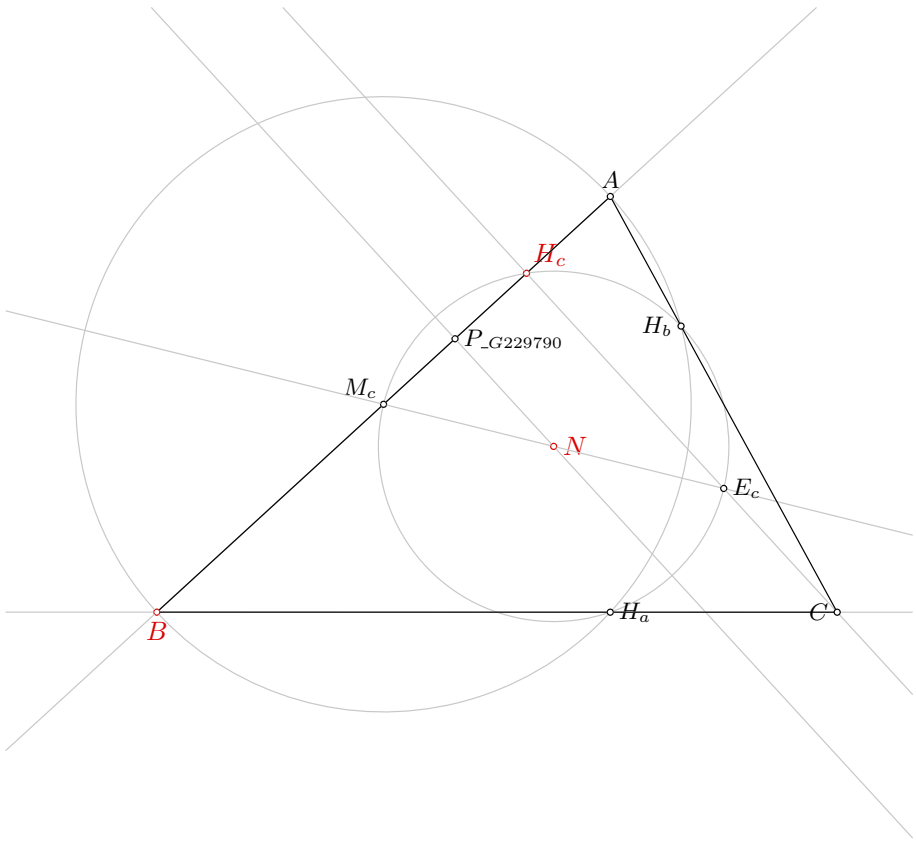

Figure 1: Illustration of the problem 0680

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H_c=$\_H_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 18 terms.

Time Complexity: Time spent by the prover is 0.345 seconds.

NDG conditions Points M_c and N are not identical

Line through points B and $P_{\_G245242}$ is not perpendicular to line through points $P_{\_G245242}$ and M_c

Line through points E_c and H_c is not parallel with line through points B and H_a

Points A, E_c and M_c are not collinear

Points A and B are not identical

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{E_cBH_a} \neq S_{H_cBH_a}$ i.e., lines E_cH_c and BH_a are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^0_{\_h_c}} \neq S_{BCF^0_{\_h_c}}$ i.e., lines AB and $CF^0_{\_h_c}$ are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving H_c=$\_H_c$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Proving failed

4.3.2 Proving H_c=$\_H_c$

Proving failed

4.3.3 Proving $N{=}\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Proving failed

4.4.2 Proving $H_c{=}\_H_c$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 681

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 681: Given a point B, a point I and a point N, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 682

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 682: Given a point B, a point M_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point M_a, construct a point C (rule W01); ;
2. Using the point B and the point M_a, construct a line a (rule W02); % DET: points B and M_a are not the same;
3. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;
4. Using the point B and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points B and M_a are not the same;
5. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
6. Using the circle $k(N, M_a)$, the line a, the point N and the point M_a, construct a point H_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points M_a and H_a must be different;
7. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;
8. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
9. Using the circle $k(M_a, B)$ and the circle $k(N, M_a)$, construct a point H_b and a point H_c (rule W07); % NDG: circles $k(M_a, B)$ and $k(N, M_a)$ intersect % DET: circles $k(M_a, B)$ and $k(N, M_a)$ are not the same;

10. Using the point B and the point H_b, construct a line h_b (rule W02); % DET: points B and H_b are not the same;

11. Using the line h_a and the line h_b, construct a point H (rule W03); % NDG: lines h_a and h_b are not parallel % DET: lines h_a and h_b are not the same;

12. Using the point N and the point H, construct a point G (rule W01); ;

13. Using the point M_a and the point G, construct a point A (rule W01); .

Non-degenerate conditions: lines h_a and h_b are not parallel; circles $k(M_a, B)$ and $k(N, M_a)$ intersect; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; line a and circle $k(N, M_a)$ intersect; points M_a and N are not the same; points B and M_a are not the same.

Determination conditions: lines h_a and h_b are not the same; points B and H_b are not the same; circles $k(M_a, B)$ and $k(N, M_a)$ are not the same; points E_a and H_a are not the same; points M_a and E_a must be different; points M_a and H_a must be different; points M_a and N are not the same; points B and M_a are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D21,D28,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L16,L19,L20,L21,L22,L38

Solving time: 5.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point M_{a} 65 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_r M_{a}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point C such that BC/BM_{a}=2
towards C B M_{a} 2
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points B and M_{a} are not the same
% Constructing a line a which passes through point B and point M_{a}
line a B M_{a}

color 200 200 200
```

```
drawline a
color 0 0 0



% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points B and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point B
circle k(M_{a},B) M_{a} B

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line a and circle k(N,M_{a}) intersect% DET: points M_{a} and H_{a} must be different
% Constructing a point P_{\_G43394} which is a foot of the point N on the line a
foot P_{\_G43394} N a
cmark_r P_{\_G43394}
color 200 200 200
drawline N P_{\_G43394}
color 0 0 0

% Constructing a point H_{a} which is an image of the point M_{a} in the symmetry to point/line P
    _{\_G43394}
sim H_{a} P_{\_G43394} M_{a}
cmark_r H_{a}


% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}
```

```
% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: circles k(M_{a},B) and k(N,M_{a}) intersect% DET: circles k(M_{a},B) and k(N,M_{a}) are not
    the same
% Constructing points H_{b} and H_{c} which are in intersection of k(M_{a},B) and k(N,M_{a})
intersec2 H_{b} H_{c} k(M_{a},B) k(N,M_{a})
cmark_l H_{b}
cmark_rt H_{c}


% DET: points B and H_{b} are not the same
% Constructing a line h_{b} which passes through point B and point H_{b}
line h_{b} B H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines h_{a} and h_{b} are not parallel% DET: lines h_{a} and h_{b} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{b}
intersec H h_{a} h_{b}
cmark_rt H



% Constructing a line L_{\_G43896} which passes through point N and point H
line L_{\_G43896} N H

color 200 200 200
drawline L_{\_G43896}
color 0 0 0


% Constructing a point P_{\_G43997} with coordinates (0,0)
point P_{\_G43997} 0 0
cmark_r P_{\_G43997}

% Constructing a point P_{\_G43921} such that NP_{\_G43921}/NP_{\_G43997}=-1
towards P_{\_G43921} N P_{\_G43997} -1
cmark_r P_{\_G43921}
color 200 200 200
drawsegment P_{\_G43997} P_{\_G43921}
color 0 0 0

% Constructing a point P_{\_G43966} such that NP_{\_G43966}/NP_{\_G43997}=3
towards P_{\_G43966} N P_{\_G43997} 3
```

```
cmark_r P_{\_G43966}
color 200 200 200
drawsegment N P_{\_G43966}
color 0 0 0

% Constructing a line L_{\_G43927} which passes through point H and point P_{\_G43966}
line L_{\_G43927} H P_{\_G43966}

color 200 200 200
drawline L_{\_G43927}
color 0 0 0


% Constructing a line L_{\_G43890} which contains the point P_{\_G43921} and is parallel to the
    line L_{\_G43927}
parallel L_{\_G43890} P_{\_G43921} L_{\_G43927}

color 200 200 200
drawline L_{\_G43890}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G43890} and line L_{\_G43896}
intersec G L_{\_G43890} L_{\_G43896}
cmark_t G



% Constructing a point A such that M_{a}A/M_{a}G=3
towards A M_{a} G 3
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{b} are not parallel; circles k(M_{a},B) and k(N,M_{
    a}) intersect; line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect; line a and circle k(N,M_{a})
     intersect; points M_{a} and N are not the same; points B and M_{a} are not the same
% Determination conditions: lines h_{a} and h_{b} are not the same; points B and H_{b} are not the
    same; circles k(M_{a},B) and k(N,M_{a}) are not the same; points E_{a} and H_{a} are not the
    same; points M_{a} and E_{a} must be different; points M_{a} and H_{a} must be different;
    points M_{a} and N are not the same; points B and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

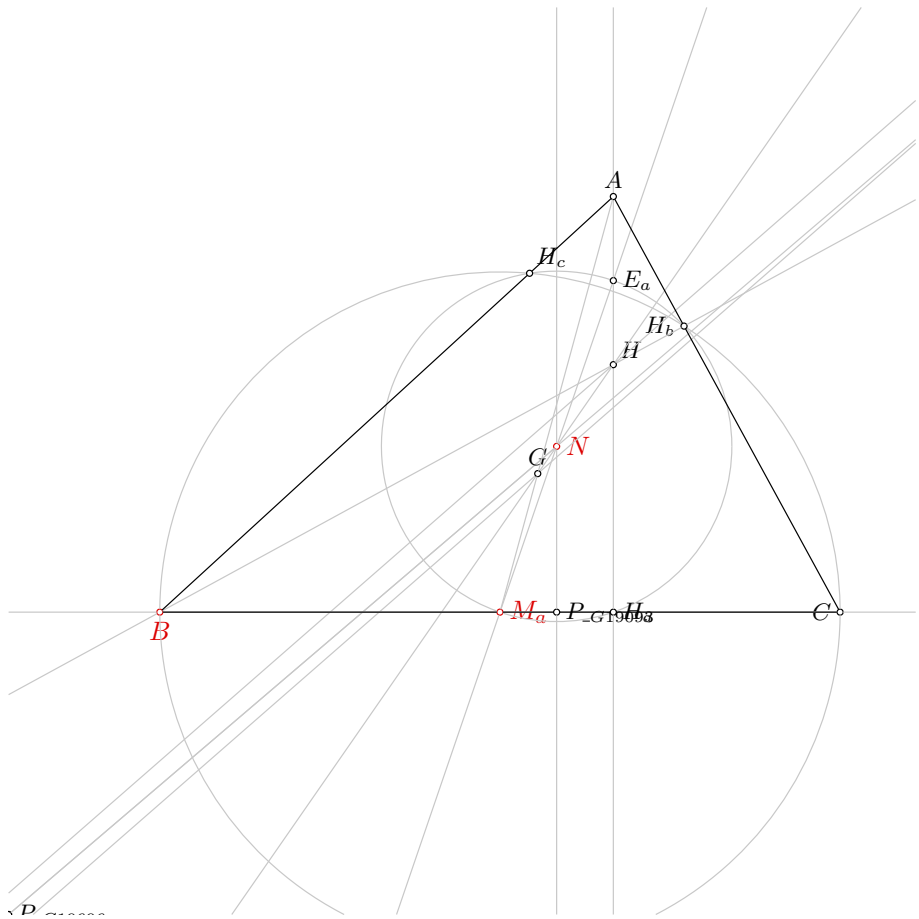

Figure 1: Illustration of the problem 0682

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving $B{=}B$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving $M_a{=}\_M_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.037 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving $N{=}\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving $B{=}B$

NDG conditions are:

$S_{E_aBH_b} \neq S_{H_aBH_b}$ i.e., lines E_aH_a and BH_b are not parallel (construction based assumption)

$S_{P_{\_G21533}NH} \neq S_{P^0_{L_{\_G21502}}NH}$ i.e., lines $P_{\_G21533}P^0_{L_{\_G21502}}$ and NH are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving $M_a{=}\_M_a$

Proving failed

4.2.3 Proving $N{=}\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 18 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 683

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 683: Given a point B, a point M_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point M_b, construct a point G (rule W01); ;
2. Using the point N and the point G, construct a point O (rule W01); ;
3. Using the point N and the point G, construct a point H (rule W01); ;
4. Using the point B and the point H, construct a point E_b (rule W01); ;
5. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
6. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
7. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
9. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; line h_b and circle $k(N, M_a)$ intersect; points M_b and N are not the same; points B and O are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points B and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L17,L20,L23,L56]

Solving time: 8.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point M_{b} 95 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_lt M_{b}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a line L_{\_G76710} which passes through point B and point M_{b}
line L_{\_G76710} B M_{b}

color 200 200 200
drawline L_{\_G76710}
color 0 0 0


% Constructing a point P_{\_G76811} with coordinates (0,0)
point P_{\_G76811} 0 0
cmark_r P_{\_G76811}

% Constructing a point P_{\_G76735} such that BP_{\_G76735}/BP_{\_G76811}=2
towards P_{\_G76735} B P_{\_G76811} 2
cmark_r P_{\_G76735}
color 200 200 200
drawsegment B P_{\_G76735}
color 0 0 0

% Constructing a point P_{\_G76780} such that BP_{\_G76780}/BP_{\_G76811}=3
towards P_{\_G76780} B P_{\_G76811} 3
cmark_r P_{\_G76780}
color 200 200 200
drawsegment B P_{\_G76780}
color 0 0 0

% Constructing a line L_{\_G76741} which passes through point M_{b} and point P_{\_G76780}
line L_{\_G76741} M_{b} P_{\_G76780}
```

```
color 200 200 200
drawline L_{\_G76741}
color 0 0 0


% Constructing a line L_{\_G76704} which contains the point P_{\_G76735} and is parallel to the
    line L_{\_G76741}
parallel L_{\_G76704} P_{\_G76735} L_{\_G76741}

color 200 200 200
drawline L_{\_G76704}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G76704} and line L_{\_G76710}
intersec G L_{\_G76704} L_{\_G76710}
cmark_t G



% Constructing a point O such that NO/NG=3
towards O N G 3
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0



% Constructing a point H such that NH/NG=-3
towards H N G -3
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point E_{b} such that BE_{b}/BH=0.5
towards E_{b} B H 0.5
cmark_r E_{b}
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G77846} which is a foot of the point N on the line h_{b}
foot P_{\_G77846} N h_{b}
cmark_r P_{\_G77846}
color 200 200 200
drawline N P_{\_G77846}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G77846}
sim H_{b} P_{\_G77846} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

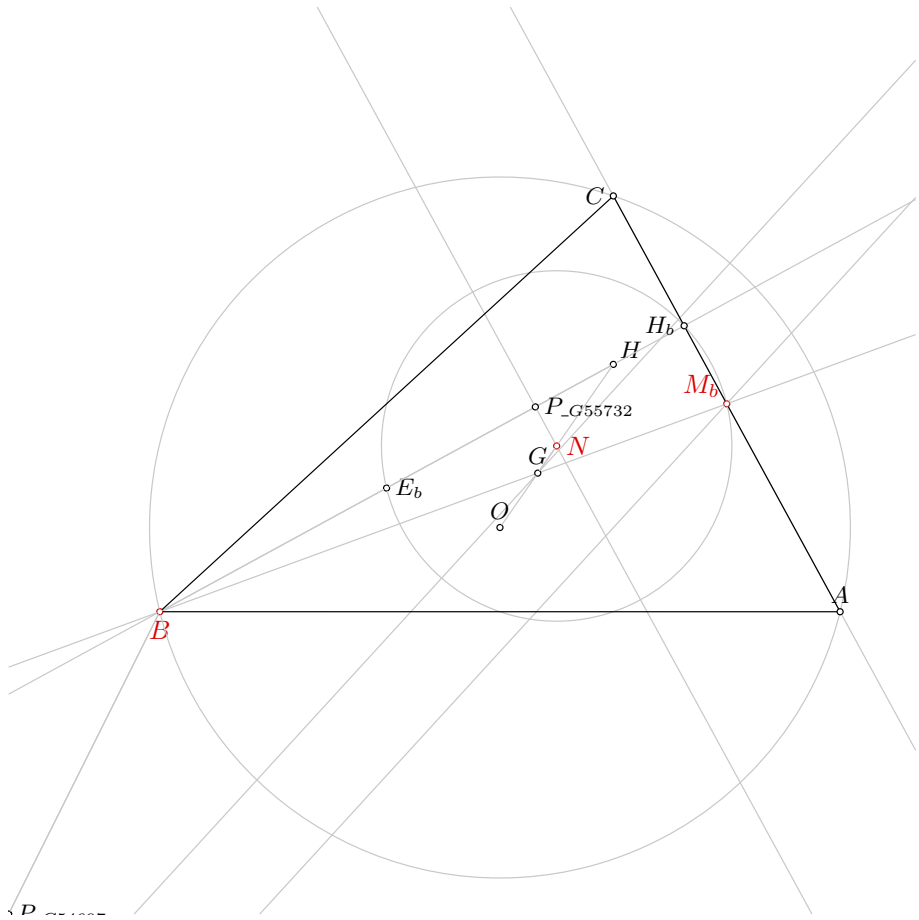

Figure 1: Illustration of the problem 0683

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; line h_{b} and circle k(N,M_{a})
    intersect; points M_{b} and N are not the same; points B and O are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points B and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving M_b=$\_M_b$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{P_{\_G56060}BM_b} \neq S_{P^0_{L_{\_G56029}}BM_b}$ i.e., lines $P_{\_G56060}P^0_{L_{\_G56029}}$ and BM_b are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving M_b=$\_M_b$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving M_b=$\_M_b$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $M_b{=}\_M_b$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 684

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 684: Given a point B, a point M_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point B and the point M_c, construct a point A (rule W01); ;
2. Using the point B and the point M_c, construct a line c (rule W02); % DET: points B and M_c are not the same;
3. Using the point M_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points M_c and N are not the same;
4. Using the point B and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points B and M_c are not the same;
5. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
6. Using the circle $k(N, M_a)$, the line c, the point N and the point M_c, construct a point H_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points M_c and H_c must be different;
7. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point M_c, construct a point E_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points M_c and E_c must be different;
8. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
9. Using the circle $k(M_c, A)$ and the circle $k(N, M_a)$, construct a point H_b and a point H_a (rule W07); % NDG: circles $k(M_c, A)$ and $k(N, M_a)$ intersect % DET: circles $k(M_c, A)$ and $k(N, M_a)$ are not the same;

10. Using the point B and the point H_b, construct a line h_b (rule W02); % DET: points B and H_b are not the same;

11. Using the line h_c and the line h_b, construct a point H (rule W03); % NDG: lines h_c and h_b are not parallel % DET: lines h_c and h_b are not the same;

12. Using the point N and the point H, construct a point G (rule W01); ;

13. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: lines h_c and h_b are not parallel; circles $k(M_c, A)$ and $k(N, M_a)$ intersect; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; line c and circle $k(N, M_a)$ intersect; points M_c and N are not the same; points B and M_c are not the same.

Determination conditions: lines h_c and h_b are not the same; points B and H_b are not the same; circles $k(M_c, A)$ and $k(N, M_a)$ are not the same; points E_c and H_c are not the same; points M_c and E_c must be different; points M_c and H_c must be different; points M_c and N are not the same; points B and M_c are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D10,D20,D3,D30,D32,D6,D7,D9,GD01,GD02,GL01,GL03,GL04,GL09,L16,L18,L19,L20,L21,L2

Solving time: 5.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point M_{c} 50 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_b B
cmark_lt M_{c}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point A such that BA/BM_{c}=2
towards A B M_{c} 2
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points B and M_{c} are not the same
% Constructing a line c which passes through point B and point M_{c}
line c B M_{c}

color 200 200 200
```

```
drawline c
color 0 0 0



% DET: points M_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point M_{c} and point N
line m(H_{b}H_{a}) M_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: points B and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point B
circle k(M_{c},A) M_{c} B

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line c and circle k(N,M_{a}) intersect% DET: points M_{c} and H_{c} must be different
% Constructing a point P_{\_G115370} which is a foot of the point N on the line c
foot P_{\_G115370} N c
cmark_r P_{\_G115370}
color 200 200 200
drawline N P_{\_G115370}
color 0 0 0

% Constructing a point H_{c} which is an image of the point M_{c} in the symmetry to point/line P
    _{\_G115370}
sim H_{c} P_{\_G115370} M_{c}
cmark_rt H_{c}


% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points M_{c} and E_{c} must be
    different
% Constructing a point E_{c} which is an image of the point M_{c} in the symmetry to point/line N
sim E_{c} N M_{c}
cmark_r E_{c}
```

```
% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: circles k(M_{c},A) and k(N,M_{a}) intersect% DET: circles k(M_{c},A) and k(N,M_{a}) are not
    the same
% Constructing points H_{b} and H_{a} which are in intersection of k(M_{c},A) and k(N,M_{a})
intersec2 H_{b} H_{a} k(M_{c},A) k(N,M_{a})
cmark_l H_{b}
cmark_r H_{a}


% DET: points B and H_{b} are not the same
% Constructing a line h_{b} which passes through point B and point H_{b}
line h_{b} B H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines h_{c} and h_{b} are not parallel% DET: lines h_{c} and h_{b} are not the same
% Constructing a point H which belongs to line h_{c} and line h_{b}
intersec H h_{c} h_{b}
cmark_rt H



% Constructing a line L_{\_G115872} which passes through point N and point H
line L_{\_G115872} N H

color 200 200 200
drawline L_{\_G115872}
color 0 0 0


% Constructing a point P_{\_G115973} with coordinates (0,0)
point P_{\_G115973} 0 0
cmark_r P_{\_G115973}

% Constructing a point P_{\_G115897} such that NP_{\_G115897}/NP_{\_G115973}=-1
towards P_{\_G115897} N P_{\_G115973} -1
cmark_r P_{\_G115897}
color 200 200 200
drawsegment P_{\_G115973} P_{\_G115897}
color 0 0 0

% Constructing a point P_{\_G115942} such that NP_{\_G115942}/NP_{\_G115973}=3
towards P_{\_G115942} N P_{\_G115973} 3
```

```
cmark_r P_{\_G115942}
color 200 200 200
drawsegment N P_{\_G115942}
color 0 0 0

% Constructing a line L_{\_G115903} which passes through point H and point P_{\_G115942}
line L_{\_G115903} H P_{\_G115942}

color 200 200 200
drawline L_{\_G115903}
color 0 0 0


% Constructing a line L_{\_G115866} which contains the point P_{\_G115897} and is parallel to the
    line L_{\_G115903}
parallel L_{\_G115866} P_{\_G115897} L_{\_G115903}

color 200 200 200
drawline L_{\_G115866}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G115866} and line L_{\_G115872}
intersec G L_{\_G115866} L_{\_G115872}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and h_{b} are not parallel; circles k(M_{c},A) and k(N,M_{
    a}) intersect; line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect; line c and circle k(N,M_{a})
     intersect; points M_{c} and N are not the same; points B and M_{c} are not the same
% Determination conditions: lines h_{c} and h_{b} are not the same; points B and H_{b} are not the
    same; circles k(M_{c},A) and k(N,M_{a}) are not the same; points E_{c} and H_{c} are not the
    same; points M_{c} and E_{c} must be different; points M_{c} and H_{c} must be different;
    points M_{c} and N are not the same; points B and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

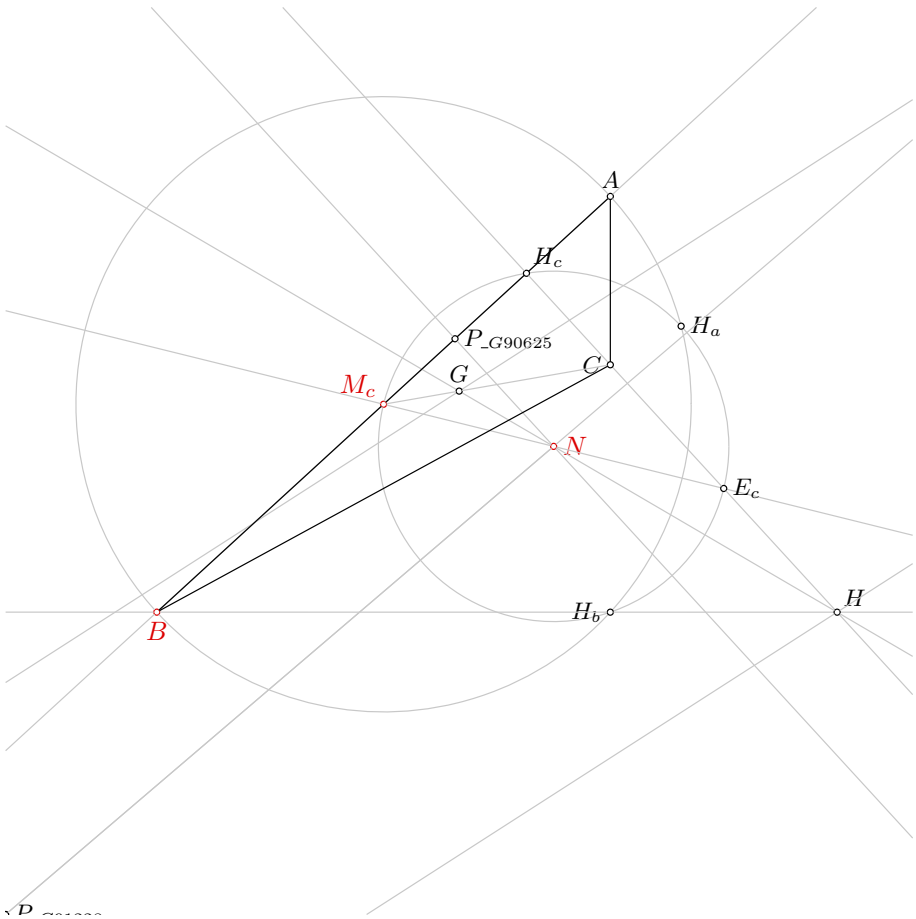

Figure 1: Illustration of the problem 0684

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.037 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{E_cBH_b} \neq S_{H_cBH_b}$ i.e., lines E_cH_c and BH_b are not parallel (construction based assumption)

$S_{P_{\_G93068}NH} \neq S_{P^0_{L_{\_G93037}}NH}$ i.e., lines $P_{\_G93068}P^0_{L_{\_G93037}}$ and NH are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving M_c=$\_M_c$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 18 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 685

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 685: Given a point B, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point B and the point G, construct a point M_b (rule W01); ;
3. Using the point N and the point O, construct a point H (rule W01); ;
4. Using the point B and the point H, construct a point E_b (rule W01); ;
5. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
6. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
7. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
9. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; line h_b and circle $k(N, M_a)$ intersect; points M_b and N are not the same; points B and O are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points B and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L15,L17,L20,L23,L56]

Solving time: 8.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point B 20 40
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_b B
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G153998} which passes through point N and point O
line L_{\_G153998} N O

color 200 200 200
drawline L_{\_G153998}
color 0 0 0


% Constructing a point P_{\_G154099} with coordinates (0,0)
point P_{\_G154099} 0 0
cmark_r P_{\_G154099}

% Constructing a point P_{\_G154023} such that NP_{\_G154023}/NP_{\_G154099}=1
towards P_{\_G154023} N P_{\_G154099} 1
cmark_r P_{\_G154023}
color 200 200 200
drawsegment N P_{\_G154023}
color 0 0 0

% Constructing a point P_{\_G154068} such that NP_{\_G154068}/NP_{\_G154099}=3
towards P_{\_G154068} N P_{\_G154099} 3
cmark_r P_{\_G154068}
color 200 200 200
drawsegment N P_{\_G154068}
color 0 0 0

% Constructing a line L_{\_G154029} which passes through point O and point P_{\_G154068}
line L_{\_G154029} O P_{\_G154068}
```

```
color 200 200 200
drawline L_{\_G154029}
color 0 0 0


% Constructing a line L_{\_G153992} which contains the point P_{\_G154023} and is parallel to the
    line L_{\_G154029}
parallel L_{\_G153992} P_{\_G154023} L_{\_G154029}

color 200 200 200
drawline L_{\_G153992}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G153992} and line L_{\_G153998}
intersec G L_{\_G153992} L_{\_G153998}
cmark_t G



% Constructing a point M_{b} such that BM_{b}/BG=1.5
towards M_{b} B G 1.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point E_{b} such that BE_{b}/BH=0.5
towards E_{b} B H 0.5
cmark_r E_{b}
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G155143} which is a foot of the point N on the line h_{b}
foot P_{\_G155143} N h_{b}
cmark_r P_{\_G155143}
color 200 200 200
drawline N P_{\_G155143}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G155143}
sim H_{b} P_{\_G155143} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

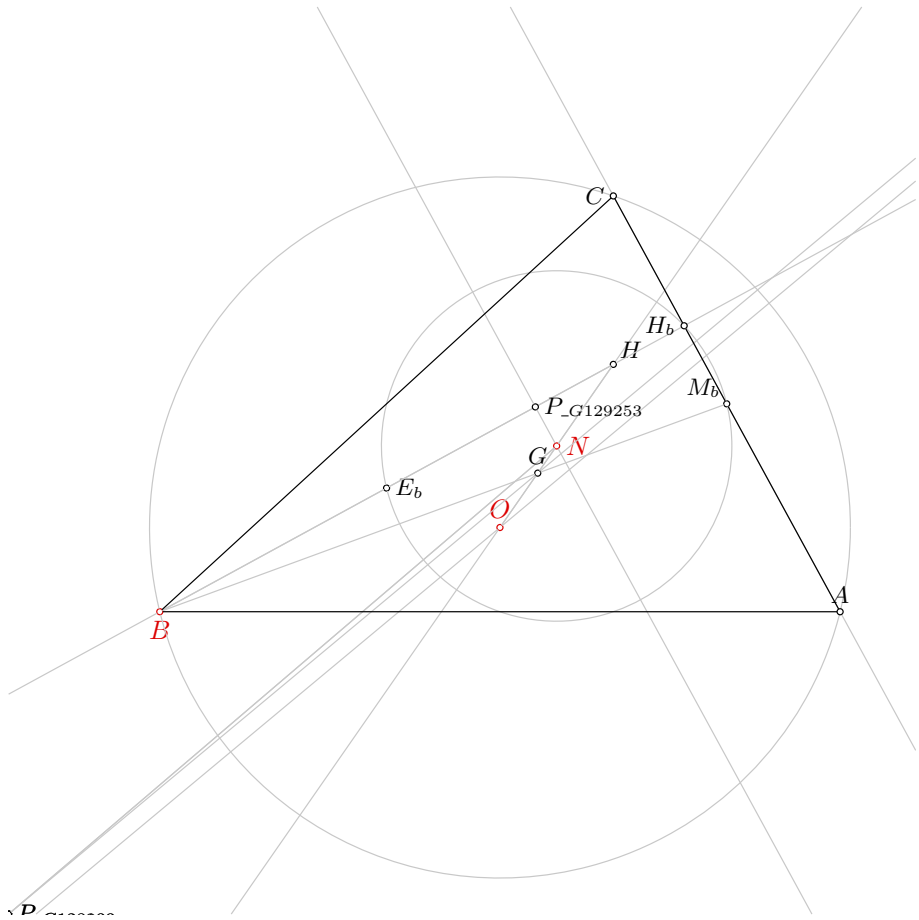

Figure 1: Illustration of the problem 0685

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; line h_{b} and circle k(N,M_{a})
    intersect; points M_{b} and N are not the same; points B and O are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points B and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving B=B

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving O=$\_O$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving B=B

NDG conditions are:

$S_{P\_G129581NO} \neq S_{P^0_{L\_G129550}NO}$ i.e., lines $P\_G129581P^0_{L\_G129550}$ and NO are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving B=B

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving O=$\_O$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $B{=}B$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4.2 Proving $N{=}\_N$

Proving failed

4.4.3 Proving $O{=}\_O$

Proving failed

Problem 686

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 686: Given a point B, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 687

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 687: Given a point B, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 688

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 688: Given a point B, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 689

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 689: Given a point C, a point E_a and a point E_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 690

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 690: Given a point C, a point E_a and a point E_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point E_c, construct a point H (rule W01); ;
2. Using the point E_a and the point H, construct a point A (rule W01); ;
3. Using the point C and the point A, construct a line b (rule W02); % DET: points C and A are not the same;
4. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
5. Using the point C and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points C and E_c are not the same;
6. Using the circle $k(E_c, C)$, the line b, the point E_c and the point C, construct a point H_b (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points C and H_b must be different;
7. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
8. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H and H_a must be different;
9. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
10. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; line h_a and circle $k(E_c, C)$ intersect; line b and circle $k(E_c, C)$ intersect; points C and E_c are not the same.

Determination conditions: lines h_b and a are not the same; points H_a and C are not the same; points H and H_a must be different; points H_b and H are not the same; points C and H_b must be different; points E_a and H are not the same; points C and A are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D28,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 11.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{a} 80 83.86
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{a}
cmark_r E_{c}
color 0 0 0
fontsize 8


% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0


% DET: points C and A are not the same
% Constructing a line b which passes through point C and point A
line b C A

color 200 200 200
drawline b
color 0 0 0
```

```
% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points C and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point C
circle k(E_{c},C) E_{c} C

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points C and H_{b} must be different
% Constructing a point P_{\_G194274} which is a foot of the point E_{c} on the line b
foot P_{\_G194274} E_{c} b
cmark_r P_{\_G194274}
color 200 200 200
drawline E_{c} P_{\_G194274}
color 0 0 0

% Constructing a point H_{b} which is an image of the point C in the symmetry to point/line P_{\_G
    194274}
sim H_{b} P_{\_G194274} C
cmark_l H_{b}


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G194512} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G194512} E_{c} h_{a}
cmark_r P_{\_G194512}
color 200 200 200
drawline E_{c} P_{\_G194512}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    194512}
sim H_{a} P_{\_G194512} H
cmark_r H_{a}
```

```
% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; line h_{a} and circle k(E_{c},C)
    intersect; line b and circle k(E_{c},C) intersect; points C and E_{c} are not the same
% Determination conditions: lines h_{b} and a are not the same; points H_{a} and C are not the same
    ; points H and H_{a} must be different; points H_{b} and H are not the same; points C and H_{b}
     must be different; points E_{a} and H are not the same; points C and A are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

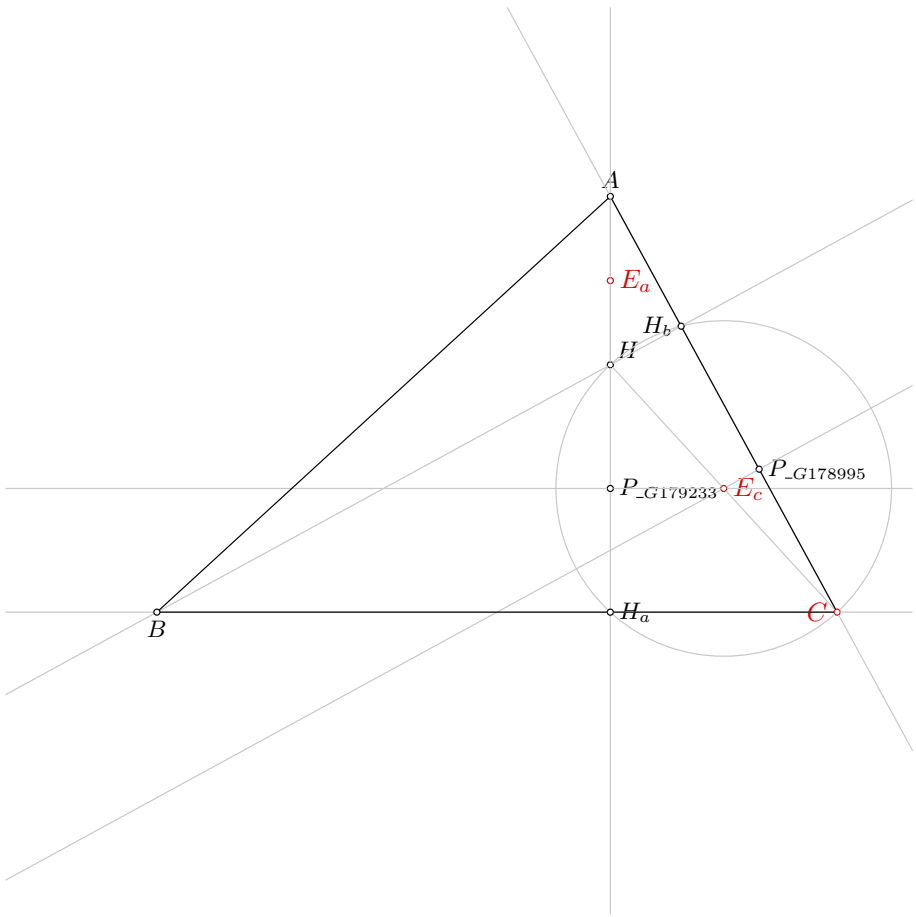

Figure 1: Illustration of the problem 0690

4.2 GCLC - Area method

4.2.1 Proving $C{=}C$

NDG conditions are:

$S_{H_bH_aC} \neq S_{HH_aC}$ i.e., lines H_bH and H_aC are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_a{=}\_E_a$

Proving failed

4.2.3 Proving $E_c{=}\_E_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_a{=}\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 1023 terms.

Time Complexity: Time spent by the prover is 6.570 seconds.There are no ndg conditions.

4.3.3 Proving $E_c{=}\_E_c$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 2819 terms.

Time Complexity: Time spent by the prover is 16.930 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving $E_c{=}\_E_c$

Proving failed

Problem 691

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 691: Given a point C, a point E_a and a point G, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 692

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 692: Given a point C, a point E_a and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point H, construct a point E_c (rule W01); ;
2. Using the point E_a and the point H, construct a point A (rule W01); ;
3. Using the point C and the point A, construct a line b (rule W02); % DET: points C and A are not the same;
4. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
5. Using the point C and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points C and E_c are not the same;
6. Using the circle $k(E_c, C)$, the line b, the point E_c and the point C, construct a point H_b (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points C and H_b must be different;
7. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
8. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H and H_a must be different;
9. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
10. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; line h_a and circle $k(E_c, C)$ intersect; line b and circle $k(E_c, C)$ intersect; points C and E_c are not the same.

Determination conditions: lines h_b and a are not the same; points H_a and C are not the same; points H and H_a must be different; points H_b and H are not the same; points C and H_b must be different; points E_a and H are not the same; points C and A are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D28,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 10.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{a} 80 83.86
point H 80 72.73

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{a}
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point E_{c} such that CE_{c}/CH=0.5
towards E_{c} C H 0.5
cmark_r E_{c}
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0


% DET: points C and A are not the same
% Constructing a line b which passes through point C and point A
line b C A

color 200 200 200
drawline b
color 0 0 0
```

```
% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points C and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point C
circle k(E_{c},C) E_{c} C

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points C and H_{b} must be different
% Constructing a point P_{\_G223752} which is a foot of the point E_{c} on the line b
foot P_{\_G223752} E_{c} b
cmark_r P_{\_G223752}
color 200 200 200
drawline E_{c} P_{\_G223752}
color 0 0 0

% Constructing a point H_{b} which is an image of the point C in the symmetry to point/line P_{\_G
    223752}
sim H_{b} P_{\_G223752} C
cmark_l H_{b}


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G223990} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G223990} E_{c} h_{a}
cmark_r P_{\_G223990}
color 200 200 200
drawline E_{c} P_{\_G223990}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    223990}
sim H_{a} P_{\_G223990} H
cmark_r H_{a}
```

```
% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; line h_{a} and circle k(E_{c},C)
    intersect; line b and circle k(E_{c},C) intersect; points C and E_{c} are not the same
% Determination conditions: lines h_{b} and a are not the same; points H_{a} and C are not the same
    ; points H and H_{a} must be different; points H_{b} and H are not the same; points C and H_{b}
     must be different; points E_{a} and H are not the same; points C and A are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving H=_H

Proving failed

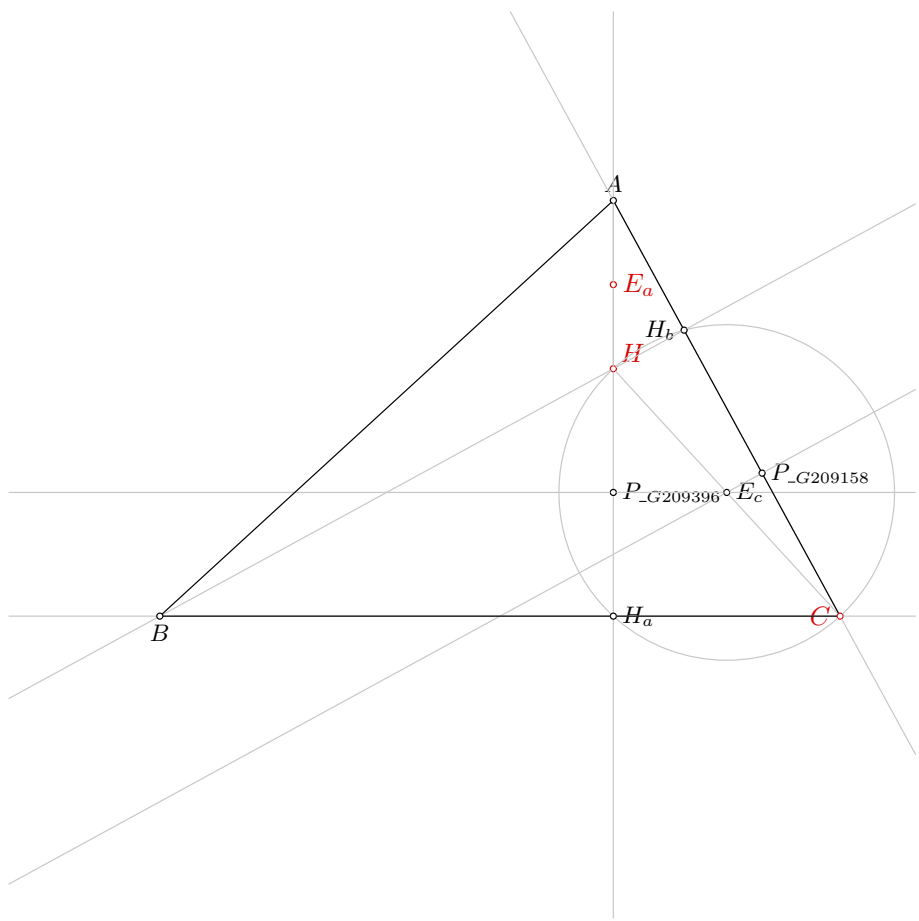

Figure 1: Illustration of the problem 0692

4.2 GCLC - Area method

4.2.1 Proving $C{=}C$

NDG conditions are:

$S_{H_bH_aC} \neq S_{HH_aC}$ i.e., lines H_bH and H_aC are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_a{=}\_E_a$

Proving failed

4.2.3 Proving $H{=}\_H$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving $E_a{=}\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 1023 terms.

Time Complexity: Time spent by the prover is 0.880 seconds.There are no ndg conditions.

4.3.3 Proving $H{=}\_H$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 182 terms.

Time Complexity: Time spent by the prover is 0.150 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving $H{=}\_H$

Proving failed

Problem 693

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 693: Given a point E_a, a point H_a and a point C, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Using the point H_a and the line h_a, construct a line a (rule W10a); ;
3. Choose freely a point C on the line a (rule WOnline2);
4. Choose freely a point A on the line h_a (rule WOnline1) ;
5. Using the point A and the point E_a, construct a point H (rule W01); ;
6. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
7. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
8. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
9. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
10. Using the line a and the line h_b, construct a point B (rule W03); % NDG: lines a and h_b are not parallel % DET: lines a and h_b are not the same.

Non-degenerate conditions: lines a and h_b are not parallel; line b and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines a and h_b are not the same; points H and H_b are not the same; points A and H_b must be different; points A and C are not the same; points E_a and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,WOnline1,WOnline2]

Lemmas used: [D28,D3,D5,D6,D8,D9,GD01,GD02,GL03,GL09,L47]

Solving time: 63.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{a} 80 40
point C 110 40

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r H_{a}
cmark_l C
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Constructing a line a which is perpendicular to line h_{a} and which passes through point H_{a}
perp a H_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0




% Generating random value V[_G247307]
random V[_G247307]


% Calculating value V[_G247328] using formula V[_G247307]*20
expression V[_G247328] { V[_G247307]*20 }
```

```
% Constructing a point C which is a point for which holds H_{a}C = V[_G247328] and angle E_{a}H_{a}
    C = 90
turtle C E_{a} H_{a} 90 V[_G247328]
cmark_l C



% Choosing randomly a point A on the line E_{a}H_{a}
online A E_{a} H_{a}
cmark_t A
color 200 200 200
drawline E_{a} H_{a}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G247848} which is a foot of the point E_{a} on the line b
foot P_{\_G247848} E_{a} b
cmark_r P_{\_G247848}
color 200 200 200
drawline E_{a} P_{\_G247848}
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    247848}
sim H_{b} P_{\_G247848} A
```

```
cmark_l H_{b}


% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines a and h_{b} are not parallel% DET: lines a and h_{b} are not the same
% Constructing a point B which belongs to line a and line h_{b}
intersec B a h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{b} are not parallel; line b and circle k(E_{a},A)
    intersect; points A and E_{a} are not the same
% Determination conditions: lines a and h_{b} are not the same; points H and H_{b} are not the same
    ; points A and H_{b} must be different; points A and C are not the same; points E_{a} and H_{a}
     are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 55 terms.

Time Complexity: Time spent by the prover is 0.976 seconds.

NDG conditions Points A and C are not identical

Points A and B are not identical

Line through points H_b and H_a is not perpendicular to line through points H_a and H

Line through points A and E_a is not parallel with line through points B and C

4.1.2 Proving H_a=_H_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

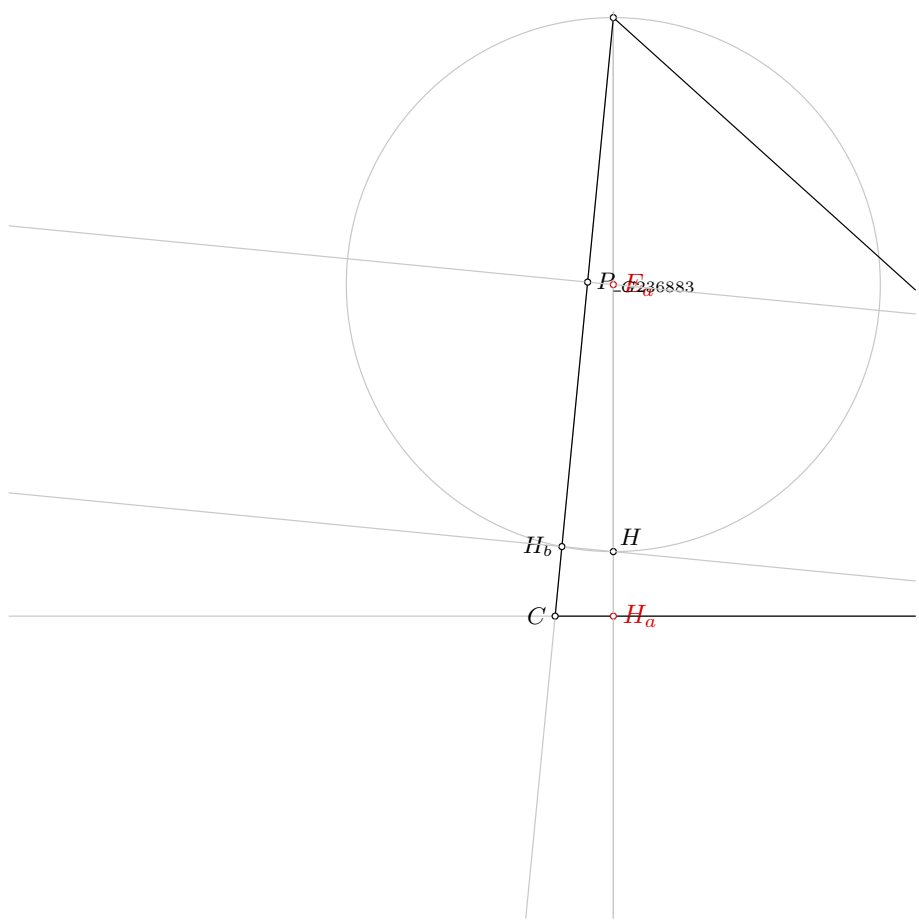

Figure 1: Illustration of the problem 0693

Time Complexity: Time spent by the prover is 0.136 seconds.

NDG conditions Points A and C are not identical

Points A and B are not identical

Line through points H_b and H_a is not perpendicular to line through points H_a and H

Line through points A and E_a is not parallel with line through points B and C

4.1.3 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.006 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving C=C

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving H_a=_H_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 16 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.3 Proving C=C

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 20 terms.

Time Complexity: Time spent by the prover is 0.060 seconds.There are no ndg conditions.

4.4.2 Proving H_a=_H_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 20 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.4.3 Proving C=C

Proving failed

Problem 694

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 694: Given a point C, a point E_a and a point H_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point H_b, construct a line b (rule W02); % DET: points C and H_b are not the same;
2. Using the point H_b and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_b and E_a are not the same;
3. Using the circle $k(E_a, A)$, the line b, the point E_a and the point H_b, construct a point A (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points H_b and A must be different;
4. Using the point E_a and the point A, construct a point H (rule W01); ;
5. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
6. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
7. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H and H_c must be different;
8. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;
9. Using the line h_b and the line c, construct a point B (rule W03); % NDG: lines h_b and c are not parallel % DET: lines h_b and c are not the same.

Non-degenerate conditions: lines h_b and c are not parallel; line h_c and circle $k(E_a, A)$ intersect; line b and circle $k(E_a, A)$ intersect; points H_b and E_a are not the same.

Determination conditions: lines h_b and c are not the same; points A and H_c are not the same; points H and H_c must be different; points H_b and H are not the same; points C and H are not the same; points H_b and A must be different; points C and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,L3,L46,L47,L48]

Solving time: 8.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{a} 80 83.86
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{a}
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points C and H_{b} are not the same
% Constructing a line b which passes through point C and point H_{b}
line b C H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points H_{b} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{b}
circle k(E_{a},A) E_{a} H_{b}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points H_{b} and A must be different
% Constructing a point P_{\_G22130} which is a foot of the point E_{a} on the line b
foot P_{\_G22130} E_{a} b
cmark_r P_{\_G22130}
color 200 200 200
drawline E_{a} P_{\_G22130}
color 0 0 0
```

```
% Constructing a point A which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    22130}
sim A P_{\_G22130} H_{b}
cmark_t A


% Constructing a point H such that E_{a}H/E_{a}A=-1
towards H E_{a} A -1
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0



% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G22493} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G22493} E_{a} h_{c}
cmark_r P_{\_G22493}
color 200 200 200
drawline E_{a} P_{\_G22493}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    22493}
sim H_{c} P_{\_G22493} H
cmark_rt H_{c}


% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
```

```
color 0 0 0



% NDG: lines h_{b} and c are not parallel% DET: lines h_{b} and c are not the same
% Constructing a point B which belongs to line h_{b} and line c
intersec B h_{b} c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and c are not parallel; line h_{c} and circle k(E_{a},A)
    intersect; line b and circle k(E_{a},A) intersect; points H_{b} and E_{a} are not the same
% Determination conditions: lines h_{b} and c are not the same; points A and H_{c} are not the same
    ; points H and H_{c} must be different; points H_{b} and H are not the same; points C and H are
     not the same; points H_{b} and A must be different; points C and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving H_b=_H_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 1176 terms.

Time Complexity: Time spent by the prover is 7.638 seconds.

NDG conditions Points H_b and C are not identical

Points H_b and C are not identical

Points C and H are not identical

Points C and H are not identical

Line through points H_b and H is not parallel with line through points A and H_c

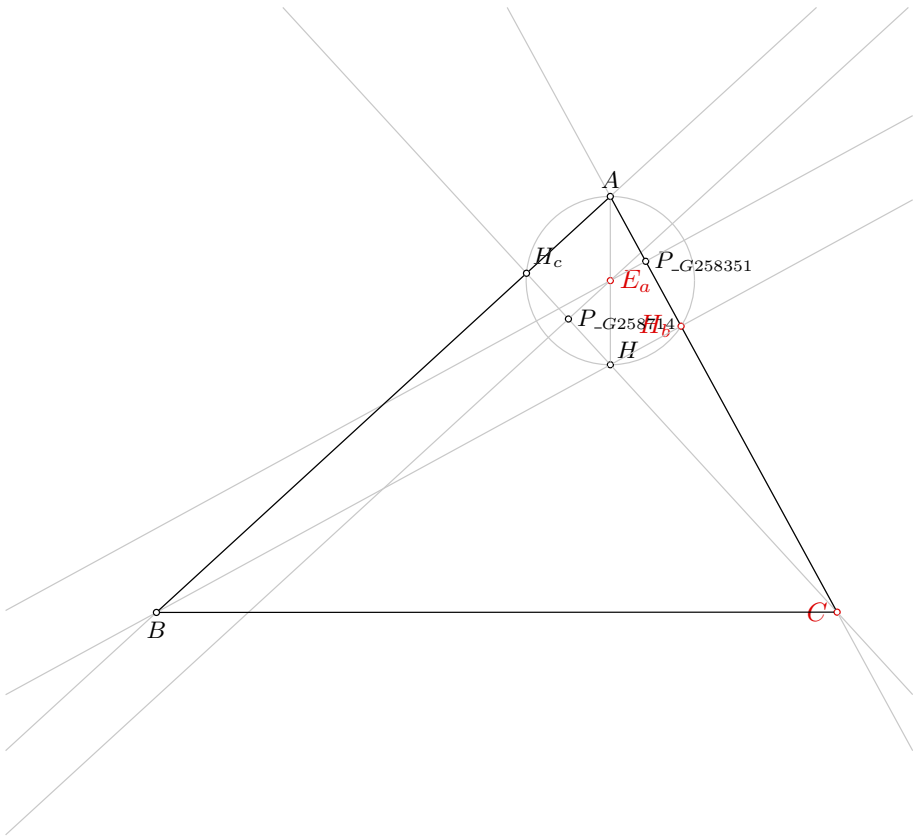

Figure 1: Illustration of the problem 0694

Line through points H_b and H is not parallel with line through points C and E_a

Points A and C are not identical

Points A and C are not identical

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{H_bAH_c} \neq S_{HAH_c}$ i.e., lines H_bH and AH_c are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving H_b=$\_H_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Proving failed

4.3.2 Proving E_a=$\_E_a$

Proving failed

4.3.3 Proving H_b=$\_H_b$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Proving failed

4.4.2 Proving E_a=$\_E_a$

Proving failed

4.4.3 Proving H_b=$\_H_b$

Proving failed

Problem 695

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 695: Given a point C, a point E_a and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point H_c, construct a line h_c (rule W02); % DET: points C and H_c are not the same;
2. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
3. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H_c, construct a point H (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H_c and H must be different;
4. Using the point E_a and the point H, construct a point A (rule W01); ;
5. Using the point C and the point A, construct a line b (rule W02); % DET: points C and A are not the same;
6. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
7. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
8. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
9. Using the line c and the line h_b, construct a point B (rule W03); % NDG: lines c and h_b are not parallel % DET: lines c and h_b are not the same.

Non-degenerate conditions: lines c and h_b are not parallel; line b and circle $k(E_a, A)$ intersect; line h_c and circle $k(E_a, A)$ intersect; points H_c and E_a are not the same.

Determination conditions: lines c and h_b are not the same; points H and H_b are not the same; points A and H_b must be different; points H_c and A are not the same; points C and A are not the same; points H_c and H must be different; points C and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,L3,L46,L47,L48]

Solving time: 8.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{a} 80 83.86
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{a}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points C and H_{c} are not the same
% Constructing a line h_{c} which passes through point C and point H_{c}
line h_{c} C H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H_{c} and H must be different
% Constructing a point P_{\_G45633} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G45633} E_{a} h_{c}
cmark_r P_{\_G45633}
color 200 200 200
drawline E_{a} P_{\_G45633}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    45633}
sim H P_{\_G45633} H_{c}
cmark_rt H


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0


% DET: points C and A are not the same
% Constructing a line b which passes through point C and point A
line b C A

color 200 200 200
drawline b
color 0 0 0



% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G45996} which is a foot of the point E_{a} on the line b
foot P_{\_G45996} E_{a} b
cmark_r P_{\_G45996}
color 200 200 200
drawline E_{a} P_{\_G45996}
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    45996}
sim H_{b} P_{\_G45996} A
cmark_l H_{b}


% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
```

```
color 0 0 0



% NDG: lines c and h_{b} are not parallel% DET: lines c and h_{b} are not the same
% Constructing a point B which belongs to line c and line h_{b}
intersec B c h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{b} are not parallel; line b and circle k(E_{a},A)
    intersect; line h_{c} and circle k(E_{a},A) intersect; points H_{c} and E_{a} are not the same
% Determination conditions: lines c and h_{b} are not the same; points H and H_{b} are not the same
    ; points A and H_{b} must be different; points H_{c} and A are not the same; points C and A are
     not the same; points H_{c} and H must be different; points C and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=$\_E_a$

Proving failed

4.1.3 Proving H_c=$\_H_c$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{H_cHH_b} \neq S_{AHH_b}$ i.e., lines H_cA and HH_b are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

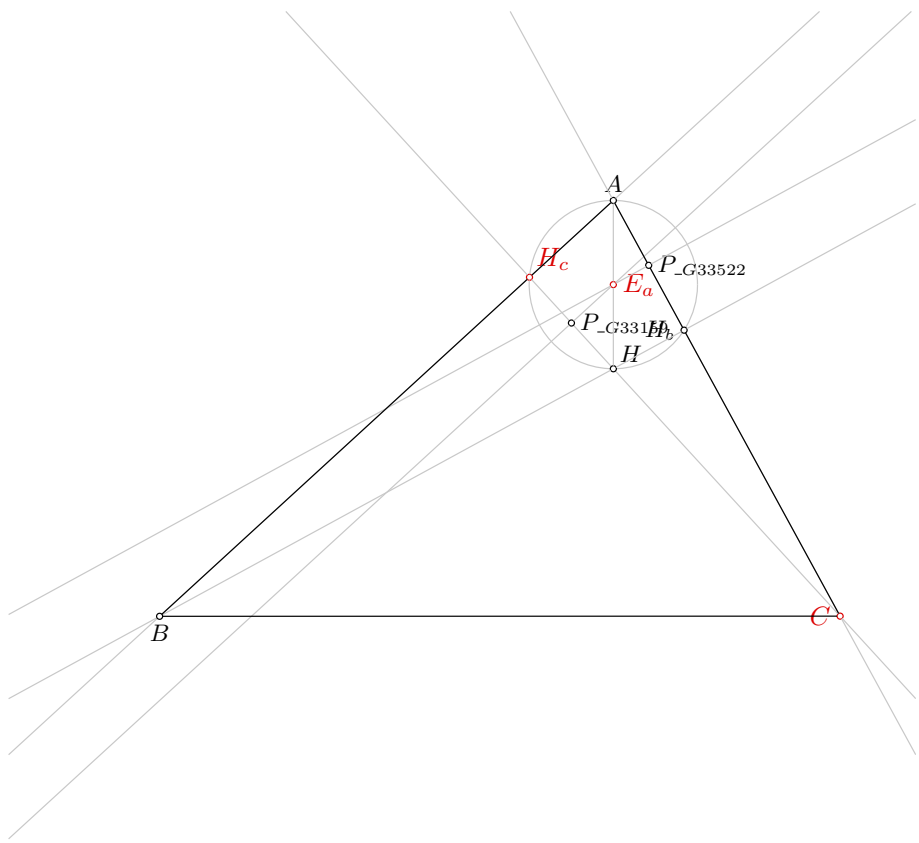

Figure 1: Illustration of the problem 0695

$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^2_{\_h_c}} \neq S_{BCF^2_{\_h_c}}$ i.e., lines AB and $CF^2_{\_h_c}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving H_c=$\_H_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Proving failed

4.3.2 Proving E_a=$\_E_a$

Proving failed

4.3.3 Proving H_c=$\_H_c$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Proving failed

4.4.2 Proving E_a=$\_E_a$

Proving failed

4.4.3 Proving H_c=$\_H_c$

Proving failed

Problem 696

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 696: Given a point C, a point E_a and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 697

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 697: Given a point C, a point E_a and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point M_a, construct a point B (rule W01); ;
2. Using the point C and the point M_a, construct a line a (rule W02); % DET: points C and M_a are not the same;
3. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
4. Using the point E_a and the line a, construct a line h_a (rule W10b); ;
5. Using the line h_a and the line a, construct a point H_a (rule W03); % NDG: lines h_a and a are not parallel % DET: lines h_a and a are not the same;
6. Using the point C and the point H_a, construct a line $m(CH_a)$ (rule W14); % DET: points C and H_a are not the same;
7. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;
8. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;
9. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
10. Using the circle $k(N, M_a)$ and the line $m(CH_a)$, construct a point M_b and a point E_c (rule W04); % NDG: line $m(CH_a)$ and circle $k(N, M_a)$ intersect;

11. Using the point M_b and the point C, construct a point A (rule W01); .

Non-degenerate conditions: line $m(CH_a)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel; lines h_a and a are not parallel.

Determination conditions: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points C and H_a are not the same; lines h_a and a are not the same; points E_a and M_a are not the same; points C and M_a are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14]

Lemmas used: [D21,D22,D28,D3,D32,D5,D8,GD01,GD02,GL01,GL03,GL04,GL09,L17,L20,L21,L22,L24,L38,L

Solving time: 2.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{a} 80 83.86
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{a}
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point B such that CB/CM_{a}=2
towards B C M_{a} 2
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0


% DET: points C and M_{a} are not the same
% Constructing a line a which passes through point C and point M_{a}
line a C M_{a}

color 200 200 200
drawline a
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
```

```
color 0 0 0



% Constructing a line h_{a} which is perpendicular to line a and which passes through point E_{a}
perp h_{a} E_{a} a

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{a} and a are not parallel% DET: lines h_{a} and a are not the same
% Constructing a point H_{a} which belongs to line h_{a} and line a
intersec H_{a} h_{a} a
cmark_r H_{a}


% DET: points C and H_{a} are not the same
% Constructing bisector m(CH_{a}) of the segment CH_{a}
med m(CH_{a}) C H_{a}

color 200 200 200
drawline m(CH_{a})
color 0 0 0

color 200 200 200
drawsegment C H_{a}
color 0 0 0


% DET: points E_{a} and M_{a} are not the same
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0


% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(CH_{a}) and circle k(N,M_{a}) intersect
% Constructing points M_{b} and E_{c} which are in intersection of k(N,M_{a}) and m(CH_{a})
intersec2 M_{b} E_{c} k(N,M_{a}) m(CH_{a})
cmark_lt M_{b}
cmark_r E_{c}



% Constructing a point A such that M_{b}A/M_{b}C=-1
towards A M_{b} C -1
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(CH_{a}) and circle k(N,M_{a}) intersect; points E_{a} and N are
     not the same; lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel; lines h_{a} and a are
    not parallel
% Determination conditions: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the same; points E_{a}
    and M_{a} are not the same; points C and H_{a} are not the same; lines h_{a} and a are not the
    same; points E_{a} and M_{a} are not the same; points C and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving $C{=}C$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving $E_a{=}\_E_a$

Proving failed

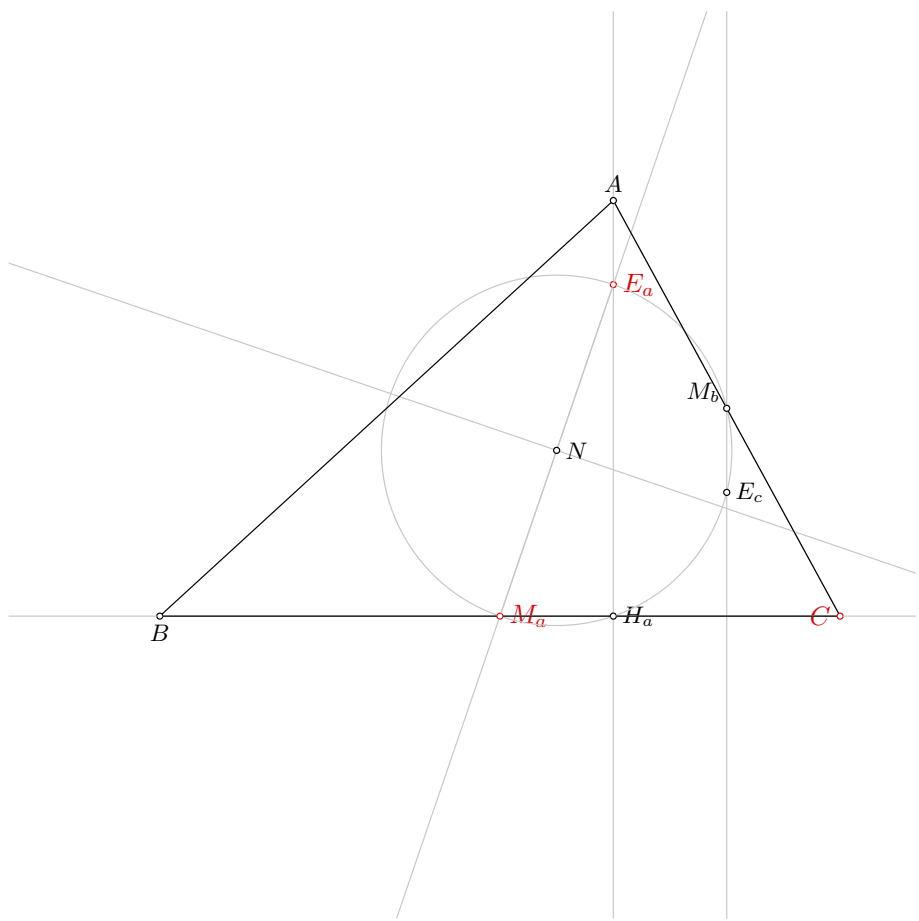

Figure 1: Illustration of the problem 0697

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{E_aCM_a} \neq 0$ i.e., points E_a, C and M_a are not collinear (foot is not the point itself; construction based assumption)

$S_{E_aCM_a} \neq S_{F^0_{h_a}CM_a}$ i.e., lines $E_aF^0_{h_a}$ and CM_a are not parallel (construction based assumption)

$S_{M^3_{m(E_aM_a)}E_aM_a} \neq S_{T^4_{m(E_aM_a)}E_aM_a}$ i.e., lines $M^3_{m(E_aM_a)}T^4_{m(E_aM_a)}$ and E_aM_a are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=_E_a

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_a=_E_a

Proving failed

4.3.3 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 13 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving $E_a{=}\_E_a$

Proving failed

4.4.3 Proving $M_a{=}\_M_a$

Proving failed

Problem 698

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 698: Given a point C, a point E_a and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point M_b, construct a point A (rule W01); ;
2. Using the point E_a and the point A, construct a point H (rule W01); ;
3. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
4. Using the point E_a and the point A, construct a line h_a (rule W02); % DET: points E_a and A are not the same;
5. Using the point C and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points C and M_b are not the same;
6. Using the circle $k(M_b, C)$, the line h_c, the point M_b and the point C, construct a point H_c (rule W05); % NDG: line h_c and circle $k(M_b, C)$ intersect % DET: points C and H_c must be different;
7. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
8. Using the circle $k(M_b, C)$, the line h_a, the point M_b and the point A, construct a point H_a (rule W05); % NDG: line h_a and circle $k(M_b, C)$ intersect % DET: points A and H_a must be different;
9. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
10. Using the line c and the line a, construct a point B (rule W03); % NDG: lines c and a are not parallel % DET: lines c and a are not the same.

Non-degenerate conditions: lines c and a are not parallel; line h_a and circle $k(M_b, C)$ intersect; line h_c and circle $k(M_b, C)$ intersect; points C and M_b are not the same.

Determination conditions: lines c and a are not the same; points H_a and C are not the same; points A and H_a must be different; points H_c and A are not the same; points C and H_c must be different; points E_a and A are not the same; points C and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D22,D28,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L43,L44,L45]

Solving time: 10.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{a} 80 83.86
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{a}
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point A such that CA/CM_{b}=2
towards A C M_{b} 2
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0



% Constructing a point H such that E_{a}H/E_{a}A=-1
towards H E_{a} A -1
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% DET: points E_{a} and A are not the same
% Constructing a line h_{a} which passes through point E_{a} and point A
line h_{a} E_{a} A

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points C and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point C
circle k(M_{b},C) M_{b} C

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: line h_{c} and circle k(M_{b},C) intersect% DET: points C and H_{c} must be different
% Constructing a point P_{\_G94160} which is a foot of the point M_{b} on the line h_{c}
foot P_{\_G94160} M_{b} h_{c}
cmark_r P_{\_G94160}
color 200 200 200
drawline M_{b} P_{\_G94160}
color 0 0 0

% Constructing a point H_{c} which is an image of the point C in the symmetry to point/line P_{\_G
    94160}
sim H_{c} P_{\_G94160} C
cmark_rt H_{c}


% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: line h_{a} and circle k(M_{b},C) intersect% DET: points A and H_{a} must be different
% Constructing a point P_{\_G94398} which is a foot of the point M_{b} on the line h_{a}
foot P_{\_G94398} M_{b} h_{a}
cmark_r P_{\_G94398}
color 200 200 200
drawline M_{b} P_{\_G94398}
color 0 0 0

% Constructing a point H_{a} which is an image of the point A in the symmetry to point/line P_{\_G
    94398}
sim H_{a} P_{\_G94398} A
cmark_r H_{a}
```

```
% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: lines c and a are not parallel% DET: lines c and a are not the same
% Constructing a point B which belongs to line c and line a
intersec B c a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and a are not parallel; line h_{a} and circle k(M_{b},C)
    intersect; line h_{c} and circle k(M_{b},C) intersect; points C and M_{b} are not the same
% Determination conditions: lines c and a are not the same; points H_{a} and C are not the same;
    points A and H_{a} must be different; points H_{c} and A are not the same; points C and H_{c}
    must be different; points E_{a} and A are not the same; points C and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=_E_a

Proving failed

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

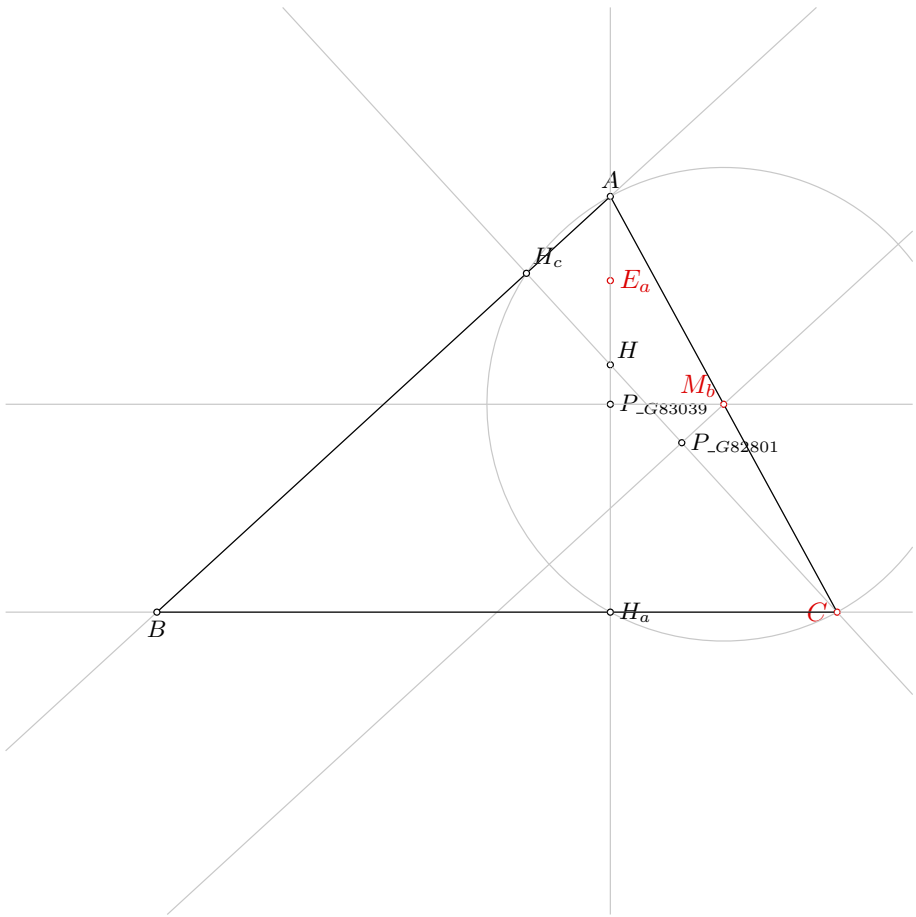

Figure 1: Illustration of the problem 0698

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{H_cH_aC} \neq S_{AH_aC}$ i.e., lines H_cA and H_aC are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving M_b=$\_M_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving E_a=$\_E_a$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 124 terms.

Time Complexity: Time spent by the prover is 0.470 seconds.There are no ndg conditions.

4.3.3 Proving M_b=$\_M_b$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving E_a=$\_E_a$

Proving failed

4.4.3 Proving M_b=$\_M_b$

Proving failed

Problem 699

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 699: Given a point C, a point E_a and a point M_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 700

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 700: Given a point C, a point E_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and N are not the same;
2. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
3. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point E_a, construct a point M_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_a and M_a must be different;
4. Using the point M_a and the point C, construct a point B (rule W01); ;
5. Using the point C and the point M_a, construct a line a (rule W02); % DET: points C and M_a are not the same;
6. Using the circle $k(N, M_a)$, the line a, the point N and the point M_a, construct a point H_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points M_a and H_a must be different;
7. Using the point H_a and the point E_a, construct a line h_a (rule W02); % DET: points H_a and E_a are not the same;
8. Using the point C and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points C and M_a are not the same;
9. Using the circle $k(N, M_a)$ and the circle $k(M_a, B)$, construct a point H_b and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_a, B)$ intersect % DET: circles $k(N, M_a)$ and $k(M_a, B)$ are not the same;

10. Using the point C and the point H_b, construct a line b (rule W02); % DET: points C and H_b are not the same;

11. Using the line h_a and the line b, construct a point A (rule W03); % NDG: lines h_a and b are not parallel % DET: lines h_a and b are not the same.

Non-degenerate conditions: lines h_a and b are not parallel; circles $k(N, M_a)$ and $k(M_a, B)$ intersect; points C and M_a are not the same; line a and circle $k(N, M_a)$ intersect; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: lines h_a and b are not the same; points C and H_b are not the same; circles $k(N, M_a)$ and $k(M_a, B)$ are not the same; points H_a and E_a are not the same; points M_a and H_a must be different; points C and M_a are not the same; points E_a and M_a must be different; points E_a and N are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D21,D28,D3,D32,D5,D6,D8,GD01,GD02,GL01,GL03,GL04,GL09,L19,L20,L21,L22,L37,L38,L3

Solving time: 4.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{a} 80 83.86
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{a}
cmark_r N
color 0 0 0
fontsize 8

% DET: points E_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point N
line m(H_{b}H_{c}) E_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{a} and M_{a} must be
    different
% Constructing a point M_{a} which is an image of the point E_{a} in the symmetry to point/line N
sim M_{a} N E_{a}
cmark_r M_{a}



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0


% DET: points C and M_{a} are not the same
% Constructing a line a which passes through point C and point M_{a}
line a C M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(N,M_{a}) intersect% DET: points M_{a} and H_{a} must be different
% Constructing a point P_{\_G132935} which is a foot of the point N on the line a
foot P_{\_G132935} N a
cmark_r P_{\_G132935}
color 200 200 200
drawline N P_{\_G132935}
color 0 0 0

% Constructing a point H_{a} which is an image of the point M_{a} in the symmetry to point/line P
    _{\_G132935}
sim H_{a} P_{\_G132935} M_{a}
cmark_r H_{a}


% DET: points H_{a} and E_{a} are not the same
% Constructing a line h_{a} which passes through point H_{a} and point E_{a}
line h_{a} H_{a} E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points C and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point C
circle k(M_{a},B) M_{a} C
```

```
color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{a},B) intersect% DET: circles k(N,M_{a}) and k(M_{a},B) are not
    the same
% Constructing points H_{b} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{a},B)
intersec2 H_{b} H_{c} k(N,M_{a}) k(M_{a},B)
cmark_l H_{b}
cmark_rt H_{c}


% DET: points C and H_{b} are not the same
% Constructing a line b which passes through point C and point H_{b}
line b C H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{a} and b are not parallel% DET: lines h_{a} and b are not the same
% Constructing a point A which belongs to line h_{a} and line b
intersec A h_{a} b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and b are not parallel; circles k(N,M_{a}) and k(M_{a},B)
    intersect; points C and M_{a} are not the same; line a and circle k(N,M_{a}) intersect; line m(
    H_{b}H_{c}) and circle k(N,M_{a}) intersect; points E_{a} and N are not the same
% Determination conditions: lines h_{a} and b are not the same; points C and H_{b} are not the same
    ; circles k(N,M_{a}) and k(M_{a},B) are not the same; points H_{a} and E_{a} are not the same;
    points M_{a} and H_{a} must be different; points C and M_{a} are not the same; points E_{a} and
     M_{a} must be different; points E_{a} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

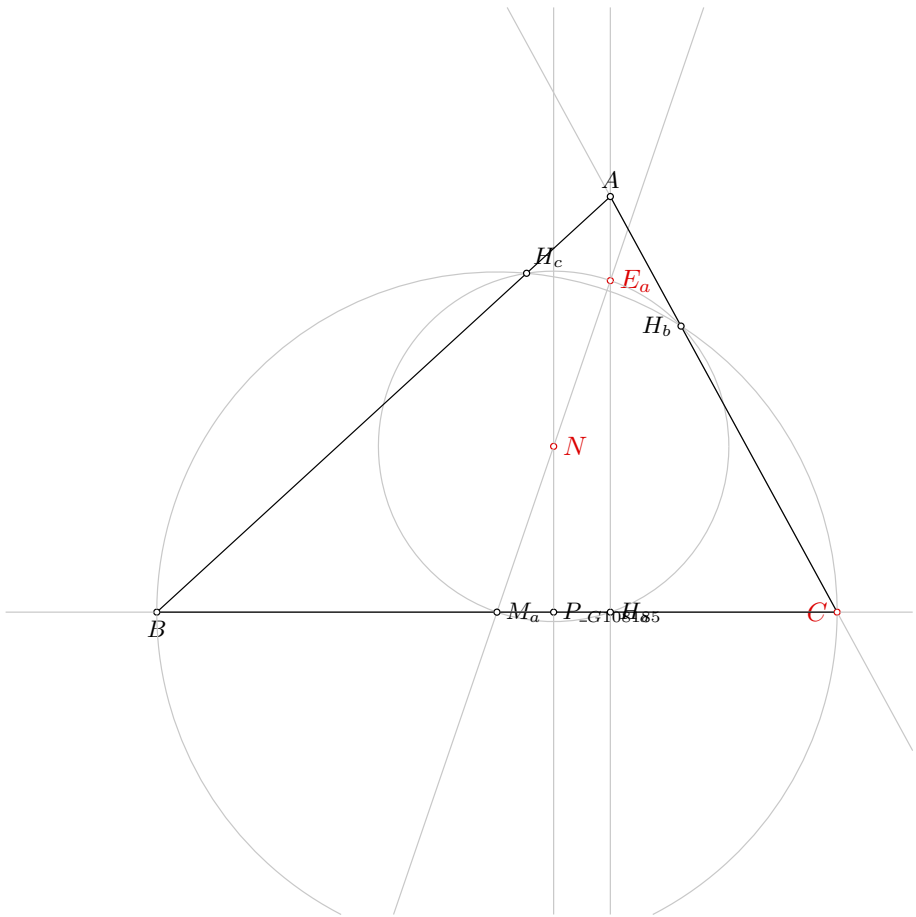

Figure 1: Illustration of the problem 0700

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.028 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_a=$\_E_a$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{H_aCH_b} \neq S_{E_aCH_b}$ i.e., lines H_aE_a and CH_b are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_a=$\_E_a$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Proving failed

4.3.2 Proving E_a=$\_E_a$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Proving failed

4.4.2 Proving $E_a = \_E_a$

Proving failed

4.4.3 Proving $N = \_N$

Proving failed

Problem 701

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 701: Given a point C, a point E_a and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 702

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 702: Given a point C, a point E_a and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 703

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 703: Given a point C, a point E_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 704

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 704: Given a point C, a point E_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 705

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 705: Given a point C, a point E_b and a point E_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point E_c, construct a point H (rule W01); ;
2. Using the point E_b and the point H, construct a point B (rule W01); ;
3. Using the point C and the point B, construct a line a (rule W02); % DET: points C and B are not the same;
4. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
5. Using the point C and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points C and E_c are not the same;
6. Using the circle $k(E_c, C)$, the line a, the point E_c and the point C, construct a point H_a (rule W05); % NDG: line a and circle $k(E_c, C)$ intersect % DET: points C and H_a must be different;
7. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
8. Using the circle $k(E_c, C)$, the line h_b, the point E_c and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_c, C)$ intersect % DET: points H and H_b must be different;
9. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
10. Using the line h_a and the line b, construct a point A (rule W03); % NDG: lines h_a and b are not parallel % DET: lines h_a and b are not the same.

Non-degenerate conditions: lines h_a and b are not parallel; line h_b and circle $k(E_c, C)$ intersect; line a and circle $k(E_c, C)$ intersect; points C and E_c are not the same.

Determination conditions: lines h_a and b are not the same; points H_b and C are not the same; points H and H_b must be different; points H_a and H are not the same; points C and H_a must be different; points E_b and H are not the same; points C and B are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D29,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 11.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{b} 50 56.36
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{b}
cmark_r E_{c}
color 0 0 0
fontsize 8


% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points C and B are not the same
% Constructing a line a which passes through point C and point B
line a C B

color 200 200 200
drawline a
color 0 0 0
```

```
% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points C and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point C
circle k(E_{c},C) E_{c} C

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line a and circle k(E_{c},C) intersect% DET: points C and H_{a} must be different
% Constructing a point P_{\_G173602} which is a foot of the point E_{c} on the line a
foot P_{\_G173602} E_{c} a
cmark_r P_{\_G173602}
color 200 200 200
drawline E_{c} P_{\_G173602}
color 0 0 0

% Constructing a point H_{a} which is an image of the point C in the symmetry to point/line P_{\_G
    173602}
sim H_{a} P_{\_G173602} C
cmark_r H_{a}


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{b} and circle k(E_{c},C) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G173840} which is a foot of the point E_{c} on the line h_{b}
foot P_{\_G173840} E_{c} h_{b}
cmark_r P_{\_G173840}
color 200 200 200
drawline E_{c} P_{\_G173840}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    173840}
sim H_{b} P_{\_G173840} H
cmark_l H_{b}
```

```
% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{a} and b are not parallel% DET: lines h_{a} and b are not the same
% Constructing a point A which belongs to line h_{a} and line b
intersec A h_{a} b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and b are not parallel; line h_{b} and circle k(E_{c},C)
    intersect; line a and circle k(E_{c},C) intersect; points C and E_{c} are not the same
% Determination conditions: lines h_{a} and b are not the same; points H_{b} and C are not the same
    ; points H and H_{b} must be different; points H_{a} and H are not the same; points C and H_{a}
     must be different; points E_{b} and H are not the same; points C and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.034 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

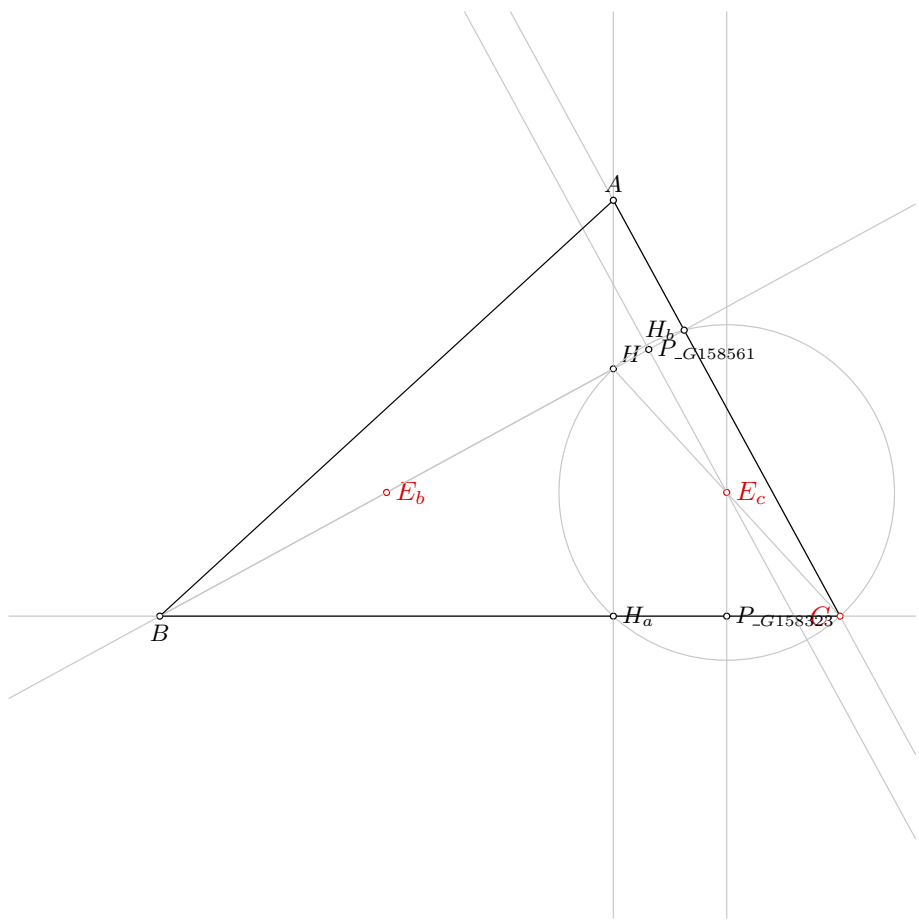

Figure 1: Illustration of the problem 0705

4.2 GCLC - Area method

4.2.1 Proving $C{=}C$

NDG conditions are:

$S_{H_aH_bC} \neq S_{HH_bC}$ i.e., lines H_aH and H_bC are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_b{=}\_E_b$

Proving failed

4.2.3 Proving $E_c{=}\_E_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_b{=}\_E_b$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 767 terms.

Time Complexity: Time spent by the prover is 3.220 seconds.There are no ndg conditions.

4.3.3 Proving $E_c{=}\_E_c$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 2083 terms.

Time Complexity: Time spent by the prover is 7.660 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_b{=}\_E_b$

Proving failed

4.4.3 Proving $E_c{=}\_E_c$

Proving failed

Problem 706

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 706: Given a point C, a point E_b and a point G, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 707

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 707: Given a point C, a point E_b and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point H, construct a point E_c (rule W01); ;
2. Using the point E_b and the point H, construct a point B (rule W01); ;
3. Using the point C and the point B, construct a line a (rule W02); % DET: points C and B are not the same;
4. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
5. Using the point C and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points C and E_c are not the same;
6. Using the circle $k(E_c, C)$, the line a, the point E_c and the point C, construct a point H_a (rule W05); % NDG: line a and circle $k(E_c, C)$ intersect % DET: points C and H_a must be different;
7. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
8. Using the circle $k(E_c, C)$, the line h_b, the point E_c and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_c, C)$ intersect % DET: points H and H_b must be different;
9. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
10. Using the line h_a and the line b, construct a point A (rule W03); % NDG: lines h_a and b are not parallel % DET: lines h_a and b are not the same.

Non-degenerate conditions: lines h_a and b are not parallel; line h_b and circle $k(E_c, C)$ intersect; line a and circle $k(E_c, C)$ intersect; points C and E_c are not the same.

Determination conditions: lines h_a and b are not the same; points H_b and C are not the same; points H and H_b must be different; points H_a and H are not the same; points C and H_a must be different; points E_b and H are not the same; points C and B are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D29,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 10.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{b} 50 56.36
point H 80 72.73

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{b}
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point E_{c} such that CE_{c}/CH=0.5
towards E_{c} C H 0.5
cmark_r E_{c}
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points C and B are not the same
% Constructing a line a which passes through point C and point B
line a C B

color 200 200 200
drawline a
color 0 0 0
```

```
% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points C and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point C
circle k(E_{c},C) E_{c} C

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line a and circle k(E_{c},C) intersect% DET: points C and H_{a} must be different
% Constructing a point P_{\_G203158} which is a foot of the point E_{c} on the line a
foot P_{\_G203158} E_{c} a
cmark_r P_{\_G203158}
color 200 200 200
drawline E_{c} P_{\_G203158}
color 0 0 0

% Constructing a point H_{a} which is an image of the point C in the symmetry to point/line P_{\_G
    203158}
sim H_{a} P_{\_G203158} C
cmark_r H_{a}


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{b} and circle k(E_{c},C) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G203396} which is a foot of the point E_{c} on the line h_{b}
foot P_{\_G203396} E_{c} h_{b}
cmark_r P_{\_G203396}
color 200 200 200
drawline E_{c} P_{\_G203396}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    203396}
sim H_{b} P_{\_G203396} H
cmark_l H_{b}
```

```
% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{a} and b are not parallel% DET: lines h_{a} and b are not the same
% Constructing a point A which belongs to line h_{a} and line b
intersec A h_{a} b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and b are not parallel; line h_{b} and circle k(E_{c},C)
    intersect; line a and circle k(E_{c},C) intersect; points C and E_{c} are not the same
% Determination conditions: lines h_{a} and b are not the same; points H_{b} and C are not the same
    ; points H and H_{b} must be different; points H_{a} and H are not the same; points C and H_{a}
     must be different; points E_{b} and H are not the same; points C and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving H=_H

Proving failed

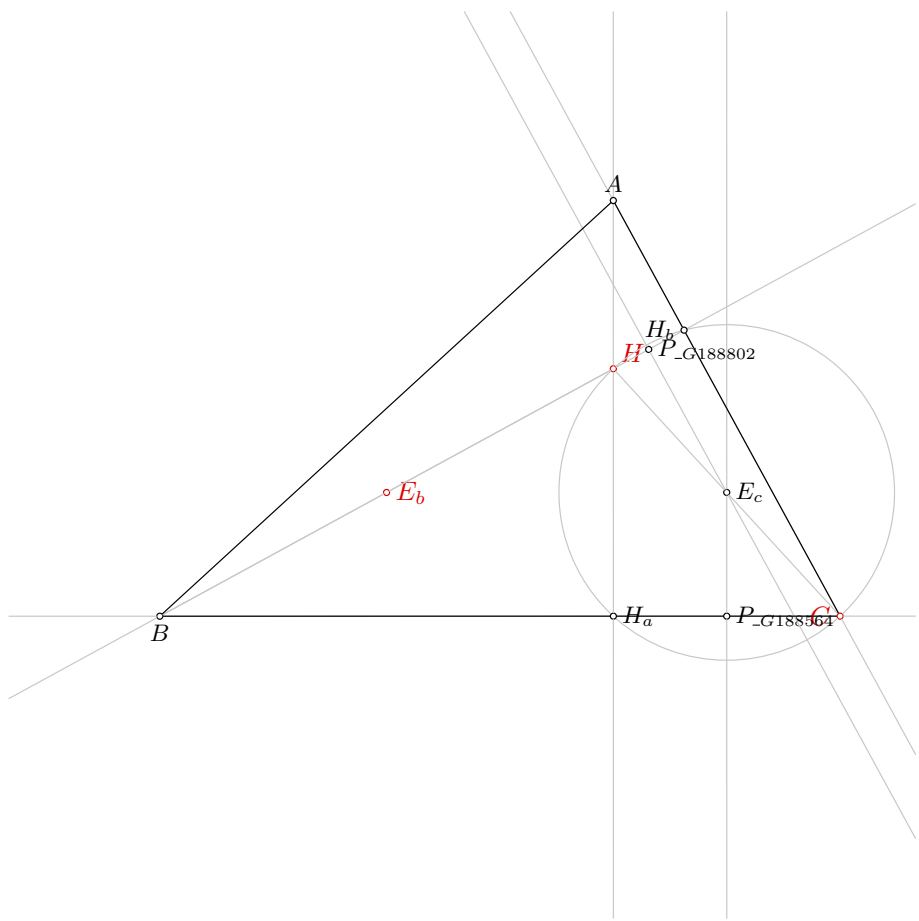

Figure 1: Illustration of the problem 0707

4.2 GCLC - Area method

4.2.1 Proving $C{=}C$

NDG conditions are:

$S_{H_aH_bC} \neq S_{HH_bC}$ i.e., lines H_aH and H_bC are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_b{=}\_E_b$

Proving failed

4.2.3 Proving $H{=}\_H$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_b{=}\_E_b$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 767 terms.

Time Complexity: Time spent by the prover is 0.520 seconds.There are no ndg conditions.

4.3.3 Proving $H{=}\_H$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 138 terms.

Time Complexity: Time spent by the prover is 0.090 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_b{=}\_E_b$

Proving failed

4.4.3 Proving $H{=}\_H$

Proving failed

Problem 708

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 708: Given a point C, a point E_b and a point H_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;
2. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;
3. Using the circle $k(E_b, B)$, the line a, the point E_b and the point H_a, construct a point B (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points H_a and B must be different;
4. Using the point E_b and the point B, construct a point H (rule W01); ;
5. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
6. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
7. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H and H_c must be different;
8. Using the point B and the point H_c, construct a line c (rule W02); % DET: points B and H_c are not the same;
9. Using the line h_a and the line c, construct a point A (rule W03); % NDG: lines h_a and c are not parallel % DET: lines h_a and c are not the same.

Non-degenerate conditions: lines h_a and c are not parallel; line h_c and circle $k(E_b, B)$ intersect; line a and circle $k(E_b, B)$ intersect; points H_a and E_b are not the same.

Determination conditions: lines h_a and c are not the same; points B and H_c are not the same; points H and H_c must be different; points H_a and H are not the same; points C and H are not the same; points H_a and B must be different; points C and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,L3,L49,L50,L51]

Solving time: 8.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{b} 50 56.36
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{b}
cmark_r H_{a}
color 0 0 0
fontsize 8

% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points H_{a} and B must be different
% Constructing a point P_{\_G226629} which is a foot of the point E_{b} on the line a
foot P_{\_G226629} E_{b} a
cmark_r P_{\_G226629}
color 200 200 200
drawline E_{b} P_{\_G226629}
color 0 0 0
```

```
% Constructing a point B which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    226629}
sim B P_{\_G226629} H_{a}
cmark_b B



% Constructing a point H such that E_{b}H/E_{b}B=-1
towards H E_{b} B -1
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0



% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G226992} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G226992} E_{b} h_{c}
cmark_r P_{\_G226992}
color 200 200 200
drawline E_{b} P_{\_G226992}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    226992}
sim H_{c} P_{\_G226992} H
cmark_rt H_{c}


% DET: points B and H_{c} are not the same
% Constructing a line c which passes through point B and point H_{c}
line c B H_{c}

color 200 200 200
drawline c
```

```
color 0 0 0



% NDG: lines h_{a} and c are not parallel% DET: lines h_{a} and c are not the same
% Constructing a point A which belongs to line h_{a} and line c
intersec A h_{a} c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and c are not parallel; line h_{c} and circle k(E_{b},B)
    intersect; line a and circle k(E_{b},B) intersect; points H_{a} and E_{b} are not the same
% Determination conditions: lines h_{a} and c are not the same; points B and H_{c} are not the same
    ; points H and H_{c} must be different; points H_{a} and H are not the same; points C and H are
     not the same; points H_{a} and B must be different; points C and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving H_a=_H_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 1176 terms.

Time Complexity: Time spent by the prover is 7.762 seconds.

NDG conditions Points C, E_b and H_a are not collinear

Points C, E_b and H_a are not collinear

Points C and H are not identical

Points C, E_b and H are not collinear

Line through points B and H_c is not parallel with line through points H and H_a

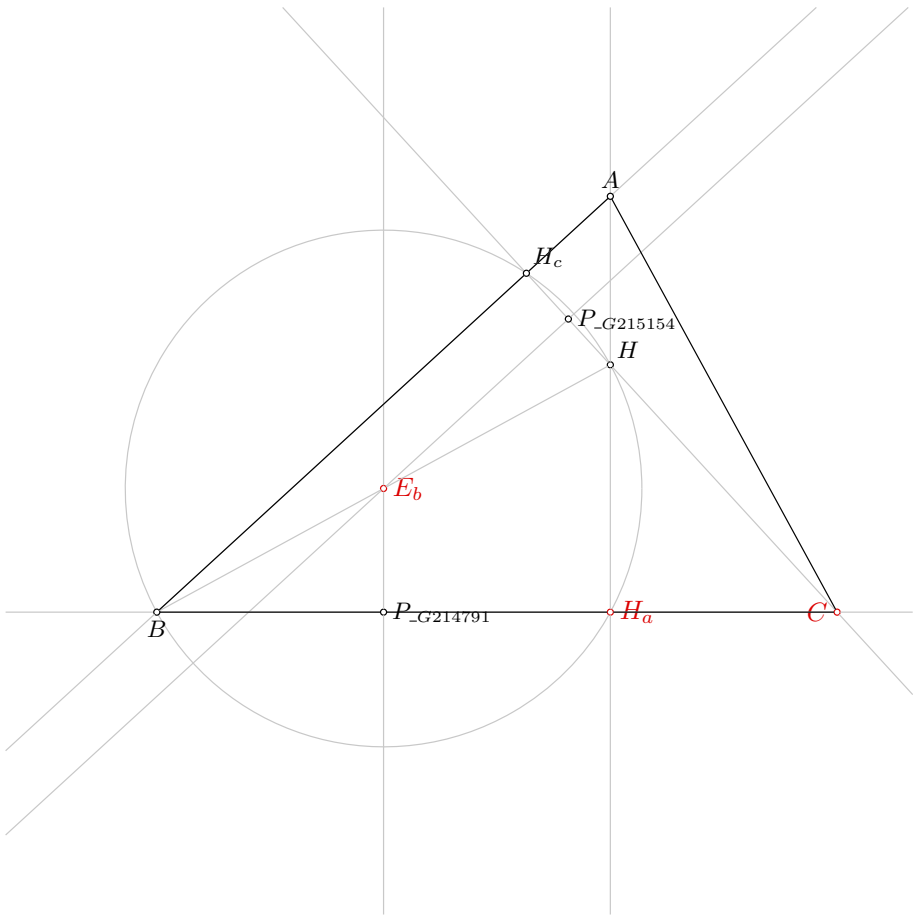

Figure 1: Illustration of the problem 0708

Line through points C and E_b is not parallel with line through points H and H_a

Points B and C are not identical

Points B and C are not identical

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{H_aBH_c} \neq S_{HBH_c}$ i.e., lines H_aH and BH_c are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving H_a=$\_H_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Proving failed

4.3.2 Proving E_b=$\_E_b$

Proving failed

4.3.3 Proving H_a=$\_H_a$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Proving failed

4.4.2 Proving E_b=$\_E_b$

Proving failed

4.4.3 Proving H_a=$\_H_a$

Proving failed

Problem 709

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 709: Given a point E_b, a point H_b and a point C, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Using the point H_b and the line h_b, construct a line b (rule W10a); ;
3. Choose freely a point C on the line b (rule WOnline2);
4. Using the point C and the point H_b, construct a line $m(CH_b)$ (rule W14); % DET: points C and H_b are not the same;
5. Using the point E_b and the point H_b, construct a line $m(E_bH_b)$ (rule W14); % DET: points E_b and H_b are not the same;
6. Choose freely a point A on the line b (rule WOnline1) ;
7. Using the point A and the point C, construct a point M_b (rule W01); ;
8. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
9. Using the line $m(E_bH_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bH_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bH_b)$ and $m(H_aH_c)$ are not the same;
10. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
11. Using the circle $k(N, M_a)$ and the line $m(CH_b)$, construct a point M_a and a point E_c (rule W04); % NDG: line $m(CH_b)$ and circle $k(N, M_a)$ intersect;

12. Using the point C and the point M_a, construct a point B (rule W01); .

Non-degenerate conditions: line $m(CH_b)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same; lines $m(E_bH_b)$ and $m(H_aH_c)$ are not parallel.

Determination conditions: lines $m(E_bH_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points E_b and H_b are not the same; points C and H_b are not the same; points E_b and H_b are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W14,WOnline1,WOnline2]

Lemmas used: [D21,D22,D29,D3,D32,D6,D9,GD02,GL01,GL03,GL04,GL09,L19,L20,L21,L23,L24,L37,L38,L44

Solving time: 55.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{b} 89.36 77.83
point C 110 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_l H_{b}
cmark_l C
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0




% Constructing a line b which is perpendicular to line h_{b} and which passes through point H_{b}
perp b H_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0




% Generating random value V[_G250743]
random V[_G250743]
```

```
% Calculating value V[_G250764] using formula V[_G250743]*20
expression V[_G250764] { V[_G250743]*20 }


% Constructing a point C which is a point for which holds H_{b}C = V[_G250764] and angle E_{b}H_{b}
    C = 90
turtle C E_{b} H_{b} 90 V[_G250764]
cmark_l C


% DET: points C and H_{b} are not the same
% Constructing bisector m(CH_{b}) of the segment CH_{b}
med m(CH_{b}) C H_{b}

color 200 200 200
drawline m(CH_{b})
color 0 0 0

color 200 200 200
drawsegment C H_{b}
color 0 0 0


% DET: points E_{b} and H_{b} are not the same
% Constructing bisector m(E_{b}H_{b}) of the segment E_{b}H_{b}
med m(E_{b}H_{b}) E_{b} H_{b}

color 200 200 200
drawline m(E_{b}H_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} H_{b}
color 0 0 0



% Choosing randomly a point A on the line CH_{b}
online A C H_{b}
cmark_t A
color 200 200 200
drawline C H_{b}
color 0 0 0



% Constructing a point M_{b} such that AM_{b}/AC=0.5
towards M_{b} A C 0.5
cmark_lt M_{b}
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
```

```
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: lines m(E_{b}H_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}H_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}H_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}H_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(CH_{b}) and circle k(N,M_{a}) intersect
% Constructing points M_{a} and E_{c} which are in intersection of k(N,M_{a}) and m(CH_{b})
intersec2 M_{a} E_{c} k(N,M_{a}) m(CH_{b})
cmark_r M_{a}
cmark_r E_{c}



% Constructing a point B such that CB/CM_{a}=2
towards B C M_{a} 2
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(CH_{b}) and circle k(N,M_{a}) intersect; points E_{b} and N are
     not the same; lines m(E_{b}H_{b}) and m(H_{a}H_{c}) are not parallel
% Determination conditions: lines m(E_{b}H_{b}) and m(H_{a}H_{c}) are not the same; points E_{b}
    and M_{b} are not the same; points E_{b} and H_{b} are not the same; points C and H_{b} are not
     the same; points E_{b} and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

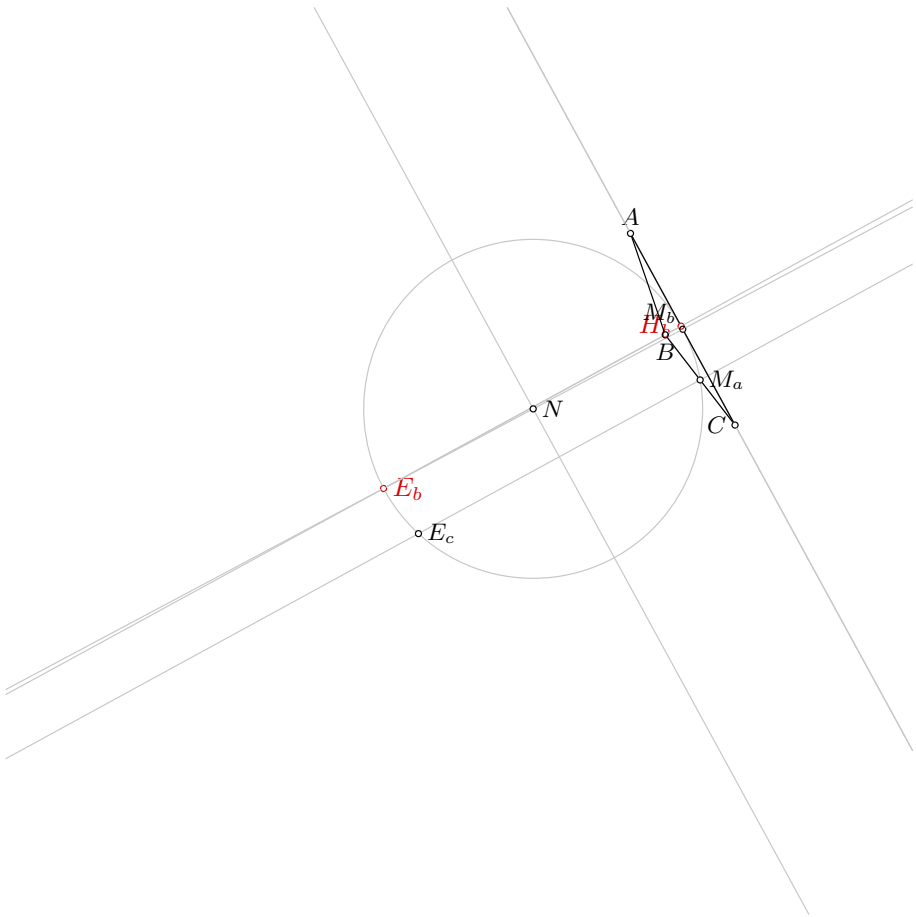

Figure 1: Illustration of the problem 0709

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 20 terms.

Time Complexity: Time spent by the prover is 0.305 seconds.

NDG conditions Points H_b and C are not identical

Line through points B and H_b is not perpendicular to line through points H_b and E_b

4.1.2 Proving H_b=_H_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 4 terms.

Time Complexity: Time spent by the prover is 0.139 seconds.

NDG conditions Point _H_b is not on circle with center H_b and point from it C

4.1.3 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.007 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving C=C

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving $C{=}C$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $E_b{=}\_E_b$

Proving failed

4.4.2 Proving $H_b{=}\_H_b$

Proving failed

4.4.3 Proving $C{=}C$

Proving failed

Problem 710

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 710: Given a point C, a point E_b and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point H_c, construct a line h_c (rule W02); % DET: points C and H_c are not the same;
2. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
3. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H_c, construct a point H (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H_c and H must be different;
4. Using the point E_b and the point H, construct a point B (rule W01); ;
5. Using the point C and the point B, construct a line a (rule W02); % DET: points C and B are not the same;
6. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
7. Using the circle $k(E_b, B)$, the line a, the point E_b and the point B, construct a point H_a (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points B and H_a must be different;
8. Using the point H and the point H_a, construct a line h_a (rule W02); % DET: points H and H_a are not the same;
9. Using the line c and the line h_a, construct a point A (rule W03); % NDG: lines c and h_a are not parallel % DET: lines c and h_a are not the same.

Non-degenerate conditions: lines c and h_a are not parallel; line a and circle $k(E_b, B)$ intersect; line h_c and circle $k(E_b, B)$ intersect; points H_c and E_b are not the same.

Determination conditions: lines c and h_a are not the same; points H and H_a are not the same; points B and H_a must be different; points H_c and B are not the same; points C and B are not the same; points H_c and H must be different; points C and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,L3,L49,L50,L51]

Solving time: 8.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{b} 50 56.36
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{b}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points C and H_{c} are not the same
% Constructing a line h_{c} which passes through point C and point H_{c}
line h_{c} C H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H_{c} and H must be different
% Constructing a point P_{\_G27748} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G27748} E_{b} h_{c}
cmark_r P_{\_G27748}
color 200 200 200
drawline E_{b} P_{\_G27748}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    27748}
sim H P_{\_G27748} H_{c}
cmark_rt H


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points C and B are not the same
% Constructing a line a which passes through point C and point B
line a C B

color 200 200 200
drawline a
color 0 0 0



% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points B and H_{a} must be different
% Constructing a point P_{\_G28111} which is a foot of the point E_{b} on the line a
foot P_{\_G28111} E_{b} a
cmark_r P_{\_G28111}
color 200 200 200
drawline E_{b} P_{\_G28111}
color 0 0 0

% Constructing a point H_{a} which is an image of the point B in the symmetry to point/line P_{\_G
    28111}
sim H_{a} P_{\_G28111} B
cmark_r H_{a}


% DET: points H and H_{a} are not the same
% Constructing a line h_{a} which passes through point H and point H_{a}
line h_{a} H H_{a}

color 200 200 200
drawline h_{a}
```

```
color 0 0 0



% NDG: lines c and h_{a} are not parallel% DET: lines c and h_{a} are not the same
% Constructing a point A which belongs to line c and line h_{a}
intersec A c h_{a}
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{a} are not parallel; line a and circle k(E_{b},B)
    intersect; line h_{c} and circle k(E_{b},B) intersect; points H_{c} and E_{b} are not the same
% Determination conditions: lines c and h_{a} are not the same; points H and H_{a} are not the same
    ; points B and H_{a} must be different; points H_{c} and B are not the same; points C and B are
     not the same; points H_{c} and H must be different; points C and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=$\_E_b$

Proving failed

4.1.3 Proving H_c=$\_H_c$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{H_cHH_a} \neq S_{BHH_a}$ i.e., lines H_cB and HH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

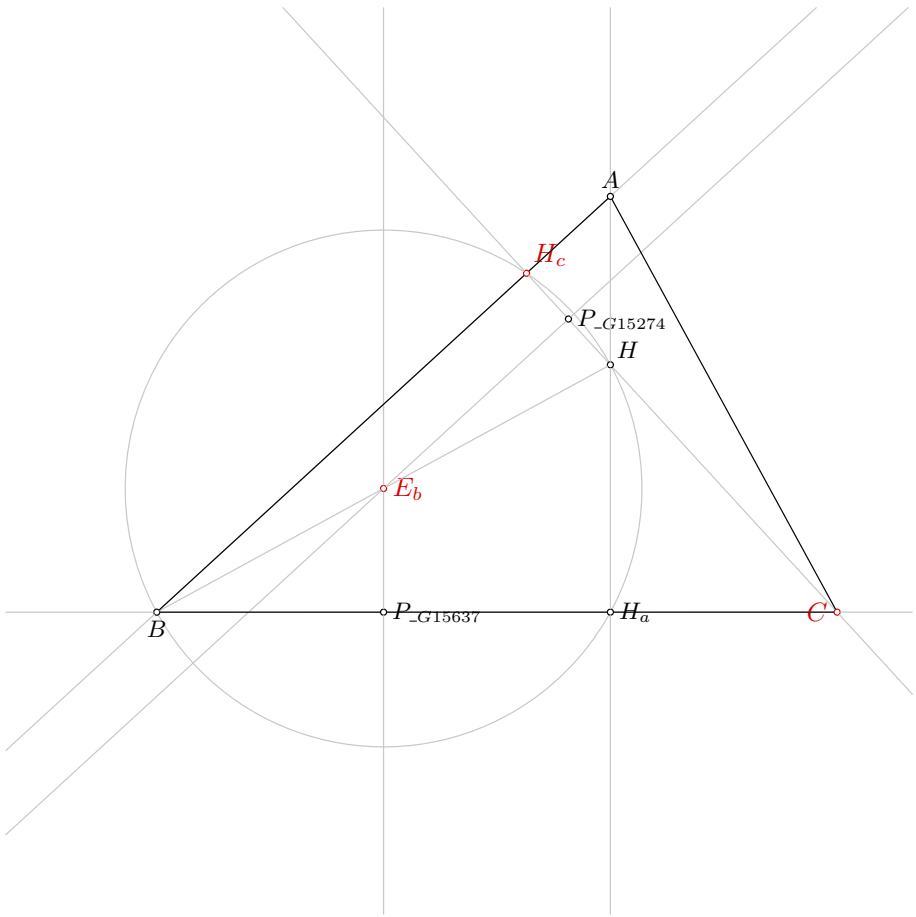

Figure 1: Illustration of the problem 0710

$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^2_{\_h_c}} \neq S_{BCF^2_{\_h_c}}$ i.e., lines AB and $CF^2_{\_h_c}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving H_c=$\_H_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Proving failed

4.3.2 Proving E_b=$\_E_b$

Proving failed

4.3.3 Proving H_c=$\_H_c$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Proving failed

4.4.2 Proving E_b=$\_E_b$

Proving failed

4.4.3 Proving H_c=$\_H_c$

Proving failed

Problem 711

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 711: Given a point C, a point E_b and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 712

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 712: Given a point C, a point E_b and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point M_a, construct a point B (rule W01); ;
2. Using the point E_b and the point B, construct a point H (rule W01); ;
3. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
4. Using the point E_b and the point B, construct a line h_b (rule W02); % DET: points E_b and B are not the same;
5. Using the point C and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points C and M_a are not the same;
6. Using the circle $k(M_a, B)$, the line h_c, the point M_a and the point C, construct a point H_c (rule W05); % NDG: line h_c and circle $k(M_a, B)$ intersect % DET: points C and H_c must be different;
7. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
8. Using the circle $k(M_a, B)$, the line h_b, the point M_a and the point B, construct a point H_b (rule W05); % NDG: line h_b and circle $k(M_a, B)$ intersect % DET: points B and H_b must be different;
9. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
10. Using the line c and the line b, construct a point A (rule W03); % NDG: lines c and b are not parallel % DET: lines c and b are not the same.

Non-degenerate conditions: lines c and b are not parallel; line h_b and circle $k(M_a, B)$ intersect; line h_c and circle $k(M_a, B)$ intersect; points C and M_a are not the same.

Determination conditions: lines c and b are not the same; points H_b and C are not the same; points B and H_b must be different; points H_c and B are not the same; points C and H_c must be different; points E_b and B are not the same; points C and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D21,D29,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L37,L38,L39]

Solving time: 10.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{b} 50 56.36
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{b}
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point B such that CB/CM_{a}=2
towards B C M_{a} 2
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0



% Constructing a point H such that E_{b}H/E_{b}B=-1
towards H E_{b} B -1
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% DET: points E_{b} and B are not the same
% Constructing a line h_{b} which passes through point E_{b} and point B
line h_{b} E_{b} B

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points C and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point C
circle k(M_{a},B) M_{a} C

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: line h_{c} and circle k(M_{a},B) intersect% DET: points C and H_{c} must be different
% Constructing a point P_{\_G54239} which is a foot of the point M_{a} on the line h_{c}
foot P_{\_G54239} M_{a} h_{c}
cmark_r P_{\_G54239}
color 200 200 200
drawline M_{a} P_{\_G54239}
color 0 0 0

% Constructing a point H_{c} which is an image of the point C in the symmetry to point/line P_{\_G
    54239}
sim H_{c} P_{\_G54239} C
cmark_rt H_{c}


% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: line h_{b} and circle k(M_{a},B) intersect% DET: points B and H_{b} must be different
% Constructing a point P_{\_G54477} which is a foot of the point M_{a} on the line h_{b}
foot P_{\_G54477} M_{a} h_{b}
cmark_r P_{\_G54477}
color 200 200 200
drawline M_{a} P_{\_G54477}
color 0 0 0

% Constructing a point H_{b} which is an image of the point B in the symmetry to point/line P_{\_G
    54477}
sim H_{b} P_{\_G54477} B
cmark_l H_{b}
```

```
% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% NDG: lines c and b are not parallel% DET: lines c and b are not the same
% Constructing a point A which belongs to line c and line b
intersec A c b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and b are not parallel; line h_{b} and circle k(M_{a},B)
    intersect; line h_{c} and circle k(M_{a},B) intersect; points C and M_{a} are not the same
% Determination conditions: lines c and b are not the same; points H_{b} and C are not the same;
    points B and H_{b} must be different; points H_{c} and B are not the same; points C and H_{c}
    must be different; points E_{b} and B are not the same; points C and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.046 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

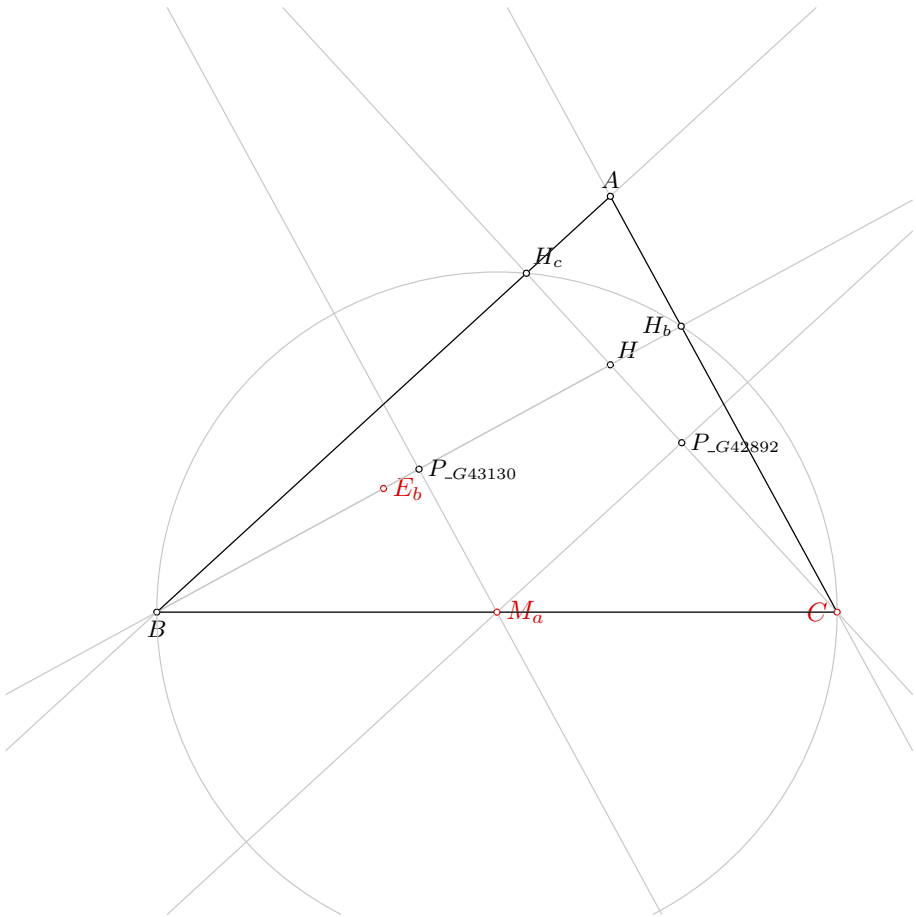

Figure 1: Illustration of the problem 0712

Time Complexity: Time spent by the prover is 0.022 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving $C{=}C$

NDG conditions are:

$S_{H_cH_bC} \neq S_{BH_bC}$ i.e., lines H_cB and H_bC are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving $E_b{=}\_E_b$

Proving failed

4.2.3 Proving $M_a{=}\_M_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving $E_b{=}\_E_b$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 124 terms.

Time Complexity: Time spent by the prover is 0.370 seconds.There are no ndg conditions.

4.3.3 Proving $M_a{=}\_M_a$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_b{=}\_E_b$

Proving failed

4.4.3 Proving M_a=$\_M_a$

Proving failed

Problem 713

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 713: Given a point C, a point E_b and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point M_b, construct a point A (rule W01); ;
2. Using the point C and the point M_b, construct a line b (rule W02); % DET: points C and M_b are not the same;
3. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
4. Using the point E_b and the line b, construct a line h_b (rule W10b); ;
5. Using the line h_b and the line b, construct a point H_b (rule W03); % NDG: lines h_b and b are not parallel % DET: lines h_b and b are not the same;
6. Using the point C and the point H_b, construct a line $m(CH_b)$ (rule W14); % DET: points C and H_b are not the same;
7. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;
8. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;
9. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
10. Using the circle $k(N, M_a)$ and the line $m(CH_b)$, construct a point M_a and a point E_c (rule W04); % NDG: line $m(CH_b)$ and circle $k(N, M_a)$ intersect;

11. Using the point M_a and the point C, construct a point B (rule W01); .

Non-degenerate conditions: line $m(CH_b)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel; lines h_b and b are not parallel.

Determination conditions: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points C and H_b are not the same; lines h_b and b are not the same; points E_b and M_b are not the same; points C and M_b are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14]

Lemmas used: [D21,D22,D29,D3,D32,D6,D9,GD01,GD02,GL01,GL03,GL04,GL09,L17,L19,L21,L23,L24,L37,L

Solving time: 2.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{b} 50 56.36
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{b}
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point A such that CA/CM_{b}=2
towards A C M_{b} 2
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0


% DET: points C and M_{b} are not the same
% Constructing a line b which passes through point C and point M_{b}
line b C M_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
```

```
color 0 0 0



% Constructing a line h_{b} which is perpendicular to line b and which passes through point E_{b}
perp h_{b} E_{b} b

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines h_{b} and b are not parallel% DET: lines h_{b} and b are not the same
% Constructing a point H_{b} which belongs to line h_{b} and line b
intersec H_{b} h_{b} b
cmark_l H_{b}


% DET: points C and H_{b} are not the same
% Constructing bisector m(CH_{b}) of the segment CH_{b}
med m(CH_{b}) C H_{b}

color 200 200 200
drawline m(CH_{b})
color 0 0 0

color 200 200 200
drawsegment C H_{b}
color 0 0 0


% DET: points E_{b} and M_{b} are not the same
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0


% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(CH_{b}) and circle k(N,M_{a}) intersect
% Constructing points M_{a} and E_{c} which are in intersection of k(N,M_{a}) and m(CH_{b})
intersec2 M_{a} E_{c} k(N,M_{a}) m(CH_{b})
cmark_r M_{a}
cmark_r E_{c}



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(CH_{b}) and circle k(N,M_{a}) intersect; points E_{b} and N are
     not the same; lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel; lines h_{b} and b are
    not parallel
% Determination conditions: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the same; points E_{b}
    and M_{b} are not the same; points C and H_{b} are not the same; lines h_{b} and b are not the
    same; points E_{b} and M_{b} are not the same; points C and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.022 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=_E_b

Proving failed

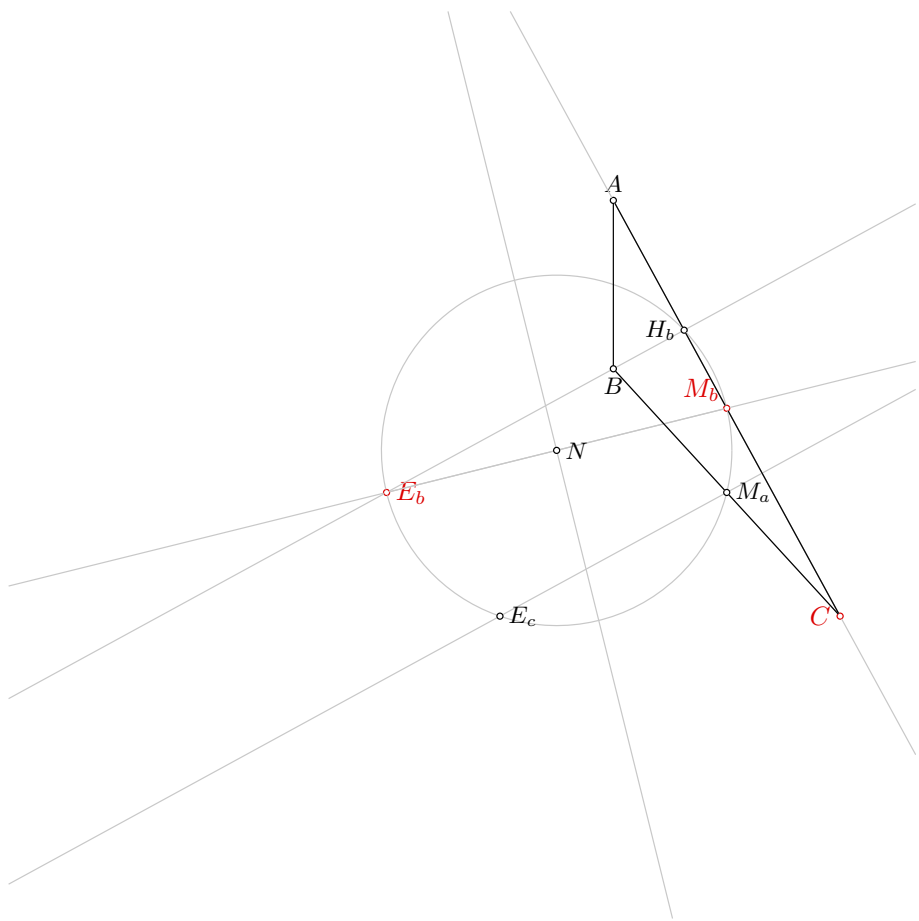

Figure 1: Illustration of the problem 0713

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{E_bCM_b} \neq 0$ i.e., points E_b, C and M_b are not collinear (foot is not the point itself; construction based assumption)

$S_{E_bCM_b} \neq S_{F^0_{h_b}CM_b}$ i.e., lines $E_bF^0_{h_b}$ and CM_b are not parallel (construction based assumption)

$S_{M^3_{m(E_bM_b)}E_bM_b} \neq S_{T^4_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^3_{m(E_bM_b)}T^4_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=_E_b

Proving failed

4.2.3 Proving M_b=_M_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_b=_E_b

Proving failed

4.3.3 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 13 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 714

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 714: Given a point C, a point E_b and a point M_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 715

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 715: Given a point C, a point E_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
2. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
3. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
4. Using the point M_b and the point C, construct a point A (rule W01); ;
5. Using the point C and the point M_b, construct a line b (rule W02); % DET: points C and M_b are not the same;
6. Using the circle $k(N, M_a)$, the line b, the point N and the point M_b, construct a point H_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points M_b and H_b must be different;
7. Using the point H_b and the point E_b, construct a line h_b (rule W02); % DET: points H_b and E_b are not the same;
8. Using the point C and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points C and M_b are not the same;
9. Using the circle $k(N, M_a)$ and the circle $k(M_b, C)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_b, C)$ intersect % DET: circles $k(N, M_a)$ and $k(M_b, C)$ are not the same;

10. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;

11. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; circles $k(N, M_a)$ and $k(M_b, C)$ intersect; points C and M_b are not the same; line b and circle $k(N, M_a)$ intersect; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: lines h_b and a are not the same; points C and H_a are not the same; circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points H_b and E_b are not the same; points M_b and H_b must be different; points C and M_b are not the same; points E_b and M_b must be different; points E_b and N are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D22,D29,D3,D32,D5,D6,D9,GD01,GD02,GL01,GL03,GL04,GL09,L17,L19,L20,L21,L23,L44,L4

Solving time: 4.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{b} 50 56.36
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{b}
cmark_r N
color 0 0 0
fontsize 8

% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}



% Constructing a point A such that M_{b}A/M_{b}C=-1
towards A M_{b} C -1
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0


% DET: points C and M_{b} are not the same
% Constructing a line b which passes through point C and point M_{b}
line b C M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(N,M_{a}) intersect% DET: points M_{b} and H_{b} must be different
% Constructing a point P_{\_G115236} which is a foot of the point N on the line b
foot P_{\_G115236} N b
cmark_r P_{\_G115236}
color 200 200 200
drawline N P_{\_G115236}
color 0 0 0

% Constructing a point H_{b} which is an image of the point M_{b} in the symmetry to point/line P
    _{\_G115236}
sim H_{b} P_{\_G115236} M_{b}
cmark_l H_{b}


% DET: points H_{b} and E_{b} are not the same
% Constructing a line h_{b} which passes through point H_{b} and point E_{b}
line h_{b} H_{b} E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points C and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point C
circle k(M_{b},C) M_{b} C
```

```
color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{b},C) intersect% DET: circles k(N,M_{a}) and k(M_{b},C) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{b},C)
intersec2 H_{a} H_{c} k(N,M_{a}) k(M_{b},C)
cmark_r H_{a}
cmark_rt H_{c}


% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; circles k(N,M_{a}) and k(M_{b},C)
    intersect; points C and M_{b} are not the same; line b and circle k(N,M_{a}) intersect; line m(
    H_{a}H_{c}) and circle k(N,M_{a}) intersect; points E_{b} and N are not the same
% Determination conditions: lines h_{b} and a are not the same; points C and H_{a} are not the same
    ; circles k(N,M_{a}) and k(M_{b},C) are not the same; points H_{b} and E_{b} are not the same;
    points M_{b} and H_{b} must be different; points C and M_{b} are not the same; points E_{b} and
     M_{b} must be different; points E_{b} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

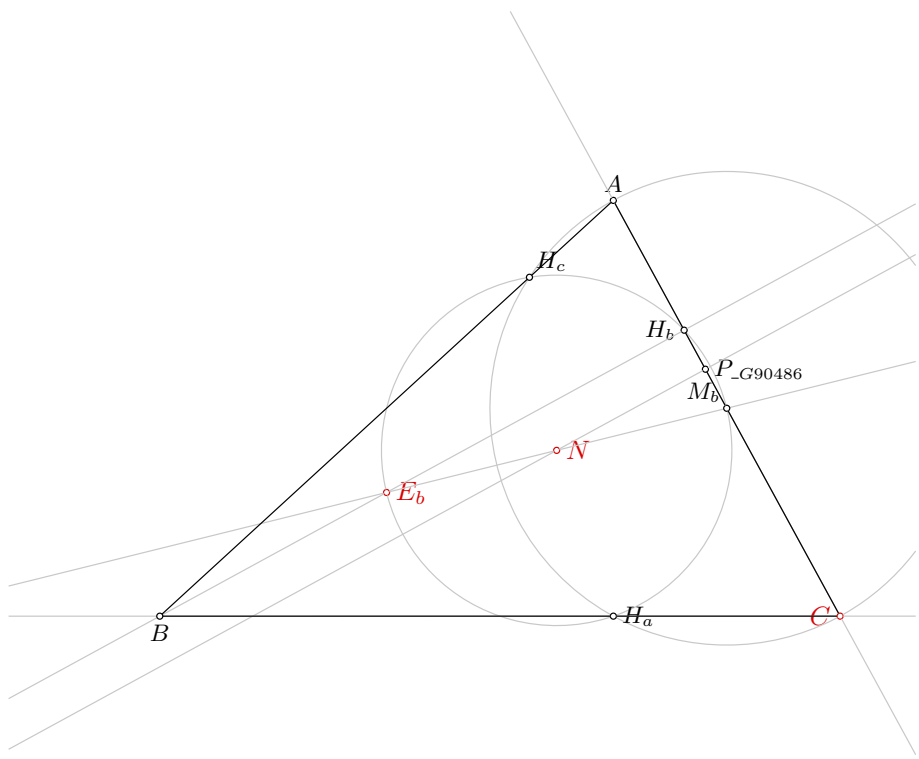

Figure 1: Illustration of the problem 0715

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.03 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_b=$\_E_b$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{H_bCH_a} \neq S_{E_bCH_a}$ i.e., lines H_bE_b and CH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_b=$\_E_b$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Proving failed

4.3.2 Proving E_b=$\_E_b$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Proving failed

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 716

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 716: Given a point C, a point E_b and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 717

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 717: Given a point C, a point E_b and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 718

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 718: Given a point C, a point E_b and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 719

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 719: Given a point C, a point E_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 720

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 720: Given a point C, a point E_c and a point G, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point E_c, construct a point H (rule W01); ;
2. Using the point C and the point G, construct a point M_c (rule W01); ;
3. Using the point G and the point H, construct a point N (rule W01); ;
4. Using the point G and the point H, construct a point O (rule W01); ;
5. Using the point C and the point E_c, construct a line h_c (rule W02); % DET: points C and E_c are not the same;
6. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
7. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
9. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same; points C and O are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points C and E_c are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L16,L21,L24,L3,L57,L58]

Solving time: 9.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{c} 95 56.36
point G 70 58.33

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{c}
cmark_t G
color 0 0 0
fontsize 8


% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0



% Constructing a point N such that GN/GH=0.25
towards N G H 0.25
cmark_r N
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
```

```
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points C and E_{c} are not the same
% Constructing a line h_{c} which passes through point C and point E_{c}
line h_{c} C E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G156485} which is a foot of the point N on the line h_{c}
foot P_{\_G156485} N h_{c}
cmark_r P_{\_G156485}
color 200 200 200
drawline N P_{\_G156485}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G156485}
sim H_{c} P_{\_G156485} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
```

```
drawline c
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; line h_{c} and circle k(N,M_{a})
    intersect; points E_{c} and N are not the same; points C and O are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points C and E_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.023 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=$\_E_c$

Proving failed

4.1.3 Proving G=$\_G$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

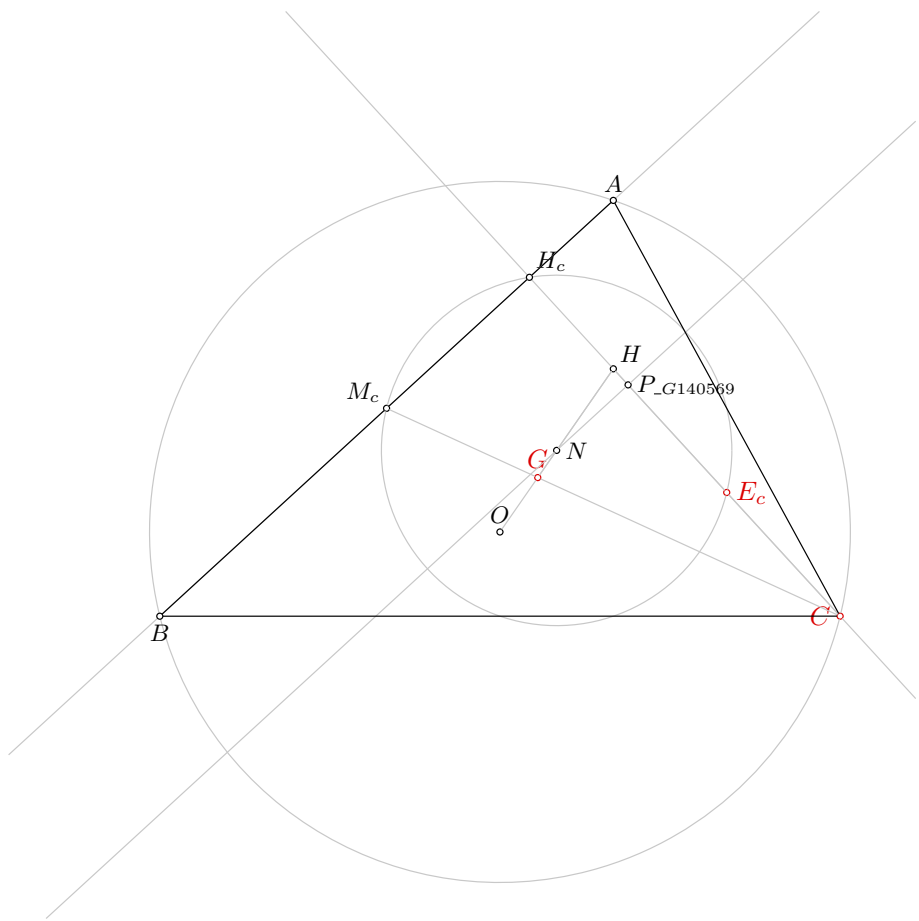

Figure 1: Illustration of the problem 0720

$S_{AB\_M_b} \neq S_{\_M_aB\_M_b}$ i.e., lines A_M_a and B_M_b are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving G=$\_G$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_c=$\_E_c$

Proving failed

4.3.3 Proving G=$\_G$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving E_c=$\_E_c$

Proving failed

4.4.3 Proving G=$\_G$

Proving failed

Problem 721

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 721: Given a point E_c, a point H and a point C, construct the triangle ABC.

2 Status

Problem is redundant.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H, construct a point C (rule W01); ;
2. Choose freely a point A (rule free);
3. Using the point A and the point H, construct a point E_a (rule W01); ;
4. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
5. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
6. Using the point A and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points A and E_a are not the same;
7. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
8. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
9. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H and H_c must be different;
10. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;

11. Using the line h_b and the line c, construct a point B (rule W03); % NDG: lines h_b and c are not parallel % DET: lines h_b and c are not the same.

Non-degenerate conditions: lines h_b and c are not parallel; line h_c and circle $k(E_a, A)$ intersect; line b and circle $k(E_a, A)$ intersect; points A and E_a are not the same.

Determination conditions: lines h_b and c are not the same; points H_c and A are not the same; points H and H_c must be different; points H_b and H are not the same; points A and H_b must be different; points E_c and H are not the same; points A and C are not the same.

Rules used: [W01,W02,W03,W05,W06,free]

Lemmas used: [D10,D28,D3,D30,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 10.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H 80 72.73
point C 110 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H
cmark_l C
color 0 0 0
fontsize 8


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0
```

```
% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points A and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point A
circle k(E_{a},A) E_{a} A

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G182772} which is a foot of the point E_{a} on the line b
foot P_{\_G182772} E_{a} b
cmark_r P_{\_G182772}
color 200 200 200
drawline E_{a} P_{\_G182772}
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    182772}
sim H_{b} P_{\_G182772} A
cmark_l H_{b}


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H and H_{c} must be different
```

```
% Constructing a point P_{\_G183010} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G183010} E_{a} h_{c}
cmark_r P_{\_G183010}
color 200 200 200
drawline E_{a} P_{\_G183010}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    183010}
sim H_{c} P_{\_G183010} H
cmark_rt H_{c}


% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{b} and c are not parallel% DET: lines h_{b} and c are not the same
% Constructing a point B which belongs to line h_{b} and line c
intersec B h_{b} c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and c are not parallel; line h_{c} and circle k(E_{a},A)
    intersect; line b and circle k(E_{a},A) intersect; points A and E_{a} are not the same
% Determination conditions: lines h_{b} and c are not the same; points H_{c} and A are not the same
    ; points H and H_{c} must be different; points H_{b} and H are not the same; points A and H_{b}
     must be different; points E_{c} and H are not the same; points A and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

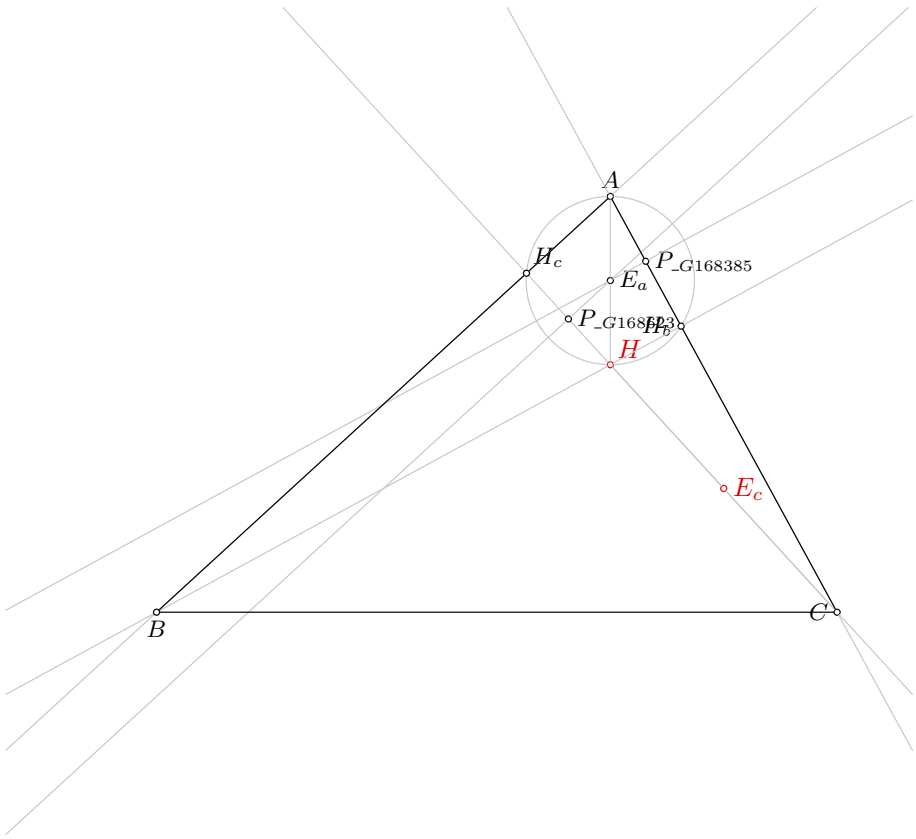

Figure 1: Illustration of the problem 0721

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2 terms.

Time Complexity: Time spent by the prover is 0.022 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving C=C

NDG conditions are:

$S_{H_bH_cA} \neq S_{HH_cA}$ i.e., lines H_bH and H_cA are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 805 terms.

Time Complexity: Time spent by the prover is 1.220 seconds.There are no ndg conditions.

4.3.2 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 152 terms.

Time Complexity: Time spent by the prover is 0.150 seconds.There are no ndg conditions.

4.3.3 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 722

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 722: Given a point E_c, a point H_a and a point C, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;
2. Choose freely a point C on the circle $k(E_c, C)$ (rule WOncircle);
3. Using the point C and the point E_c, construct a point H (rule W01); ;
4. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;
5. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
6. Choose freely a point A on the line h_a (rule WOnline1) ;
7. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
8. Using the circle $k(E_c, C)$, the line b, the point E_c and the point C, construct a point H_b (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points C and H_b must be different;
9. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
10. Using the line a and the line h_b, construct a point B (rule W03); % NDG: lines a and h_b are not parallel % DET: lines a and h_b are not the same.

Non-degenerate conditions: lines a and h_b are not parallel; line b and circle $k(E_c, C)$ intersect; points H_a and E_c are not the same.

Determination conditions: lines a and h_b are not the same; points H and H_b are not the same; points C and H_b must be different; points A and C are not the same; points H_a and H are not the same; points C and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06,WOncircle1,WOnline1]

Lemmas used: [D3,D30,D5,D6,D9,GD01,GD02,GL03,L53,L54]

Solving time: 687.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{a} 80 40
point C 110 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_r H_{a}
cmark_l C
color 0 0 0
fontsize 8

% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0




% Choosing randomly a point C on the circle with center E_{c} through point H_{a}
oncircle C E_{c} H_{a}
cmark_l C
color 200 200 200
drawcircle E_{c} H_{a}
color 0 0 0



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0
```

```
% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
color 0 0 0



% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% Choosing randomly a point A on the line H_{a}H
online A H_{a} H
cmark_t A
color 200 200 200
drawline H_{a} H
color 0 0 0


% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points C and H_{b} must be different
% Constructing a point P_{\_G207351} which is a foot of the point E_{c} on the line b
foot P_{\_G207351} E_{c} b
cmark_r P_{\_G207351}
color 200 200 200
drawline E_{c} P_{\_G207351}
color 0 0 0

% Constructing a point H_{b} which is an image of the point C in the symmetry to point/line P_{\_G
    207351}
sim H_{b} P_{\_G207351} C
cmark_l H_{b}


% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
```

```
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines a and h_{b} are not parallel% DET: lines a and h_{b} are not the same
% Constructing a point B which belongs to line a and line h_{b}
intersec B a h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{b} are not parallel; line b and circle k(E_{c},C)
    intersect; points H_{a} and E_{c} are not the same
% Determination conditions: lines a and h_{b} are not the same; points H and H_{b} are not the same
    ; points C and H_{b} must be different; points A and C are not the same; points H_{a} and H are
     not the same; points C and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2 terms.

Time Complexity: Time spent by the prover is 0.02 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

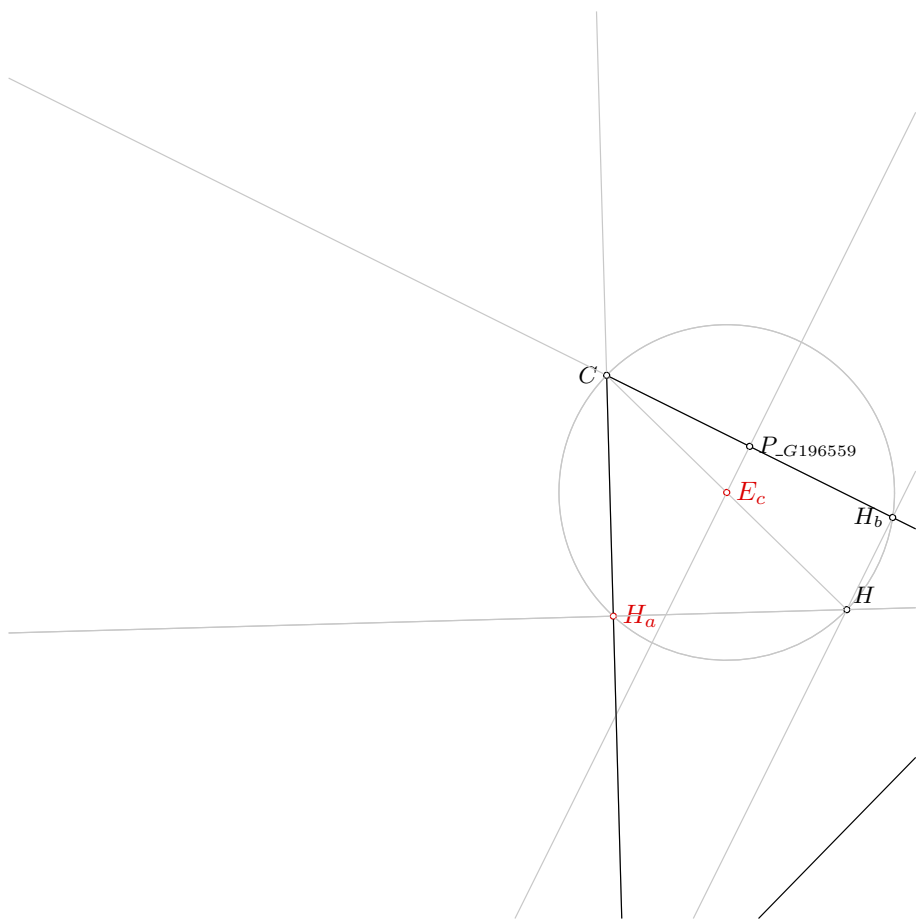

Figure 1: Illustration of the problem 0722

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving C=C

NDG conditions are:

$S_{CHH_b} \neq S_{H_aHH_b}$ i.e., lines CH_a and HH_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{BAF^1_{\_h_a}} \neq S_{CAF^1_{\_h_a}}$ i.e., lines BC and $AF^1_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 723

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 723: Given a point E_c, a point H_b and a point C, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
2. Choose freely a point C on the circle $k(E_c, C)$ (rule WOncircle);
3. Using the point C and the point E_c, construct a point H (rule W01); ;
4. Using the point C and the point H_b, construct a line b (rule W02); % DET: points C and H_b are not the same;
5. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
6. Choose freely a point A on the line b (rule WOnline1) ;
7. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
8. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H and H_a must be different;
9. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
10. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; line h_a and circle $k(E_c, C)$ intersect; points H_b and E_c are not the same.

Determination conditions: lines h_b and a are not the same; points H_a and C are not the same; points H and H_a must be different; points A and H are not the same; points H_b and H are not the same; points C and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06,WOncircle1,WOnline1]

Lemmas used: [D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,L52,L53,L54]

Solving time: 691.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{b} 89.36 77.83
point C 110 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_l H_{b}
cmark_l C
color 0 0 0
fontsize 8

% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0




% Choosing randomly a point C on the circle with center E_{c} through point H_{b}
oncircle C E_{c} H_{b}
cmark_l C
color 200 200 200
drawcircle E_{c} H_{b}
color 0 0 0



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0
```

```
% DET: points C and H_{b} are not the same
% Constructing a line b which passes through point C and point H_{b}
line b C H_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% Choosing randomly a point A on the line CH_{b}
online A C H_{b}
cmark_t A
color 200 200 200
drawline C H_{b}
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G231135} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G231135} E_{c} h_{a}
cmark_r P_{\_G231135}
color 200 200 200
drawline E_{c} P_{\_G231135}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    231135}
sim H_{a} P_{\_G231135} H
cmark_r H_{a}


% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
```

```
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; line h_{a} and circle k(E_{c},C)
    intersect; points H_{b} and E_{c} are not the same
% Determination conditions: lines h_{b} and a are not the same; points H_{a} and C are not the same
    ; points H and H_{a} must be different; points A and H are not the same; points H_{b} and H are
     not the same; points C and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_b=_H_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2241 terms.

Time Complexity: Time spent by the prover is 15.109 seconds.

NDG conditions Points H_b and C are not identical

Points A and H are not identical

Line through points H_b and E_c is not parallel with line through points A and H

Line through points H_b and H is not parallel with line through points C and H_a

Points H_b, E_c and H are not collinear

Points A and C are not identical

Points H_b and E_c are not identical

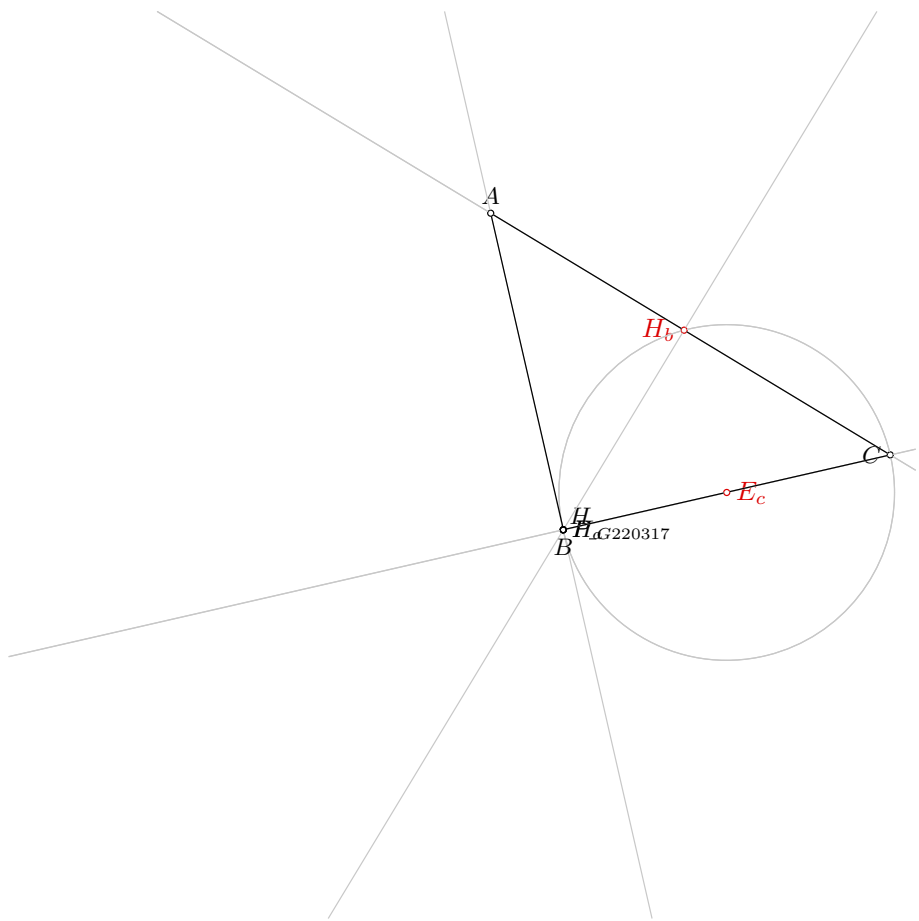

Figure 1: Illustration of the problem 0723

4.1.3 Proving $C{=}C$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving $E_c{=}\_E_c$

Proving failed

4.2.2 Proving $H_b{=}\_H_b$

Proving failed

4.2.3 Proving $C{=}C$

NDG conditions are:

$S_{H_bH_aC} \neq S_{HH_aC}$ i.e., lines H_bH and H_aC are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)
$S_{ABF^2_{\_h_b}} \neq S_{CBF^2_{\_h_b}}$ i.e., lines AC and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving $E_c{=}\_E_c$

Proving failed

4.3.2 Proving $H_b{=}\_H_b$

Proving failed

4.3.3 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $E_c{=}\_E_c$

Proving failed

4.4.2 Proving $H_b{=}\_H_b$

Proving failed

4.4.3 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 724

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 724: Given a point E_c, a point H_c and a point C, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Choose freely a point C on the line h_c (rule WOnline1) ;
3. Using the point C and the point E_c, construct a point H (rule W01); ;
4. Using the point C and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points C and E_c are not the same;
5. Using the point H_c and the line h_c, construct a line c (rule W10a); ;
6. Choose freely a point A on the line c (rule WOnline2);
7. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
8. Using the circle $k(E_c, C)$, the line b, the point E_c and the point C, construct a point H_b (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points C and H_b must be different;
9. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
10. Using the line c and the line h_b, construct a point B (rule W03); % NDG: lines c and h_b are not parallel % DET: lines c and h_b are not the same.

Non-degenerate conditions: lines c and h_b are not parallel; line b and circle $k(E_c, C)$ intersect; points C and E_c are not the same.

Determination conditions: lines c and h_b are not the same; points H and H_b are not the same; points C and H_b must be different; points A and C are not the same; points E_c and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,WOnline1,WOnline2]

Lemmas used: [D10,D3,D30,D6,D7,D9,GD01,GD02,GL03,GL09,L3,L53]

Solving time: 172.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{c} 68.91 84.83
point C 110 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H_{c}
cmark_l C
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0




% Choosing randomly a point C on the line E_{c}H_{c}
online C E_{c} H_{c}
cmark_l C
color 200 200 200
drawline E_{c} H_{c}
color 0 0 0



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0
```

```
% NDG: points C and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point C
circle k(E_{c},C) E_{c} C

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0




% Constructing a line c which is perpendicular to line h_{c} and which passes through point H_{c}
perp c H_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0




% Generating random value V[_G254177]
random V[_G254177]


% Calculating value V[_G254198] using formula V[_G254177]*20
expression V[_G254198] { V[_G254177]*20 }


% Constructing a point A which is a point for which holds H_{c}A = V[_G254198] and angle CH_{c}A =
    90
turtle A C H_{c} 90 V[_G254198]
cmark_t A


% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points C and H_{b} must be different
% Constructing a point P_{\_G254470} which is a foot of the point E_{c} on the line b
foot P_{\_G254470} E_{c} b
cmark_r P_{\_G254470}
color 200 200 200
drawline E_{c} P_{\_G254470}
color 0 0 0

% Constructing a point H_{b} which is an image of the point C in the symmetry to point/line P_{\_G
    254470}
sim H_{b} P_{\_G254470} C
```

```
cmark_l H_{b}


% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines c and h_{b} are not parallel% DET: lines c and h_{b} are not the same
% Constructing a point B which belongs to line c and line h_{b}
intersec B c h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{b} are not parallel; line b and circle k(E_{c},C)
    intersect; points C and E_{c} are not the same
% Determination conditions: lines c and h_{b} are not the same; points H and H_{b} are not the same
    ; points C and H_{b} must be different; points A and C are not the same; points E_{c} and H_{c}
     are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 55 terms.

Time Complexity: Time spent by the prover is 1.301 seconds.

NDG conditions Points E_c and A are not identical

Points E_c, B and C are not collinear

Line through points H_b and E_c is not perpendicular to line through points E_c and H

Points A, B and C are not collinear

4.1.2 Proving H_c=_H_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

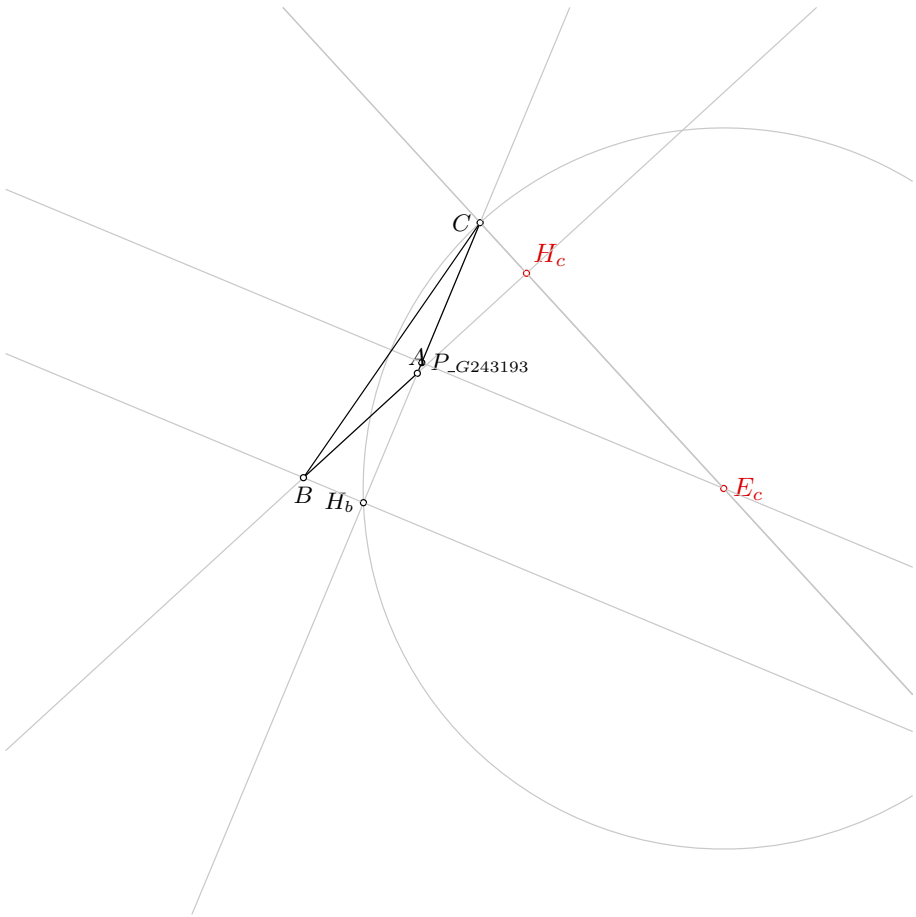

Figure 1: Illustration of the problem 0724

Time Complexity: Time spent by the prover is 0.151 seconds.

NDG conditions Points E_c and A are not identical

Points E_c, B and C are not collinear

Line through points H_b and E_c is not perpendicular to line through points E_c and H

Points E_c, A and B are not collinear

4.1.3 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.019 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving E_c=$\_E_c$

Proving failed

4.2.2 Proving H_c=$\_H_c$

Proving failed

4.2.3 Proving C=C

NDG conditions are:

$S_{H_cHH_b} \neq S_{T_c^1HH_b}$ i.e., lines $H_cT_c^1$ and HH_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)

$S_{ACF^4_{\_h_c}} \neq S_{BCF^4_{\_h_c}}$ i.e., lines AB and $CF^4_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=$\_E_c$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 6 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving H_c=$\_H_c$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 6 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $E_c{=}\_E_c$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 4 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $H_c{=}\_H_c$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 5 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

Problem 725

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 725: Given a point C, a point E_c and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 726

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 726: Given a point C, a point E_c and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point E_c, construct a point H (rule W01); ;
2. Using the point C and the point M_a, construct a point B (rule W01); ;
3. Using the point C and the point M_a, construct a line a (rule W02); % DET: points C and M_a are not the same;
4. Using the point H and the point B, construct a line h_b (rule W02); % DET: points H and B are not the same;
5. Using the point C and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points C and E_c are not the same;
6. Using the circle $k(E_c, C)$, the line a, the point E_c and the point C, construct a point H_a (rule W05); % NDG: line a and circle $k(E_c, C)$ intersect % DET: points C and H_a must be different;
7. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
8. Using the circle $k(E_c, C)$, the line h_b, the point E_c and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_c, C)$ intersect % DET: points H and H_b must be different;
9. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
10. Using the line h_a and the line b, construct a point A (rule W03); % NDG: lines h_a and b are not parallel % DET: lines h_a and b are not the same.

Non-degenerate conditions: lines h_a and b are not parallel; line h_b and circle $k(E_c, C)$ intersect; line a and circle $k(E_c, C)$ intersect; points C and E_c are not the same.

Determination conditions: lines h_a and b are not the same; points H_b and C are not the same; points H and H_b must be different; points H_a and H are not the same; points C and H_a must be different; points H and B are not the same; points C and M_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D21,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 12.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{c} 95 56.36
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{c}
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point B such that CB/CM_{a}=2
towards B C M_{a} 2
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0


% DET: points C and M_{a} are not the same
% Constructing a line a which passes through point C and point M_{a}
line a C M_{a}

color 200 200 200
drawline a
color 0 0 0
```

```
% DET: points H and B are not the same
% Constructing a line h_{b} which passes through point H and point B
line h_{b} H B

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points C and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point C
circle k(E_{c},C) E_{c} C

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line a and circle k(E_{c},C) intersect% DET: points C and H_{a} must be different
% Constructing a point P_{\_G31845} which is a foot of the point E_{c} on the line a
foot P_{\_G31845} E_{c} a
cmark_r P_{\_G31845}
color 200 200 200
drawline E_{c} P_{\_G31845}
color 0 0 0

% Constructing a point H_{a} which is an image of the point C in the symmetry to point/line P_{\_G
    31845}
sim H_{a} P_{\_G31845} C
cmark_r H_{a}


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{b} and circle k(E_{c},C) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G32083} which is a foot of the point E_{c} on the line h_{b}
foot P_{\_G32083} E_{c} h_{b}
cmark_r P_{\_G32083}
color 200 200 200
drawline E_{c} P_{\_G32083}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    32083}
sim H_{b} P_{\_G32083} H
cmark_l H_{b}
```

```
% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{a} and b are not parallel% DET: lines h_{a} and b are not the same
% Constructing a point A which belongs to line h_{a} and line b
intersec A h_{a} b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and b are not parallel; line h_{b} and circle k(E_{c},C)
    intersect; line a and circle k(E_{c},C) intersect; points C and E_{c} are not the same
% Determination conditions: lines h_{a} and b are not the same; points H_{b} and C are not the same
    ; points H and H_{b} must be different; points H_{a} and H are not the same; points C and H_{a}
     must be different; points H and B are not the same; points C and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 1741 terms.

Time Complexity: Time spent by the prover is 16.322 seconds.

NDG conditions Points C and M_a are not identical

Points C and M_a are not identical

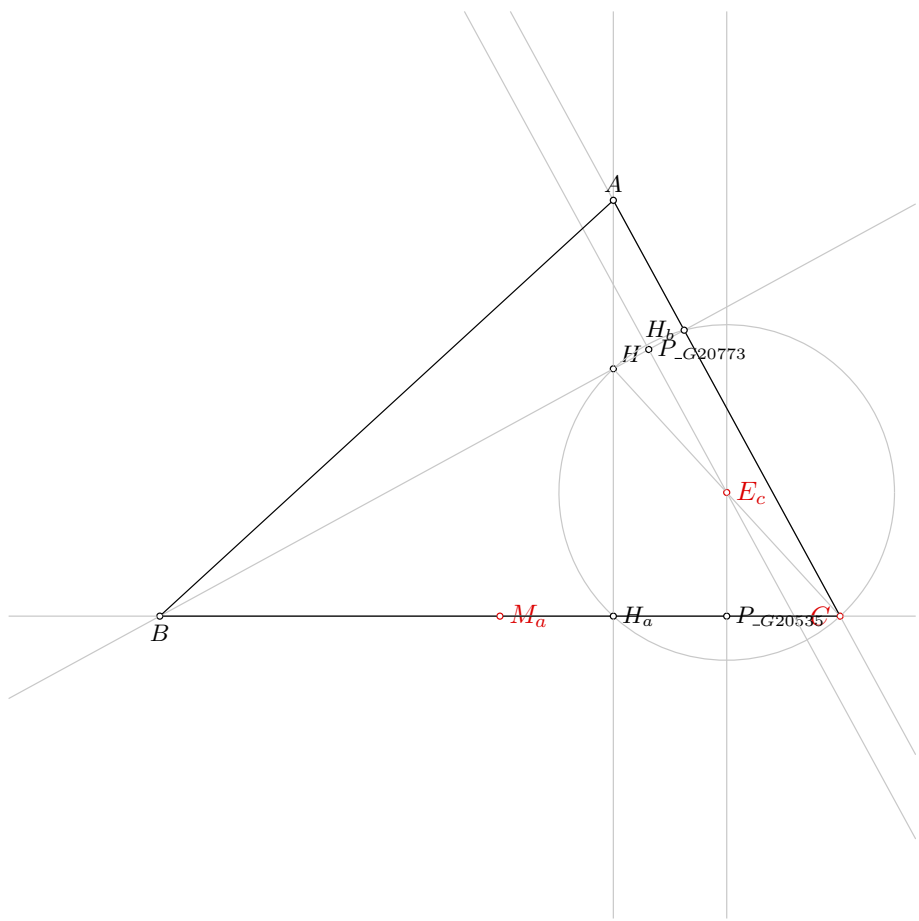

Figure 1: Illustration of the problem 0726

Points B and H are not identical

Line through points E_c and B is not perpendicular to line through points B and C

Line through points H_b and C is not parallel with line through points H and H_a

Points C and H_a are not identical

Points A, B and C are not collinear

Points B, C and H are not collinear

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{H_aH_bC} \neq S_{HH_bC}$ i.e., lines H_aH and H_bC are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving E_c=_E_c

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 117 terms.

Time Complexity: Time spent by the prover is 0.360 seconds.There are no ndg conditions.

4.3.3 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 8 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving $E_c{=}\_E_c$

Proving failed

4.4.3 Proving $M_a{=}\_M_a$

Proving failed

Problem 727

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 727: Given a point C, a point E_c and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point E_c, construct a point H (rule W01); ;
2. Using the point C and the point M_b, construct a point A (rule W01); ;
3. Using the point C and the point M_b, construct a line b (rule W02); % DET: points C and M_b are not the same;
4. Using the point H and the point A, construct a line h_a (rule W02); % DET: points H and A are not the same;
5. Using the point C and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points C and E_c are not the same;
6. Using the circle $k(E_c, C)$, the line b, the point E_c and the point C, construct a point H_b (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points C and H_b must be different;
7. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
8. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H and H_a must be different;
9. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
10. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; line h_a and circle $k(E_c, C)$ intersect; line b and circle $k(E_c, C)$ intersect; points C and E_c are not the same.

Determination conditions: lines h_b and a are not the same; points H_a and C are not the same; points H and H_a must be different; points H_b and H are not the same; points C and H_b must be different; points H and A are not the same; points C and M_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D22,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL09,L52,L53,L54]

Solving time: 12.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{c} 95 56.36
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{c}
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point A such that CA/CM_{b}=2
towards A C M_{b} 2
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0


% DET: points C and M_{b} are not the same
% Constructing a line b which passes through point C and point M_{b}
line b C M_{b}

color 200 200 200
drawline b
color 0 0 0
```

```
% DET: points H and A are not the same
% Constructing a line h_{a} which passes through point H and point A
line h_{a} H A

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points C and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point C
circle k(E_{c},C) E_{c} C

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points C and H_{b} must be different
% Constructing a point P_{\_G54417} which is a foot of the point E_{c} on the line b
foot P_{\_G54417} E_{c} b
cmark_r P_{\_G54417}
color 200 200 200
drawline E_{c} P_{\_G54417}
color 0 0 0

% Constructing a point H_{b} which is an image of the point C in the symmetry to point/line P_{\_G
    54417}
sim H_{b} P_{\_G54417} C
cmark_l H_{b}


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G54655} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G54655} E_{c} h_{a}
cmark_r P_{\_G54655}
color 200 200 200
drawline E_{c} P_{\_G54655}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    54655}
sim H_{a} P_{\_G54655} H
cmark_r H_{a}
```

```
% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; line h_{a} and circle k(E_{c},C)
    intersect; line b and circle k(E_{c},C) intersect; points C and E_{c} are not the same
% Determination conditions: lines h_{b} and a are not the same; points H_{a} and C are not the same
    ; points H and H_{a} must be different; points H_{b} and H are not the same; points C and H_{b}
     must be different; points H and A are not the same; points C and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.034 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

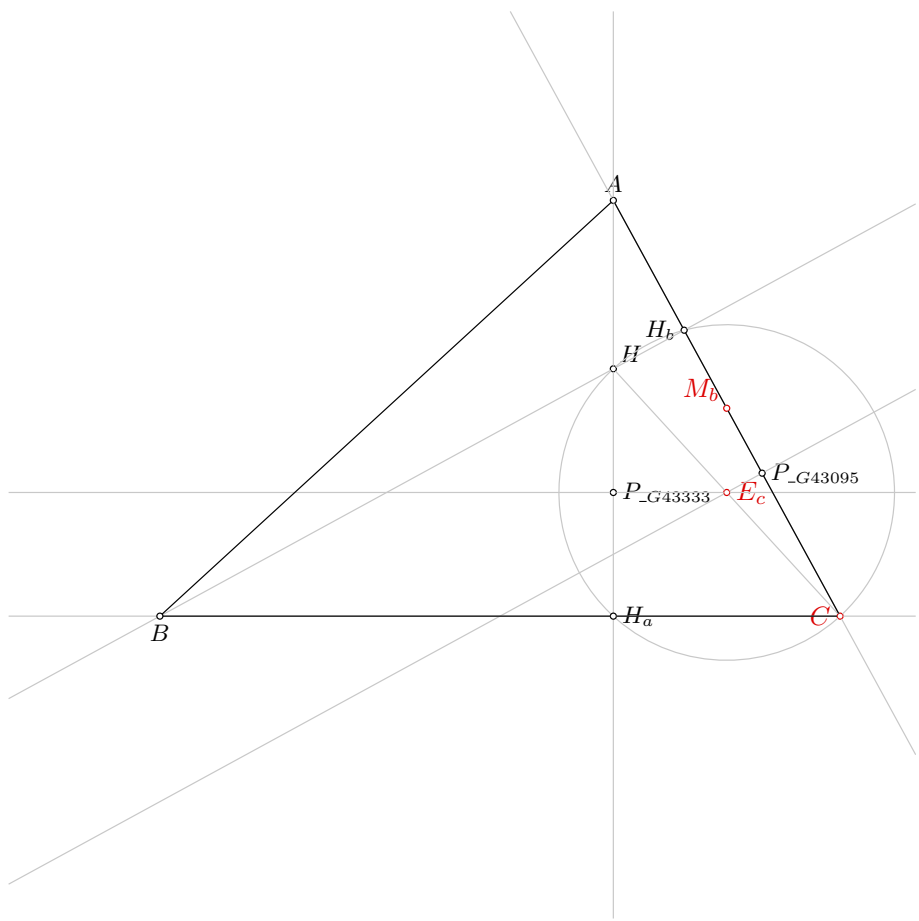

Figure 1: Illustration of the problem 0727

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{H_bH_aC} \neq S_{HH_aC}$ i.e., lines H_bH and H_aC are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving M_b=$\_M_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving E_c=$\_E_c$

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 117 terms.

Time Complexity: Time spent by the prover is 0.410 seconds.There are no ndg conditions.

4.3.3 Proving M_b=$\_M_b$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 8 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving E_c=$\_E_c$

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 728

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 728: Given a point C, a point E_c and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point E_c, construct a point H (rule W01); ;
2. Using the point C and the point M_c, construct a point G (rule W01); ;
3. Using the point H and the point G, construct a point N (rule W01); ;
4. Using the point H and the point G, construct a point O (rule W01); ;
5. Using the point C and the point E_c, construct a line h_c (rule W02); % DET: points C and E_c are not the same;
6. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
7. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
9. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same; points C and O are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points C and E_c are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL09,L11,L12,L16,L21,L24,L3,L57,L58]

Solving time: 9.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{c} 95 56.36
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{c}
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a line L_{\_G78192} which passes through point C and point M_{c}
line L_{\_G78192} C M_{c}

color 200 200 200
drawline L_{\_G78192}
color 0 0 0


% Constructing a point P_{\_G78293} with coordinates (0,0)
point P_{\_G78293} 0 0
cmark_r P_{\_G78293}

% Constructing a point P_{\_G78217} such that CP_{\_G78217}/CP_{\_G78293}=2
towards P_{\_G78217} C P_{\_G78293} 2
cmark_r P_{\_G78217}
color 200 200 200
drawsegment C P_{\_G78217}
color 0 0 0
```

```
% Constructing a point P_{\_G78262} such that CP_{\_G78262}/CP_{\_G78293}=3
towards P_{\_G78262} C P_{\_G78293} 3
cmark_r P_{\_G78262}
color 200 200 200
drawsegment C P_{\_G78262}
color 0 0 0

% Constructing a line L_{\_G78223} which passes through point M_{c} and point P_{\_G78262}
line L_{\_G78223} M_{c} P_{\_G78262}

color 200 200 200
drawline L_{\_G78223}
color 0 0 0


% Constructing a line L_{\_G78186} which contains the point P_{\_G78217} and is parallel to the
    line L_{\_G78223}
parallel L_{\_G78186} P_{\_G78217} L_{\_G78223}

color 200 200 200
drawline L_{\_G78186}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G78186} and line L_{\_G78192}
intersec G L_{\_G78186} L_{\_G78192}
cmark_t G



% Constructing a point N such that HN/HG=0.75
towards N H G 0.75
cmark_r N
color 200 200 200
drawsegment H G
color 0 0 0



% Constructing a point O such that HO/HG=1.5
towards O H G 1.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points C and E_{c} are not the same
% Constructing a line h_{c} which passes through point C and point E_{c}
line h_{c} C E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G79263} which is a foot of the point N on the line h_{c}
foot P_{\_G79263} N h_{c}
cmark_r P_{\_G79263}
color 200 200 200
drawline N P_{\_G79263}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G79263}
sim H_{c} P_{\_G79263} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

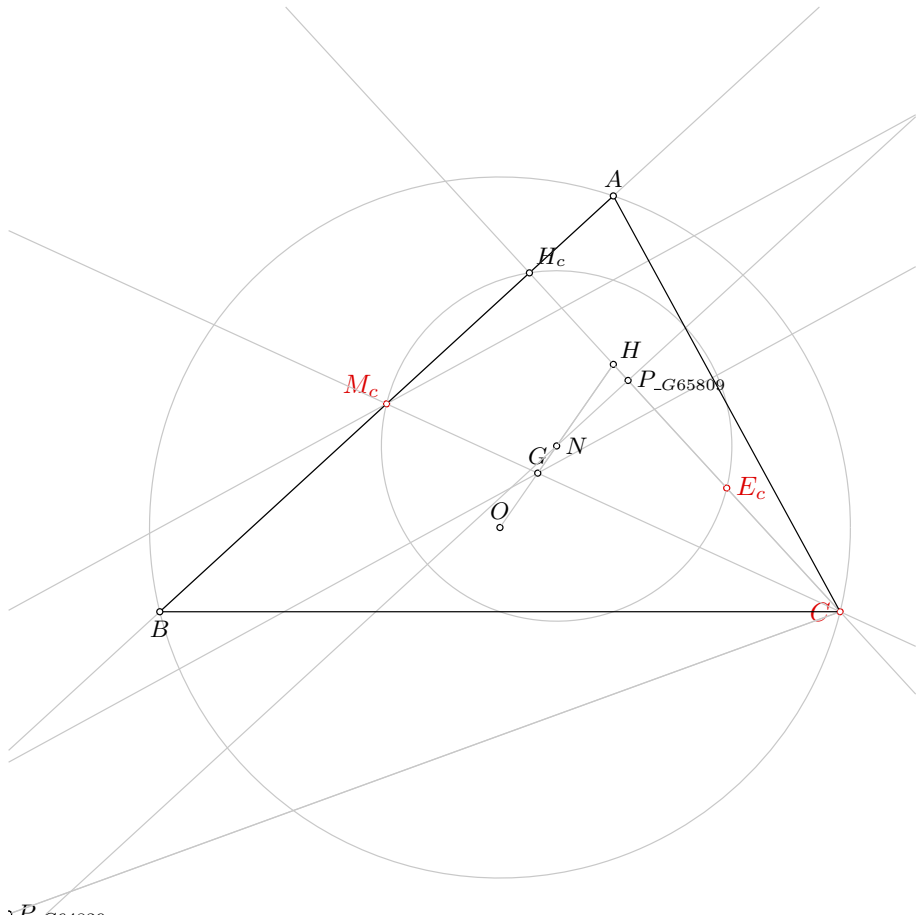

Figure 1: Illustration of the problem 0728

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; line h_{c} and circle k(N,M_{a})
    intersect; points E_{c} and N are not the same; points C and O are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points C and E_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=$\_E_c$

Proving failed

4.1.3 Proving M_c=$\_M_c$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{P_{\_G66208}CM_c} \neq S_{P^0_{L_{\_G66177}}CM_c}$ i.e., lines $P_{\_G66208}P^0_{L_{\_G66177}}$ and CM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving M_c=$\_M_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.2 Proving E_c=$\_E_c$

Proving failed

4.3.3 Proving M_c=$\_M_c$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 729

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 729: Given a point C, a point E_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point E_c, construct a point H (rule W01); ;
2. Using the point N and the point H, construct a point O (rule W01); ;
3. Using the point N and the point H, construct a point G (rule W01); ;
4. Using the point C and the point G, construct a point M_c (rule W01); ;
5. Using the point C and the point E_c, construct a line h_c (rule W02); % DET: points C and E_c are not the same;
6. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
7. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
9. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same; points C and O are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points C and E_c are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L16,L21,L24,L3,L57]

Solving time: 9.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{c} 95 56.36
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{c}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point O such that NO/NH=-1
towards O N H -1
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G114709} which passes through point N and point H
line L_{\_G114709} N H

color 200 200 200
drawline L_{\_G114709}
color 0 0 0


% Constructing a point P_{\_G114810} with coordinates (0,0)
point P_{\_G114810} 0 0
```

```
cmark_r P_{\_G114810}

% Constructing a point P_{\_G114734} such that NP_{\_G114734}/NP_{\_G114810}=-1
towards P_{\_G114734} N P_{\_G114810} -1
cmark_r P_{\_G114734}
color 200 200 200
drawsegment P_{\_G114810} P_{\_G114734}
color 0 0 0

% Constructing a point P_{\_G114779} such that NP_{\_G114779}/NP_{\_G114810}=3
towards P_{\_G114779} N P_{\_G114810} 3
cmark_r P_{\_G114779}
color 200 200 200
drawsegment N P_{\_G114779}
color 0 0 0

% Constructing a line L_{\_G114740} which passes through point H and point P_{\_G114779}
line L_{\_G114740} H P_{\_G114779}

color 200 200 200
drawline L_{\_G114740}
color 0 0 0


% Constructing a line L_{\_G114703} which contains the point P_{\_G114734} and is parallel to the
    line L_{\_G114740}
parallel L_{\_G114703} P_{\_G114734} L_{\_G114740}

color 200 200 200
drawline L_{\_G114703}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G114703} and line L_{\_G114709}
intersec G L_{\_G114703} L_{\_G114709}
cmark_t G



% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points C and E_{c} are not the same
% Constructing a line h_{c} which passes through point C and point E_{c}
line h_{c} C E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G115705} which is a foot of the point N on the line h_{c}
foot P_{\_G115705} N h_{c}
cmark_r P_{\_G115705}
color 200 200 200
drawline N P_{\_G115705}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G115705}
sim H_{c} P_{\_G115705} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

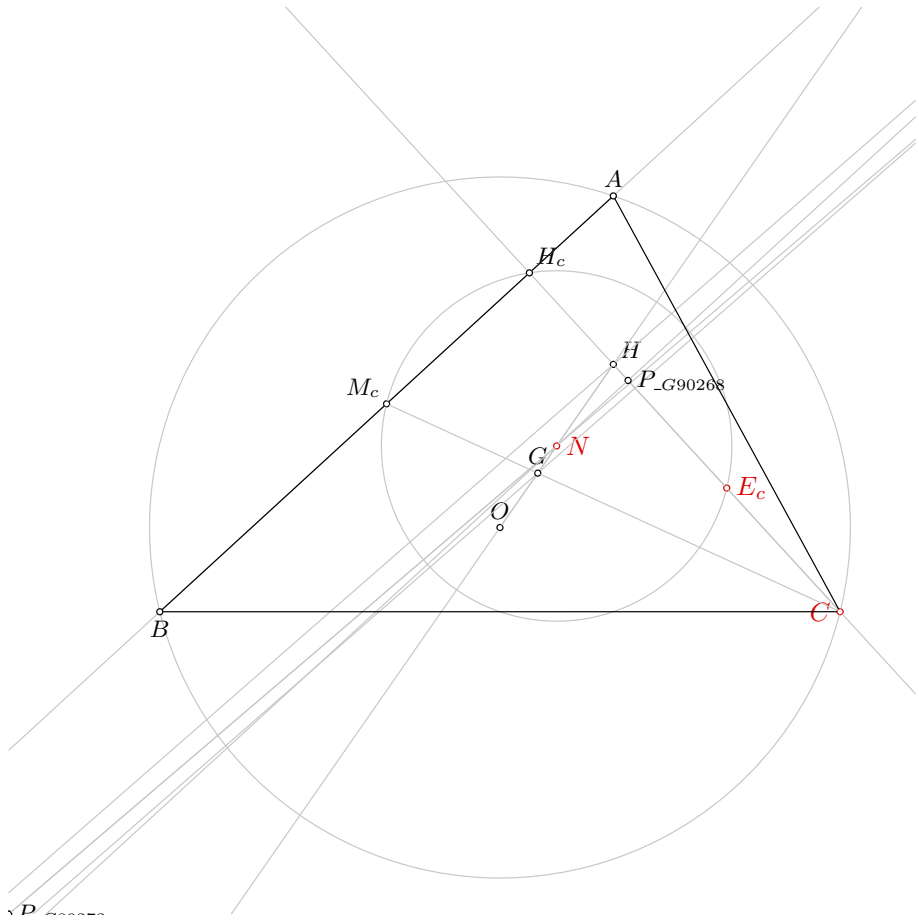

Figure 1: Illustration of the problem 0729

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; line h_{c} and circle k(N,M_{a})
    intersect; points E_{c} and N are not the same; points C and O are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points C and E_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.03 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=$\_E_c$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{P_{\_G90744}NH} \neq S_{P^0_{L_{\_G90713}}NH}$ i.e., lines $P_{\_G90744}P^0_{L_{\_G90713}}$ and NH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^4_{\_m_b}} \neq S_{F^3_{\_m_a}\_M_bF^4_{\_m_b}}$ i.e., lines $\_M_aF^3_{\_m_a}$ and $\_M_bF^4_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving E_c=$\_E_c$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $E_c{=}\_E_c$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 730

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 730: Given a point C, a point E_c and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point E_c, construct a point H (rule W01); ;
2. Using the point O and the point H, construct a point N (rule W01); ;
3. Using the point O and the point H, construct a point G (rule W01); ;
4. Using the point C and the point G, construct a point M_c (rule W01); ;
5. Using the point C and the point E_c, construct a line h_c (rule W02); % DET: points C and E_c are not the same;
6. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
7. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
9. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same; points C and O are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points C and E_c are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L21,L24,L3,L57,L58]

Solving time: 9.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{c} 95 56.36
point O 65 51.14

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{c}
cmark_t O
color 0 0 0
fontsize 8


% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point N such that ON/OH=0.5
towards N O H 0.5
cmark_r N
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a line L_{\_G145711} which passes through point O and point H
line L_{\_G145711} O H

color 200 200 200
drawline L_{\_G145711}
color 0 0 0


% Constructing a point P_{\_G145812} with coordinates (0,0)
point P_{\_G145812} 0 0
```

```
cmark_r P_{\_G145812}

% Constructing a point P_{\_G145736} such that OP_{\_G145736}/OP_{\_G145812}=1
towards P_{\_G145736} O P_{\_G145812} 1
cmark_r P_{\_G145736}
color 200 200 200
drawsegment O P_{\_G145736}
color 0 0 0

% Constructing a point P_{\_G145781} such that OP_{\_G145781}/OP_{\_G145812}=3
towards P_{\_G145781} O P_{\_G145812} 3
cmark_r P_{\_G145781}
color 200 200 200
drawsegment O P_{\_G145781}
color 0 0 0

% Constructing a line L_{\_G145742} which passes through point H and point P_{\_G145781}
line L_{\_G145742} H P_{\_G145781}

color 200 200 200
drawline L_{\_G145742}
color 0 0 0


% Constructing a line L_{\_G145705} which contains the point P_{\_G145736} and is parallel to the
    line L_{\_G145742}
parallel L_{\_G145705} P_{\_G145736} L_{\_G145742}

color 200 200 200
drawline L_{\_G145705}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G145705} and line L_{\_G145711}
intersec G L_{\_G145705} L_{\_G145711}
cmark_t G



% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points C and E_{c} are not the same
% Constructing a line h_{c} which passes through point C and point E_{c}
line h_{c} C E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G146699} which is a foot of the point N on the line h_{c}
foot P_{\_G146699} N h_{c}
cmark_r P_{\_G146699}
color 200 200 200
drawline N P_{\_G146699}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G146699}
sim H_{c} P_{\_G146699} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

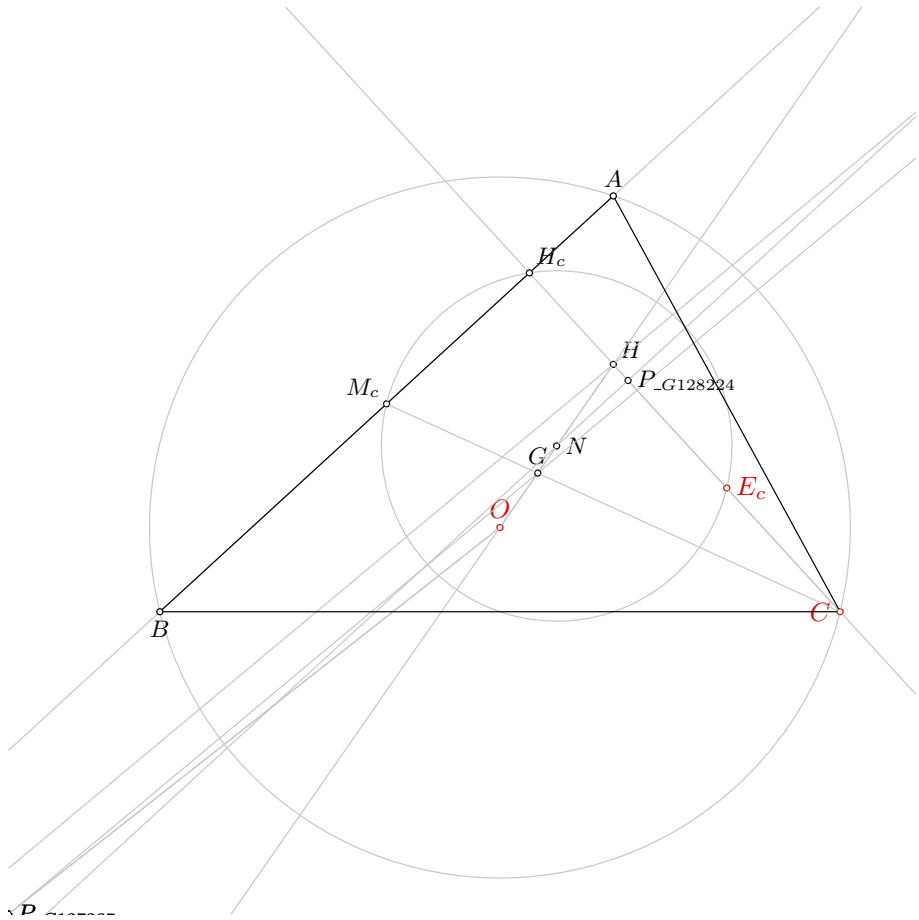

Figure 1: Illustration of the problem 0730

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; line h_{c} and circle k(N,M_{a})
    intersect; points E_{c} and N are not the same; points C and O are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points C and E_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.036 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=$\_E_c$

Proving failed

4.1.3 Proving O=$\_O$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 4143 terms.

Time Complexity: Time spent by the prover is 17.205 seconds.

NDG conditions Points H, O and $P_{\_G142682}$ are not collinear

Points H_c, C and $P_{\_G142682}$ are not collinear

Points H_c and M_c are not identical

Points M_c and H are not identical

Points A, B and C are not collinear

Points E_c, B and C are not collinear

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{P_{\_G128706}OH} \neq S_{P^0_{L_{\_G128675}}OH}$ i.e., lines $P_{\_G128706}P^0_{L_{\_G128675}}$ and OH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^4_{\_m_b}} \neq S_{F^3_{\_m_a}\_M_bF^4_{\_m_b}}$ i.e., lines $\_M_aF^3_{\_m_a}$ and $\_M_bF^4_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 731

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 731: Given a point C, a point E_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 732

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 732: Given a point C, a point E_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 733

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 733: Given a point C, a point E_c and a point T_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point E_c, construct a point H (rule W01); ;
2. Using the point C and the point E_c, construct a line h_c (rule W02); % DET: points C and E_c are not the same;
3. Using the point C and the point T_c, construct a line s_c (rule W02); % DET: points C and T_c are not the same;
4. Using the point T_c and the line h_c, construct a line c (rule W10a); ;
5. Using the point E_c, the point C, the point T_c, the line s_c and the line h_c, construct a line CO (rule W17); % NDG: points C and T_c are not the same; points E_c and C are not the same % DET: points C and T_c are not the same;
6. Using the point E_c and the line CO, construct a line $m(H_bH_a)$ (rule W16); ;
7. Using the line $m(H_bH_a)$ and the line c, construct a point M_c (rule W03); % NDG: lines $m(H_bH_a)$ and c are not parallel % DET: lines $m(H_bH_a)$ and c are not the same;
8. Using the point M_c and the point C, construct a point G (rule W01); ;
9. Using the point H and the point G, construct a point O (rule W01); ;
10. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
11. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; lines $m(H_bH_a)$ and c are not parallel; points C and T_c are not the same; points E_c and C are not the same.

Determination conditions: lines $m(H_bH_a)$ and c are not the same; points C and T_c are not the same; points C and T_c are not the same; points C and E_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W16,W17]

Lemmas used: [D10,D20,D25,D26,D30,GD01,GD02,GL01,GL03,GL04,GL09,GL17,L106,L11,L12,L3,L41,L42,L

Solving time: 27.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point E_{c} 95 56.36
point T_{c} 55.38 72.43

color 220 0 0
fontsize 9

cmark_l C
cmark_r E_{c}
cmark_rt T_{c}
color 0 0 0
fontsize 8


% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points C and E_{c} are not the same
% Constructing a line h_{c} which passes through point C and point E_{c}
line h_{c} C E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% DET: points C and T_{c} are not the same
% Constructing a line s_{c} which passes through point C and point T_{c}
line s_{c} C T_{c}

color 200 200 200
drawline s_{c}
color 0 0 0
```

```
% Constructing a line c which is perpendicular to line h_{c} and which passes through point T_{c}
perp c T_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and T_{c} are not the same; points E_{c} and C are not the same% DET: points C and
    T_{c} are not the same
% Constructing an angle V[_G184813] which is equal to the angle E_{c}CT_{c}
angle_o V[_G184813] E_{c} C T_{c}


% Calculating value angle[_G184892] using formula 1/pow(2,0)*V[_G184813]+0/pow(2,0)*180
expression angle[_G184892] { 1/pow(2,0)*V[_G184813]+0/pow(2,0)*180 }


% Constructing a point P_{\_G184889} which is an image of the point T_{c} in a rotation around the
    point C for the angle 1/pow(2,0)*V[_G184813]+0/pow(2,0)*180
rotate P_{\_G184889} C angle[_G184892] T_{c}
cmark_r P_{\_G184889}
color 200 200 200
drawarc_p C T_{c} angle[_G184892]
color 0 0 0

% Constructing a line CO which passes through point C and point P_{\_G184889}
line CO C P_{\_G184889}

color 200 200 200
drawline CO
color 0 0 0



% Constructing a line m(H_{b}H_{a}) which contains the point E_{c} and is parallel to the line CO
parallel m(H_{b}H_{a}) E_{c} CO

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: lines m(H_{b}H_{a}) and c are not parallel% DET: lines m(H_{b}H_{a}) and c are not the same
% Constructing a point M_{c} which belongs to line m(H_{b}H_{a}) and line c
intersec M_{c} m(H_{b}H_{a}) c
cmark_lt M_{c}



% Constructing a line L_{\_G185414} which passes through point M_{c} and point C
```

```
line L_{\_G185414} M_{c} C

color 200 200 200
drawline L_{\_G185414}
color 0 0 0


% Constructing a point P_{\_G185515} with coordinates (0,0)
point P_{\_G185515} 0 0
cmark_r P_{\_G185515}

% Constructing a point P_{\_G185439} such that M_{c}P_{\_G185439}/M_{c}P_{\_G185515}=1
towards P_{\_G185439} M_{c} P_{\_G185515} 1
cmark_r P_{\_G185439}
color 200 200 200
drawsegment M_{c} P_{\_G185439}
color 0 0 0

% Constructing a point P_{\_G185484} such that M_{c}P_{\_G185484}/M_{c}P_{\_G185515}=3
towards P_{\_G185484} M_{c} P_{\_G185515} 3
cmark_r P_{\_G185484}
color 200 200 200
drawsegment M_{c} P_{\_G185484}
color 0 0 0

% Constructing a line L_{\_G185445} which passes through point C and point P_{\_G185484}
line L_{\_G185445} C P_{\_G185484}

color 200 200 200
drawline L_{\_G185445}
color 0 0 0


% Constructing a line L_{\_G185408} which contains the point P_{\_G185439} and is parallel to the
    line L_{\_G185445}
parallel L_{\_G185408} P_{\_G185439} L_{\_G185445}

color 200 200 200
drawline L_{\_G185408}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G185408} and line L_{\_G185414}
intersec G L_{\_G185408} L_{\_G185414}
cmark_t G



% Constructing a point O such that HO/HG=1.5
towards O H G 1.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0
```

```
% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    lines m(H_{b}H_{a}) and c are not parallel; points C and T_{c} are not the same; points E_{c}
    and C are not the same
% Determination conditions: lines m(H_{b}H_{a}) and c are not the same; points C and T_{c} are not
    the same; points C and T_{c} are not the same; points C and E_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving E_c=_E_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 103 terms.

Time Complexity: Time spent by the prover is 3.815 seconds.

NDG conditions Points A and B are not identical

Points H and T_c are not identical

Line through points E_c and H is not perpendicular to line through points H and C

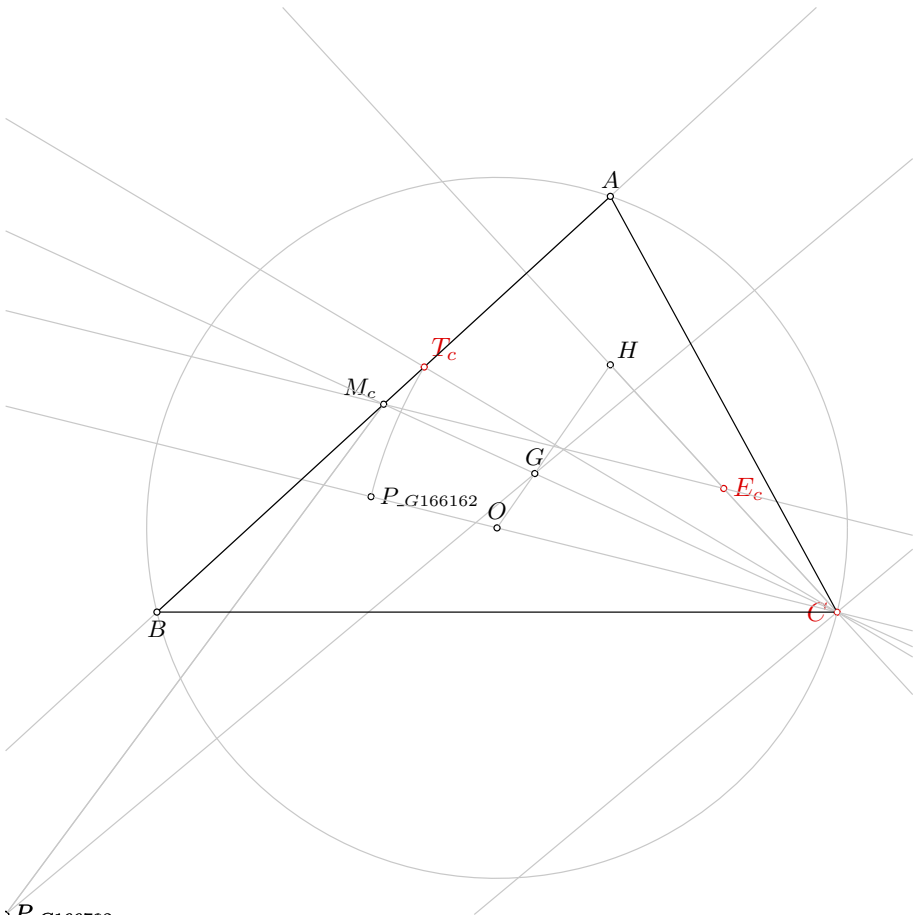

Figure 1: Illustration of the problem 0733

Points $P_{\_G179800}$, C and M_c are not collinear

Points $P_{\_G179800}$ and H are not identical

Points A, B and C are not collinear

4.1.3 Proving T_c=$\_T_c$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{T_cCE_c} \neq 0$ i.e., points T_c, C and E_c are not collinear (foot is not the point itself; construction based assumption)

$S_{E_cT_cF_c^0} \neq S_{P^1_{m(H_bH_a)}T_cF_c^0}$ i.e., lines $E_cP^1_{m(H_bH_a)}$ and $T_cF_c^0$ are not parallel (construction based assumption)

$S_{P_{\_G168587}M_cC} \neq S_{P^2_{L_{\_G168556}}M_cC}$ i.e., lines $P_{\_G168587}P^2_{L_{\_G168556}}$ and M_cC are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving T_c=$\_T_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving E_c=$\_E_c$

Proving failed

4.3.3 Proving T_c=$\_T_c$

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 8 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $E_c{=}\_E_c$

Proving failed

4.4.3 Proving $T_c{=}\_T_c$

Proving failed

Problem 734

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 734: Given a point C, a point G and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point G, construct a point M_c (rule W01); ;
2. Using the point G and the point N, construct a point H (rule W01); ;
3. Using the point C and the point H, construct a point E_c (rule W01); ;
4. Using the point G and the point N, construct a point O (rule W01); ;
5. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
6. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
7. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
9. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; line h_c and circle $k(N, M_a)$ intersect; points M_c and N are not the same; points C and O are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points C and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L18,L21,L24,L3,L57]

Solving time: 9.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point G 70 58.33
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_t G
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0



% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point E_{c} such that CE_{c}/CH=0.5
towards E_{c} C H 0.5
cmark_r E_{c}
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point O such that GO/GN=-2
```

```
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0


% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G221439} which is a foot of the point N on the line h_{c}
foot P_{\_G221439} N h_{c}
cmark_r P_{\_G221439}
color 200 200 200
drawline N P_{\_G221439}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G221439}
sim H_{c} P_{\_G221439} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
```

```
drawline c
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; line h_{c} and circle k(N,M_{a})
    intersect; points M_{c} and N are not the same; points C and O are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points C and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving G=$\_G$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{AB\_M_b} \neq S_{\_M_aB\_M_b}$ i.e., lines A_M_a and B_M_b are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

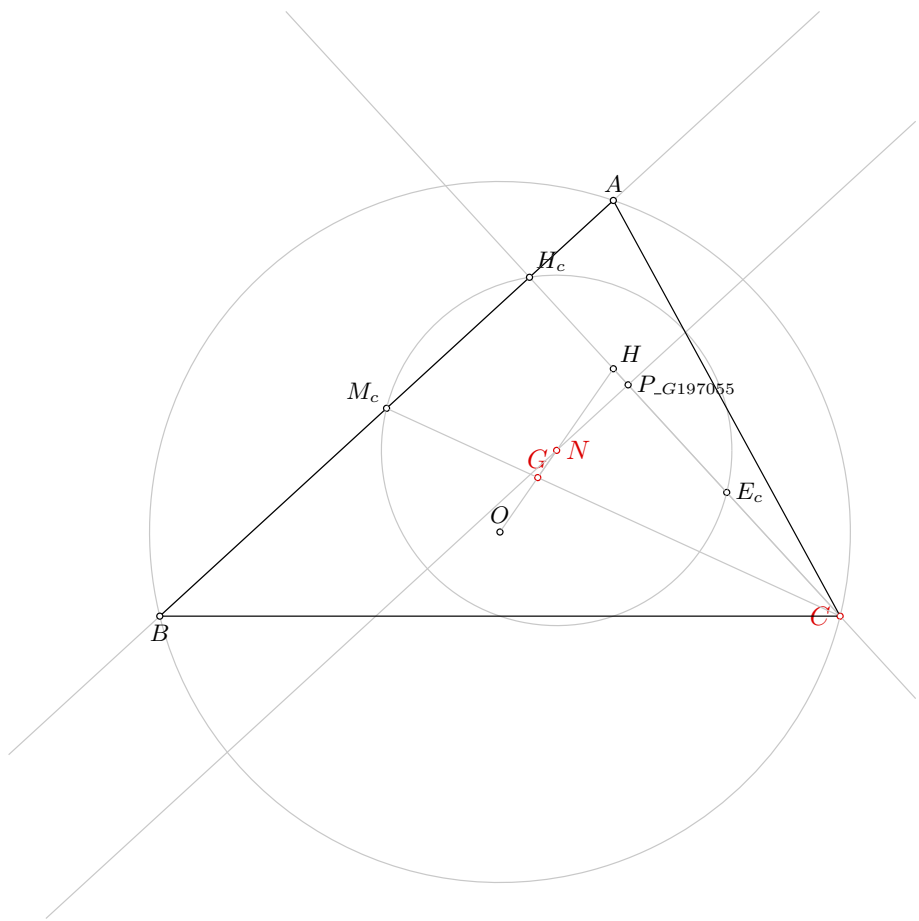

Figure 1: Illustration of the problem 0734

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)
Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 735

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 735: Given a point C, a point H and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point H, construct a point E_c (rule W01); ;
2. Using the point H and the point N, construct a point O (rule W01); ;
3. Using the point H and the point N, construct a point G (rule W01); ;
4. Using the point C and the point G, construct a point M_c (rule W01); ;
5. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
6. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
7. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
9. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same; points C and O are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points C and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL09,L11,L12,L16,L21,L24,L3,L57]

Solving time: 9.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point H 80 72.73
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_rt H
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point E_{c} such that CE_{c}/CH=0.5
towards E_{c} C H 0.5
cmark_r E_{c}
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G257771} which passes through point H and point N
line L_{\_G257771} H N

color 200 200 200
drawline L_{\_G257771}
color 0 0 0


% Constructing a point P_{\_G257872} with coordinates (0,0)
point P_{\_G257872} 0 0
```

```
cmark_r P_{\_G257872}

% Constructing a point P_{\_G257796} such that HP_{\_G257796}/HP_{\_G257872}=4
towards P_{\_G257796} H P_{\_G257872} 4
cmark_r P_{\_G257796}
color 200 200 200
drawsegment H P_{\_G257796}
color 0 0 0

% Constructing a point P_{\_G257841} such that HP_{\_G257841}/HP_{\_G257872}=3
towards P_{\_G257841} H P_{\_G257872} 3
cmark_r P_{\_G257841}
color 200 200 200
drawsegment H P_{\_G257841}
color 0 0 0

% Constructing a line L_{\_G257802} which passes through point N and point P_{\_G257841}
line L_{\_G257802} N P_{\_G257841}

color 200 200 200
drawline L_{\_G257802}
color 0 0 0


% Constructing a line L_{\_G257765} which contains the point P_{\_G257796} and is parallel to the
    line L_{\_G257802}
parallel L_{\_G257765} P_{\_G257796} L_{\_G257802}

color 200 200 200
drawline L_{\_G257765}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G257765} and line L_{\_G257771}
intersec G L_{\_G257765} L_{\_G257771}
cmark_t G



% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G258759} which is a foot of the point N on the line h_{c}
foot P_{\_G258759} N h_{c}
cmark_r P_{\_G258759}
color 200 200 200
drawline N P_{\_G258759}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G258759}
sim H_{c} P_{\_G258759} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

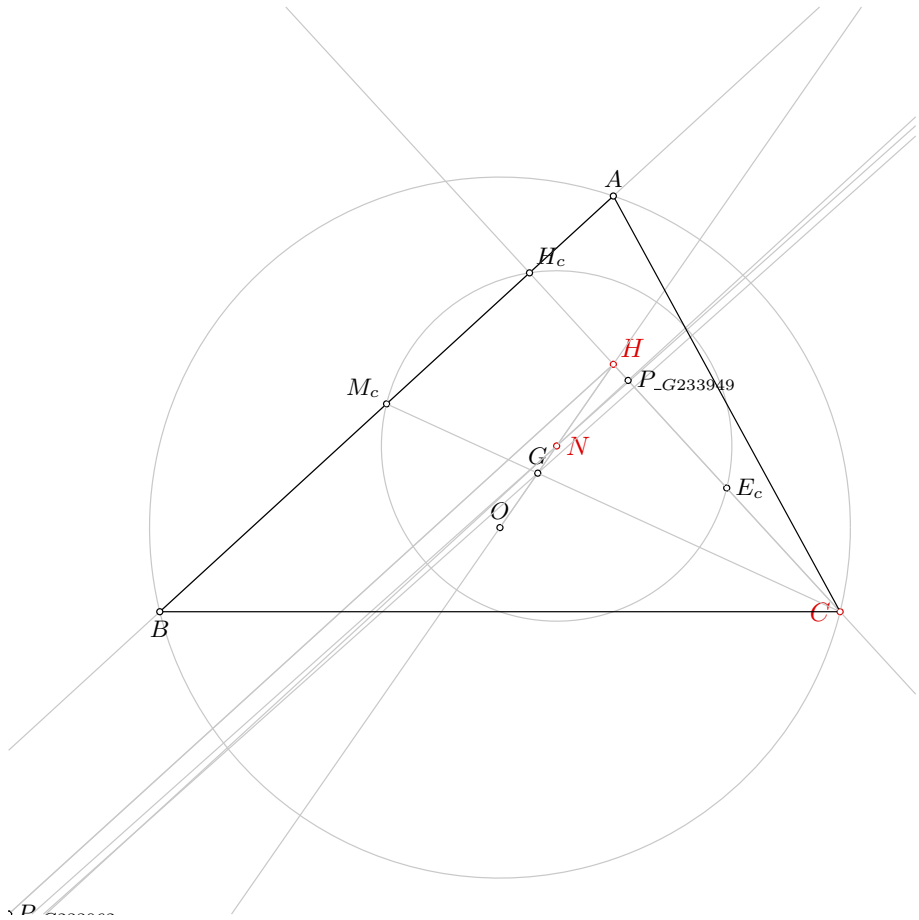

Figure 1: Illustration of the problem 0735

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; line h_{c} and circle k(N,M_{a})
    intersect; points E_{c} and N are not the same; points C and O are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points C and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.034 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H=$\_H$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{P_{\_G234434}HN} \neq S_{P^0_{L_{\_G234403}}HN}$ i.e., lines $P_{\_G234434}P^0_{L_{\_G234403}}$ and HN are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^2_{\_h_b}} \neq S_{F^1_{\_h_a}BF^2_{\_h_b}}$ i.e., lines $AF^1_{\_h_a}$ and $BF^2_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^4_{\_m_b}} \neq S_{F^3_{\_m_a}\_M_bF^4_{\_m_b}}$ i.e., lines $\_M_aF^3_{\_m_a}$ and $\_M_bF^4_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving H=$\_H$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving H=$\_H$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $H{=}\_H$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 736

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 736: Given a point C, a point H_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;

2. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;

3. Using the circle $k(N, M_a)$, the line a, the point N and the point H_a, construct a point M_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points H_a and M_a must be different;

4. Using the point M_a and the point C, construct a point B (rule W01); ;

5. Using the point N and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points N and M_a are not the same;

6. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;

7. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;

8. Using the point C and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points C and M_a are not the same;

9. Using the circle $k(N, M_a)$ and the circle $k(M_a, B)$, construct a point H_b and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_a, B)$ intersect % DET: circles $k(N, M_a)$ and $k(M_a, B)$ are not the same;

10. Using the point C and the point H_b, construct a line b (rule W02); % DET: points C and H_b are not the same;

11. Using the line h_a and the line b, construct a point A (rule W03); % NDG: lines h_a and b are not parallel % DET: lines h_a and b are not the same.

Non-degenerate conditions: lines h_a and b are not parallel; circles $k(N, M_a)$ and $k(M_a, B)$ intersect; points C and M_a are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; line a and circle $k(N, M_a)$ intersect; points H_a and N are not the same.

Determination conditions: lines h_a and b are not the same; points C and H_b are not the same; circles $k(N, M_a)$ and $k(M_a, B)$ are not the same; points E_a and H_a are not the same; points M_a and E_a must be different; points N and M_a are not the same; points H_a and M_a must be different; points C and H_a are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D21,D28,D3,D32,D5,D6,D8,GD01,GD02,GL01,GL03,GL04,GL09,L19,L20,L21,L22,L37,L38,L3

Solving time: 4.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point H_{a} 80 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_r H_{a}
cmark_r N
color 0 0 0
fontsize 8

% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% NDG: line a and circle k(N,M_{a}) intersect% DET: points H_{a} and M_{a} must be different
% Constructing a point P_{\_G45212} which is a foot of the point N on the line a
foot P_{\_G45212} N a
cmark_r P_{\_G45212}
color 200 200 200
drawline N P_{\_G45212}
color 0 0 0

% Constructing a point M_{a} which is an image of the point H_{a} in the symmetry to point/line P
    _{\_G45212}
sim M_{a} P_{\_G45212} H_{a}
cmark_r M_{a}



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0


% DET: points N and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point N and point M_{a}
line m(H_{b}H_{c}) N M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points C and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point C
circle k(M_{a},B) M_{a} C
```

```
color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{a},B) intersect% DET: circles k(N,M_{a}) and k(M_{a},B) are not
    the same
% Constructing points H_{b} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{a},B)
intersec2 H_{b} H_{c} k(N,M_{a}) k(M_{a},B)
cmark_l H_{b}
cmark_rt H_{c}


% DET: points C and H_{b} are not the same
% Constructing a line b which passes through point C and point H_{b}
line b C H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{a} and b are not parallel% DET: lines h_{a} and b are not the same
% Constructing a point A which belongs to line h_{a} and line b
intersec A h_{a} b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and b are not parallel; circles k(N,M_{a}) and k(M_{a},B)
    intersect; points C and M_{a} are not the same; line m(H_{b}H_{c}) and circle k(N,M_{a})
    intersect; line a and circle k(N,M_{a}) intersect; points H_{a} and N are not the same
% Determination conditions: lines h_{a} and b are not the same; points C and H_{b} are not the same
    ; circles k(N,M_{a}) and k(M_{a},B) are not the same; points E_{a} and H_{a} are not the same;
    points M_{a} and E_{a} must be different; points N and M_{a} are not the same; points H_{a} and
     M_{a} must be different; points C and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

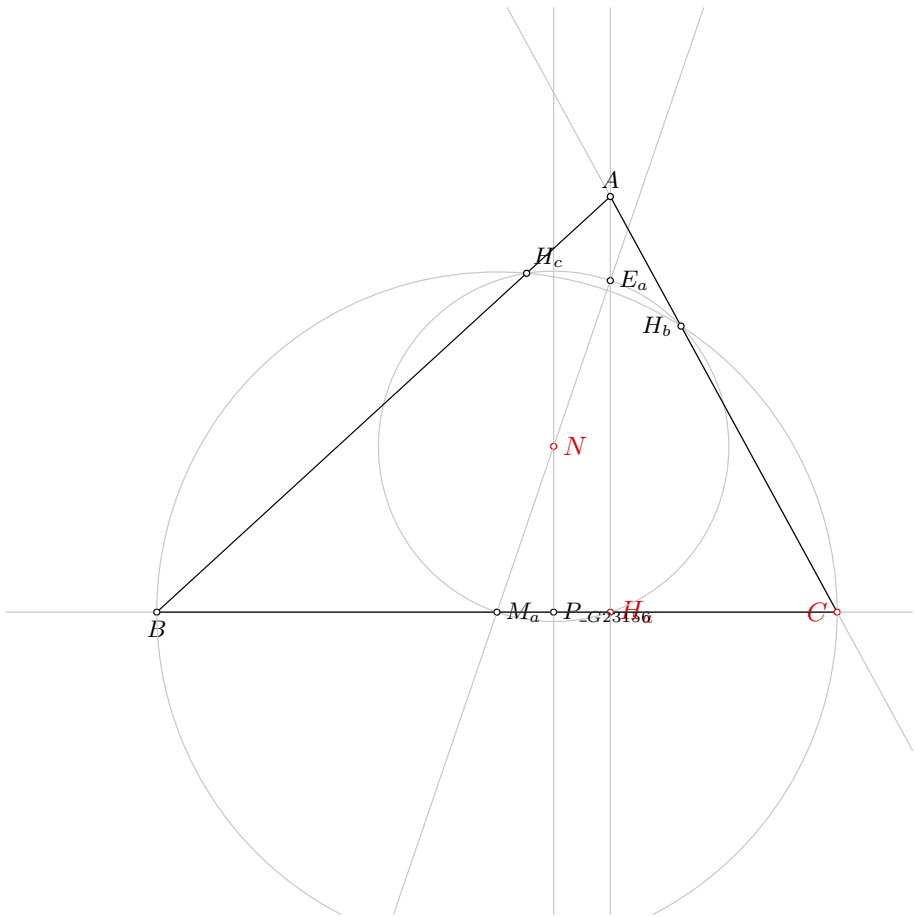

Figure 1: Illustration of the problem 0736

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H_a=$\_H_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 18 terms.

Time Complexity: Time spent by the prover is 0.407 seconds.

NDG conditions Points N and M_a are not identical

Line through points C and N is not perpendicular to line through points N and H_a

Line through points H_b and C is not parallel with line through points E_a and H_a

Points B, H_a and E_a are not collinear

Point B is not on circle with center H_a and point from it C

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{E_aCH_b} \neq S_{H_aCH_b}$ i.e., lines E_aH_a and CH_b are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^0_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving H_a=$\_H_a$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Proving failed

4.3.2 Proving H_a=$\_H_a$

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 737

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 737: Given a point C, a point H_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point H_b, construct a line b (rule W02); % DET: points C and H_b are not the same;

2. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;

3. Using the circle $k(N, M_a)$, the line b, the point N and the point H_b, construct a point M_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points H_b and M_b must be different;

4. Using the point M_b and the point C, construct a point A (rule W01); ;

5. Using the point N and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points N and M_b are not the same;

6. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point M_b, construct a point E_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_b and E_b must be different;

7. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;

8. Using the point C and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points C and M_b are not the same;

9. Using the circle $k(N, M_a)$ and the circle $k(M_b, C)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_b, C)$ intersect % DET: circles $k(N, M_a)$ and $k(M_b, C)$ are not the same;

10. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;

11. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; circles $k(N, M_a)$ and $k(M_b, C)$ intersect; points C and M_b are not the same; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; line b and circle $k(N, M_a)$ intersect; points H_b and N are not the same.

Determination conditions: lines h_b and a are not the same; points C and H_a are not the same; circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points E_b and H_b are not the same; points M_b and E_b must be different; points N and M_b are not the same; points H_b and M_b must be different; points C and H_b are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D22,D29,D3,D32,D5,D6,D9,GD01,GD02,GL01,GL03,GL04,GL09,L17,L19,L20,L21,L23,L44,L4

Solving time: 4.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point H_{b} 89.36 77.83
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_l H_{b}
cmark_r N
color 0 0 0
fontsize 8

% DET: points C and H_{b} are not the same
% Constructing a line b which passes through point C and point H_{b}
line b C H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% NDG: line b and circle k(N,M_{a}) intersect% DET: points H_{b} and M_{b} must be different
% Constructing a point P_{\_G80580} which is a foot of the point N on the line b
foot P_{\_G80580} N b
cmark_r P_{\_G80580}
color 200 200 200
drawline N P_{\_G80580}
color 0 0 0

% Constructing a point M_{b} which is an image of the point H_{b} in the symmetry to point/line P
    _{\_G80580}
sim M_{b} P_{\_G80580} H_{b}
cmark_lt M_{b}



% Constructing a point A such that M_{b}A/M_{b}C=-1
towards A M_{b} C -1
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0


% DET: points N and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point N and point M_{b}
line m(H_{a}H_{c}) N M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{b} and E_{b} must be
    different
% Constructing a point E_{b} which is an image of the point M_{b} in the symmetry to point/line N
sim E_{b} N M_{b}
cmark_r E_{b}


% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points C and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point C
circle k(M_{b},C) M_{b} C
```

```
color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{b},C) intersect% DET: circles k(N,M_{a}) and k(M_{b},C) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{b},C)
intersec2 H_{a} H_{c} k(N,M_{a}) k(M_{b},C)
cmark_r H_{a}
cmark_rt H_{c}


% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; circles k(N,M_{a}) and k(M_{b},C)
    intersect; points C and M_{b} are not the same; line m(H_{a}H_{c}) and circle k(N,M_{a})
    intersect; line b and circle k(N,M_{a}) intersect; points H_{b} and N are not the same
% Determination conditions: lines h_{b} and a are not the same; points C and H_{a} are not the same
    ; circles k(N,M_{a}) and k(M_{b},C) are not the same; points E_{b} and H_{b} are not the same;
    points M_{b} and E_{b} must be different; points N and M_{b} are not the same; points H_{b} and
     M_{b} must be different; points C and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

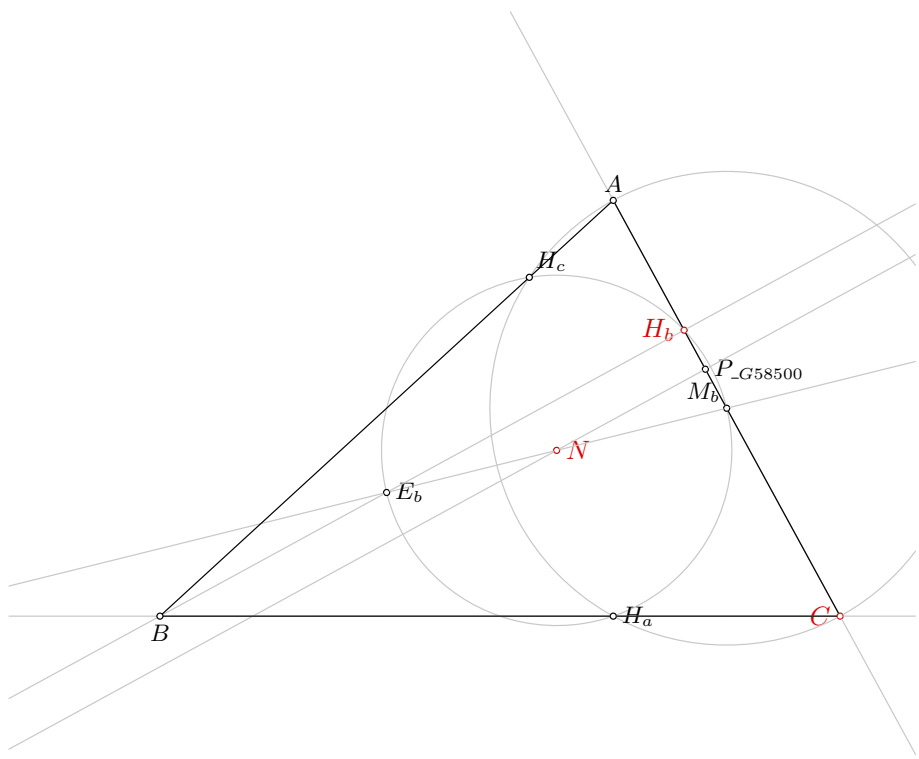

Figure 1: Illustration of the problem 0737

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H_b=$\_H_b$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 18 terms.

Time Complexity: Time spent by the prover is 0.387 seconds.

NDG conditions Points M_b and N are not identical

Points M_b, $P_{\_G73304}$ and N are not collinear

Line through points H_b and E_b is not parallel with line through points C and H_a

Points $P_{\_G73304}$, C and E_b are not collinear

Points A and C are not identical

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{E_bCH_a} \neq S_{H_bCH_a}$ i.e., lines E_bH_b and CH_a are not parallel (construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^0_{\_h_b}} \neq S_{CBF^0_{\_h_b}}$ i.e., lines AC and $BF^0_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^0_{\_h_b}} \neq S_{F^3_{\_h_a}BF^0_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^0_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving H_b=$\_H_b$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Proving failed

4.3.2 Proving H_b=$\_H_b$

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 738

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 738: Given a point C, a point H_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point H_c, construct a line h_c (rule W02); % DET: points C and H_c are not the same;
2. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;
3. Using the circle $k(N, M_a)$, the line h_c, the point N and the point H_c, construct a point E_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points H_c and E_c must be different;
4. Using the point E_c and the point C, construct a point H (rule W01); ;
5. Using the point N and the point H, construct a point O (rule W01); ;
6. Using the point N and the point H, construct a point G (rule W01); ;
7. Using the point C and the point G, construct a point M_c (rule W01); ;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points H_c and E_c must be different; points C and H_c are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L16,L21,L24,L3,L57]

Solving time: 3.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point H_{c} 68.91 84.83
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_rt H_{c}
cmark_r N
color 0 0 0
fontsize 8

% DET: points C and H_{c} are not the same
% Constructing a line h_{c} which passes through point C and point H_{c}
line h_{c} C H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points H_{c} and E_{c} must be different
% Constructing a point P_{\_G116575} which is a foot of the point N on the line h_{c}
foot P_{\_G116575} N h_{c}
cmark_r P_{\_G116575}
color 200 200 200
drawline N P_{\_G116575}
color 0 0 0
```

```
% Constructing a point E_{c} which is an image of the point H_{c} in the symmetry to point/line P
    _{\_G116575}
sim E_{c} P_{\_G116575} H_{c}
cmark_r E_{c}



% Constructing a point H such that E_{c}H/E_{c}C=-1
towards H E_{c} C -1
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point O such that NO/NH=-1
towards O N H -1
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G116837} which passes through point N and point H
line L_{\_G116837} N H

color 200 200 200
drawline L_{\_G116837}
color 0 0 0


% Constructing a point P_{\_G116938} with coordinates (0,0)
point P_{\_G116938} 0 0
cmark_r P_{\_G116938}

% Constructing a point P_{\_G116862} such that NP_{\_G116862}/NP_{\_G116938}=-1
towards P_{\_G116862} N P_{\_G116938} -1
cmark_r P_{\_G116862}
color 200 200 200
drawsegment P_{\_G116938} P_{\_G116862}
color 0 0 0

% Constructing a point P_{\_G116907} such that NP_{\_G116907}/NP_{\_G116938}=3
towards P_{\_G116907} N P_{\_G116938} 3
cmark_r P_{\_G116907}
color 200 200 200
drawsegment N P_{\_G116907}
color 0 0 0

% Constructing a line L_{\_G116868} which passes through point H and point P_{\_G116907}
line L_{\_G116868} H P_{\_G116907}

color 200 200 200
drawline L_{\_G116868}
```

```
color 0 0 0


% Constructing a line L_{\_G116831} which contains the point P_{\_G116862} and is parallel to the
    line L_{\_G116868}
parallel L_{\_G116831} P_{\_G116862} L_{\_G116868}

color 200 200 200
drawline L_{\_G116831}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G116831} and line L_{\_G116837}
intersec G L_{\_G116831} L_{\_G116837}
cmark_t G



% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
```

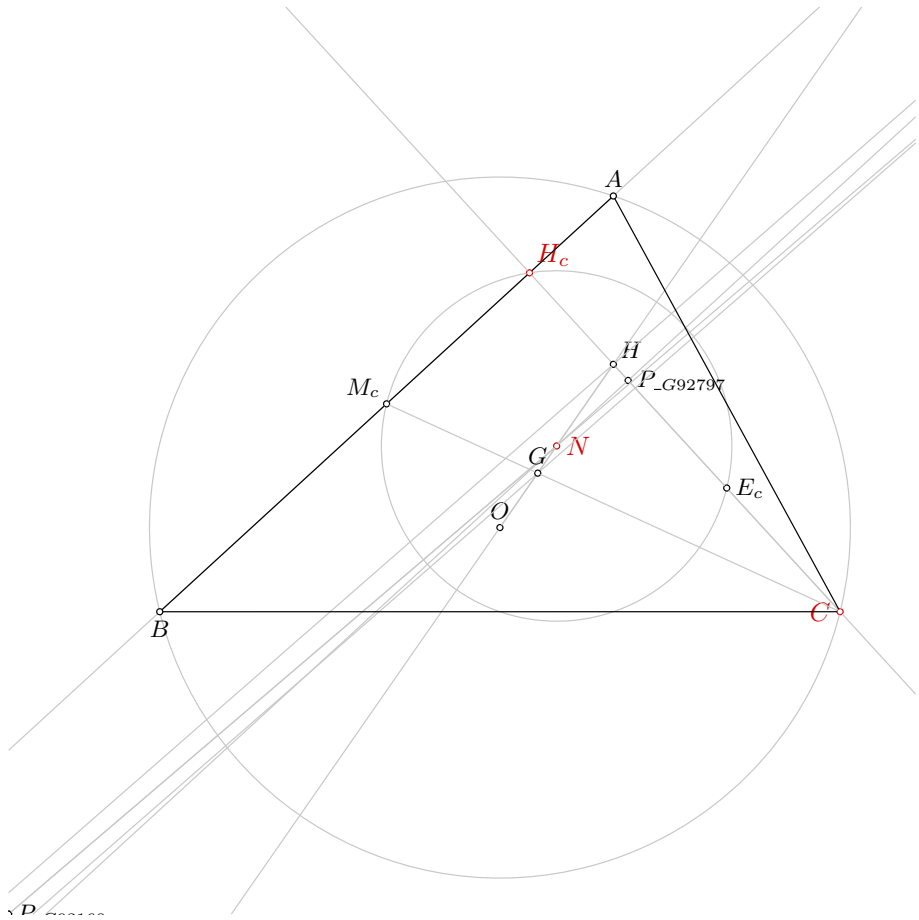

Figure 1: Illustration of the problem 0738

```
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points H_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points H_{c} and E_{c} must be
     different; points C and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving H_c=$\_H_c$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{P\_G94534NH} \neq S_{P^0_{L\_G94503}NH}$ i.e., lines $P\_G94534P^0_{L\_G94503}$ and NH are not parallel (construction based assumption)

$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)

$S_{ACF^1_{\_h_c}} \neq S_{BCF^1_{\_h_c}}$ i.e., lines AB and $CF^1_{\_h_c}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^5_{\_h_b}} \neq S_{F^4_{\_h_a}BF^5_{\_h_b}}$ i.e., lines $AF^4_{\_h_a}$ and $BF^5_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^3_{\_m_b}} \neq S_{F^2_{\_m_a}\_M_bF^3_{\_m_b}}$ i.e., lines $\_M_aF^2_{\_m_a}$ and $\_M_bF^3_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving H_c=$\_H_c$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Proving failed

4.3.2 Proving H_c=$\_H_c$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Proving failed

4.4.2 Proving $H_c{=}\_H_c$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 739

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 739: Given a point C, a point I and a point N, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 740

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 740: Given a point C, a point M_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point M_a, construct a point B (rule W01); ;
2. Using the point C and the point M_a, construct a line a (rule W02); % DET: points C and M_a are not the same;
3. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;
4. Using the point C and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points C and M_a are not the same;
5. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
6. Using the circle $k(N, M_a)$, the line a, the point N and the point M_a, construct a point H_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points M_a and H_a must be different;
7. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;
8. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
9. Using the circle $k(M_a, B)$ and the circle $k(N, M_a)$, construct a point H_b and a point H_c (rule W07); % NDG: circles $k(M_a, B)$ and $k(N, M_a)$ intersect % DET: circles $k(M_a, B)$ and $k(N, M_a)$ are not the same;

10. Using the point C and the point H_b, construct a line b (rule W02); % DET: points C and H_b are not the same;

11. Using the line h_a and the line b, construct a point A (rule W03); % NDG: lines h_a and b are not parallel % DET: lines h_a and b are not the same.

Non-degenerate conditions: lines h_a and b are not parallel; circles $k(M_a, B)$ and $k(N, M_a)$ intersect; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; line a and circle $k(N, M_a)$ intersect; points M_a and N are not the same; points C and M_a are not the same.

Determination conditions: lines h_a and b are not the same; points C and H_b are not the same; circles $k(M_a, B)$ and $k(N, M_a)$ are not the same; points E_a and H_a are not the same; points M_a and E_a must be different; points M_a and H_a must be different; points M_a and N are not the same; points C and M_a are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D21,D28,D3,D32,D5,D6,D8,GD01,GD02,GL01,GL03,GL04,GL09,L19,L20,L21,L22,L37,L38,L3

Solving time: 4.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point M_{a} 65 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_r M_{a}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point B such that CB/CM_{a}=2
towards B C M_{a} 2
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0


% DET: points C and M_{a} are not the same
% Constructing a line a which passes through point C and point M_{a}
line a C M_{a}

color 200 200 200
drawline a
color 0 0 0
```

```
% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points C and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point C
circle k(M_{a},B) M_{a} C

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line a and circle k(N,M_{a}) intersect% DET: points M_{a} and H_{a} must be different
% Constructing a point P_{\_G155520} which is a foot of the point N on the line a
foot P_{\_G155520} N a
cmark_r P_{\_G155520}
color 200 200 200
drawline N P_{\_G155520}
color 0 0 0

% Constructing a point H_{a} which is an image of the point M_{a} in the symmetry to point/line P
    _{\_G155520}
sim H_{a} P_{\_G155520} M_{a}
cmark_r H_{a}


% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}
```

```
color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: circles k(M_{a},B) and k(N,M_{a}) intersect% DET: circles k(M_{a},B) and k(N,M_{a}) are not
    the same
% Constructing points H_{b} and H_{c} which are in intersection of k(M_{a},B) and k(N,M_{a})
intersec2 H_{b} H_{c} k(M_{a},B) k(N,M_{a})
cmark_l H_{b}
cmark_rt H_{c}


% DET: points C and H_{b} are not the same
% Constructing a line b which passes through point C and point H_{b}
line b C H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{a} and b are not parallel% DET: lines h_{a} and b are not the same
% Constructing a point A which belongs to line h_{a} and line b
intersec A h_{a} b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and b are not parallel; circles k(M_{a},B) and k(N,M_{a})
    intersect; line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect; line a and circle k(N,M_{a})
    intersect; points M_{a} and N are not the same; points C and M_{a} are not the same
% Determination conditions: lines h_{a} and b are not the same; points C and H_{b} are not the same
    ; circles k(M_{a},B) and k(N,M_{a}) are not the same; points E_{a} and H_{a} are not the same;
    points M_{a} and E_{a} must be different; points M_{a} and H_{a} must be different; points M_{a
    } and N are not the same; points C and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

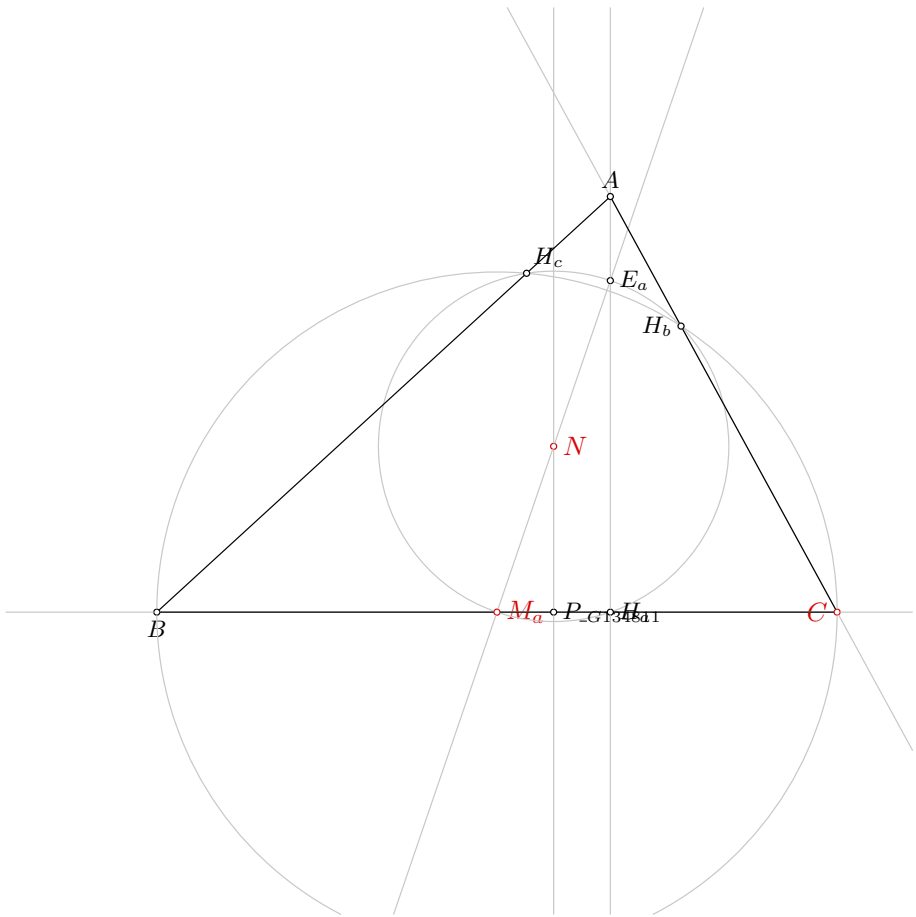

Figure 1: Illustration of the problem 0740

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving M_a=$\_M_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.033 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving N=$\_N$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 140 terms.

Time Complexity: Time spent by the prover is 4.114 seconds.

NDG conditions Points B, N and M_a are not collinear

Points B, N and M_a are not collinear

Line through points H_b and C is not parallel with line through points E_a and H_a

Points $\_M_a$ and E_a are not identical

Points A, B and C are not collinear

Points B and C are not identical

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{E_aCH_b} \neq S_{H_aCH_b}$ i.e., lines E_aH_a and CH_b are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving M_a=$\_M_a$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 6 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.3 Proving N=_N

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 158 terms.

Time Complexity: Time spent by the prover is 0.310 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 741

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 741: Given a point C, a point M_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point M_b, construct a point A (rule W01); ;
2. Using the point C and the point M_b, construct a line b (rule W02); % DET: points C and M_b are not the same;
3. Using the point M_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points M_b and N are not the same;
4. Using the point C and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points C and M_b are not the same;
5. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
6. Using the circle $k(N, M_a)$, the line b, the point N and the point M_b, construct a point H_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points M_b and H_b must be different;
7. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point M_b, construct a point E_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_b and E_b must be different;
8. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
9. Using the circle $k(M_b, C)$ and the circle $k(N, M_a)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(M_b, C)$ and $k(N, M_a)$ intersect % DET: circles $k(M_b, C)$ and $k(N, M_a)$ are not the same;

10. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;

11. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; circles $k(M_b, C)$ and $k(N, M_a)$ intersect; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; line b and circle $k(N, M_a)$ intersect; points M_b and N are not the same; points C and M_b are not the same.

Determination conditions: lines h_b and a are not the same; points C and H_a are not the same; circles $k(M_b, C)$ and $k(N, M_a)$ are not the same; points E_b and H_b are not the same; points M_b and E_b must be different; points M_b and H_b must be different; points M_b and N are not the same; points C and M_b are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07]

Lemmas used: [D22,D29,D3,D32,D5,D6,D9,GD01,GD02,GL01,GL03,GL09,L17,L19,L20,L21,L23,L44,L45,L50,

Solving time: 4.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point M_{b} 95 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_lt M_{b}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point A such that CA/CM_{b}=2
towards A C M_{b} 2
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0


% DET: points C and M_{b} are not the same
% Constructing a line b which passes through point C and point M_{b}
line b C M_{b}

color 200 200 200
drawline b
color 0 0 0
```

```
% DET: points M_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point M_{b} and point N
line m(H_{a}H_{c}) M_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: points C and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point C
circle k(M_{b},C) M_{b} C

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line b and circle k(N,M_{a}) intersect% DET: points M_{b} and H_{b} must be different
% Constructing a point P_{\_G189339} which is a foot of the point N on the line b
foot P_{\_G189339} N b
cmark_r P_{\_G189339}
color 200 200 200
drawline N P_{\_G189339}
color 0 0 0

% Constructing a point H_{b} which is an image of the point M_{b} in the symmetry to point/line P
    _{\_G189339}
sim H_{b} P_{\_G189339} M_{b}
cmark_l H_{b}


% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{b} and E_{b} must be
    different
% Constructing a point E_{b} which is an image of the point M_{b} in the symmetry to point/line N
sim E_{b} N M_{b}
cmark_r E_{b}


% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}
```

```
color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: circles k(M_{b},C) and k(N,M_{a}) intersect% DET: circles k(M_{b},C) and k(N,M_{a}) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(M_{b},C) and k(N,M_{a})
intersec2 H_{a} H_{c} k(M_{b},C) k(N,M_{a})
cmark_r H_{a}
cmark_rt H_{c}


% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; circles k(M_{b},C) and k(N,M_{a})
    intersect; line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; line b and circle k(N,M_{a})
    intersect; points M_{b} and N are not the same; points C and M_{b} are not the same
% Determination conditions: lines h_{b} and a are not the same; points C and H_{a} are not the same
    ; circles k(M_{b},C) and k(N,M_{a}) are not the same; points E_{b} and H_{b} are not the same;
    points M_{b} and E_{b} must be different; points M_{b} and H_{b} must be different; points M_{b
    } and N are not the same; points C and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

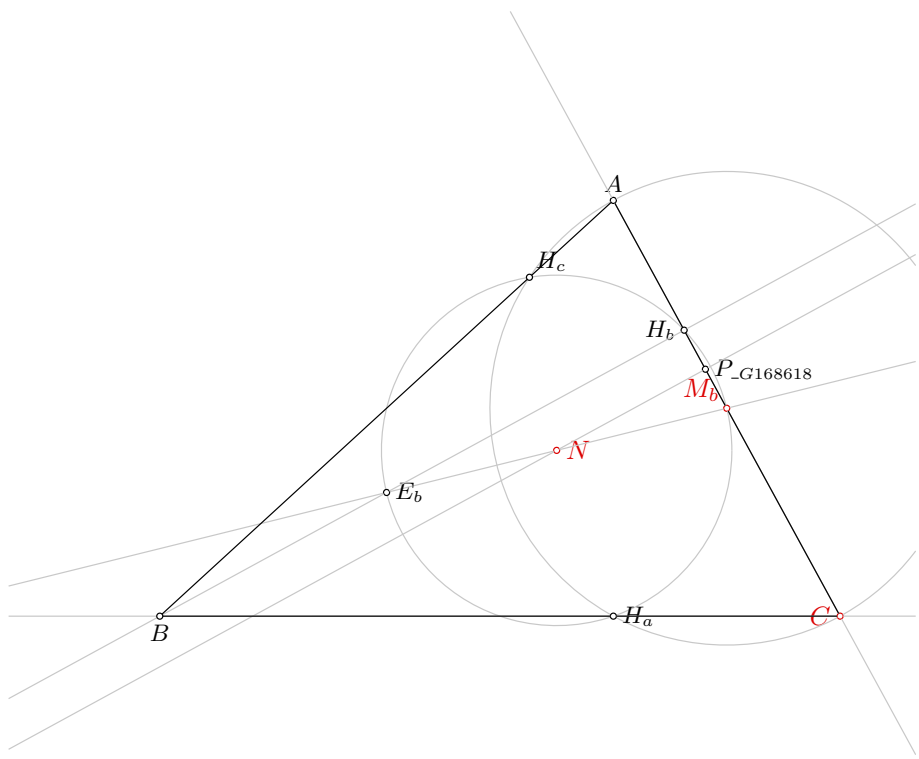

Figure 1: Illustration of the problem 0741

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.027 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving M_b=$\_M_b$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{E_bCH_a} \neq S_{H_bCH_a}$ i.e., lines E_bH_b and CH_a are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1
Time spent by the prover: 0.000 seconds

4.2.2 Proving M_b=$\_M_b$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving M_b=$\_M_b$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 6 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.3.3 Proving N=_N

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 59 terms.

Time Complexity: Time spent by the prover is 0.080 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 742

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 742: Given a point C, a point M_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point C and the point M_c, construct a point G (rule W01); ;
2. Using the point N and the point G, construct a point O (rule W01); ;
3. Using the point N and the point G, construct a point H (rule W01); ;
4. Using the point C and the point H, construct a point E_c (rule W01); ;
5. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
6. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
7. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
9. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; line h_c and circle $k(N, M_a)$ intersect; points M_c and N are not the same; points C and O are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points C and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L18,L21,L24,L3,L57]

Solving time: 8.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point M_{c} 50 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_l C
cmark_lt M_{c}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a line L_{\_G224459} which passes through point C and point M_{c}
line L_{\_G224459} C M_{c}

color 200 200 200
drawline L_{\_G224459}
color 0 0 0


% Constructing a point P_{\_G224560} with coordinates (0,0)
point P_{\_G224560} 0 0
cmark_r P_{\_G224560}

% Constructing a point P_{\_G224484} such that CP_{\_G224484}/CP_{\_G224560}=2
towards P_{\_G224484} C P_{\_G224560} 2
cmark_r P_{\_G224484}
color 200 200 200
drawsegment C P_{\_G224484}
color 0 0 0

% Constructing a point P_{\_G224529} such that CP_{\_G224529}/CP_{\_G224560}=3
towards P_{\_G224529} C P_{\_G224560} 3
cmark_r P_{\_G224529}
color 200 200 200
drawsegment C P_{\_G224529}
color 0 0 0

% Constructing a line L_{\_G224490} which passes through point M_{c} and point P_{\_G224529}
line L_{\_G224490} M_{c} P_{\_G224529}
```

```
color 200 200 200
drawline L_{\_G224490}
color 0 0 0


% Constructing a line L_{\_G224453} which contains the point P_{\_G224484} and is parallel to the
    line L_{\_G224490}
parallel L_{\_G224453} P_{\_G224484} L_{\_G224490}

color 200 200 200
drawline L_{\_G224453}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G224453} and line L_{\_G224459}
intersec G L_{\_G224453} L_{\_G224459}
cmark_t G



% Constructing a point O such that NO/NG=3
towards O N G 3
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0



% Constructing a point H such that NH/NG=-3
towards H N G -3
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point E_{c} such that CE_{c}/CH=0.5
towards E_{c} C H 0.5
cmark_r E_{c}
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G225595} which is a foot of the point N on the line h_{c}
foot P_{\_G225595} N h_{c}
cmark_r P_{\_G225595}
color 200 200 200
drawline N P_{\_G225595}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G225595}
sim H_{c} P_{\_G225595} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

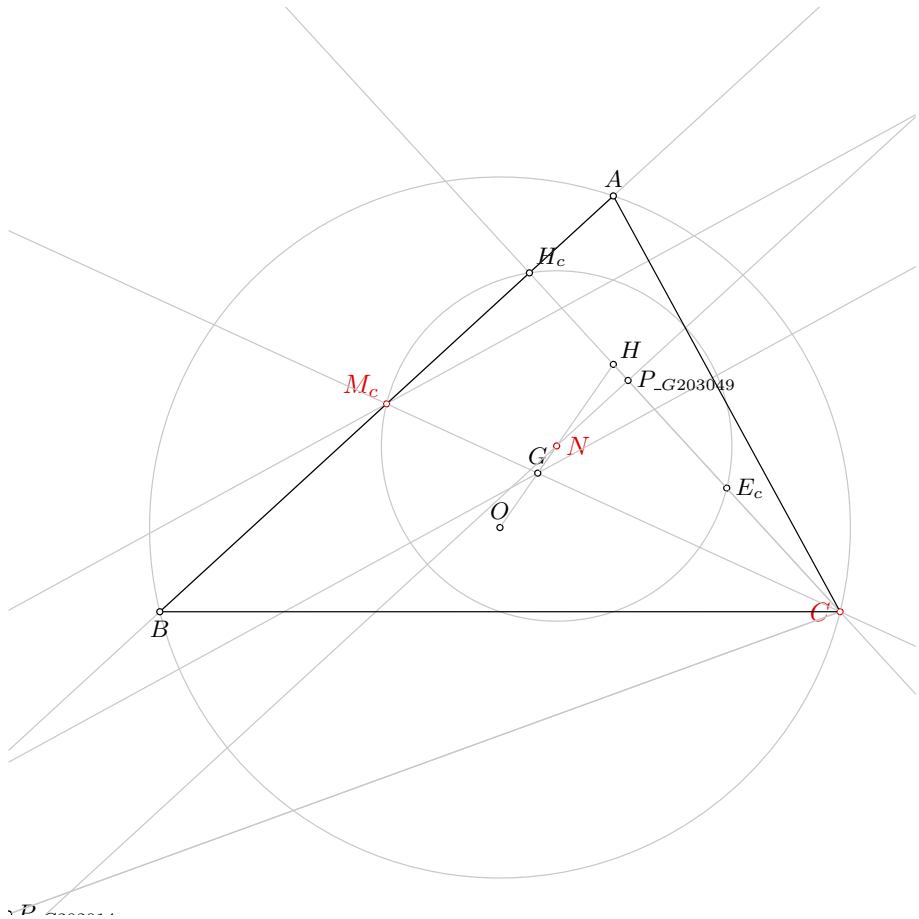

Figure 1: Illustration of the problem 0742

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; line h_{c} and circle k(N,M_{a})
    intersect; points M_{c} and N are not the same; points C and O are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points C and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.037 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving M_c=$\_M_c$

Proving failed

4.1.3 Proving N=$\_N$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{P_{\_G203377}CM_c} \neq S_{P^0_{L_{\_G203346}}CM_c}$ i.e., lines $P_{\_G203377}P^0_{L_{\_G203346}}$ and CM_c are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving M_c=$\_M_c$

Proving failed

4.2.3 Proving N=$\_N$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.2 Proving M_c=$\_M_c$

Proving failed

4.3.3 Proving N=$\_N$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $M_c{=}\_M_c$

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 743

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 743: Given a point C, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point C and the point G, construct a point M_c (rule W01); ;
3. Using the point N and the point O, construct a point H (rule W01); ;
4. Using the point C and the point H, construct a point E_c (rule W01); ;
5. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
6. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
7. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
8. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
9. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; line h_c and circle $k(N, M_a)$ intersect; points M_c and N are not the same; points C and O are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points C and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L15,L18,L21,L24,L3,L57]

Solving time: 8.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point C 110 40
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_l C
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G20203} which passes through point N and point O
line L_{\_G20203} N O

color 200 200 200
drawline L_{\_G20203}
color 0 0 0


% Constructing a point P_{\_G20304} with coordinates (0,0)
point P_{\_G20304} 0 0
cmark_r P_{\_G20304}

% Constructing a point P_{\_G20228} such that NP_{\_G20228}/NP_{\_G20304}=1
towards P_{\_G20228} N P_{\_G20304} 1
cmark_r P_{\_G20228}
color 200 200 200
drawsegment N P_{\_G20228}
color 0 0 0

% Constructing a point P_{\_G20273} such that NP_{\_G20273}/NP_{\_G20304}=3
towards P_{\_G20273} N P_{\_G20304} 3
cmark_r P_{\_G20273}
color 200 200 200
drawsegment N P_{\_G20273}
color 0 0 0

% Constructing a line L_{\_G20234} which passes through point O and point P_{\_G20273}
line L_{\_G20234} O P_{\_G20273}
```

```
color 200 200 200
drawline L_{\_G20234}
color 0 0 0


% Constructing a line L_{\_G20197} which contains the point P_{\_G20228} and is parallel to the
    line L_{\_G20234}
parallel L_{\_G20197} P_{\_G20228} L_{\_G20234}

color 200 200 200
drawline L_{\_G20197}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G20197} and line L_{\_G20203}
intersec G L_{\_G20197} L_{\_G20203}
cmark_t G



% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point E_{c} such that CE_{c}/CH=0.5
towards E_{c} C H 0.5
cmark_r E_{c}
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G21348} which is a foot of the point N on the line h_{c}
foot P_{\_G21348} N h_{c}
cmark_r P_{\_G21348}
color 200 200 200
drawline N P_{\_G21348}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G21348}
sim H_{c} P_{\_G21348} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

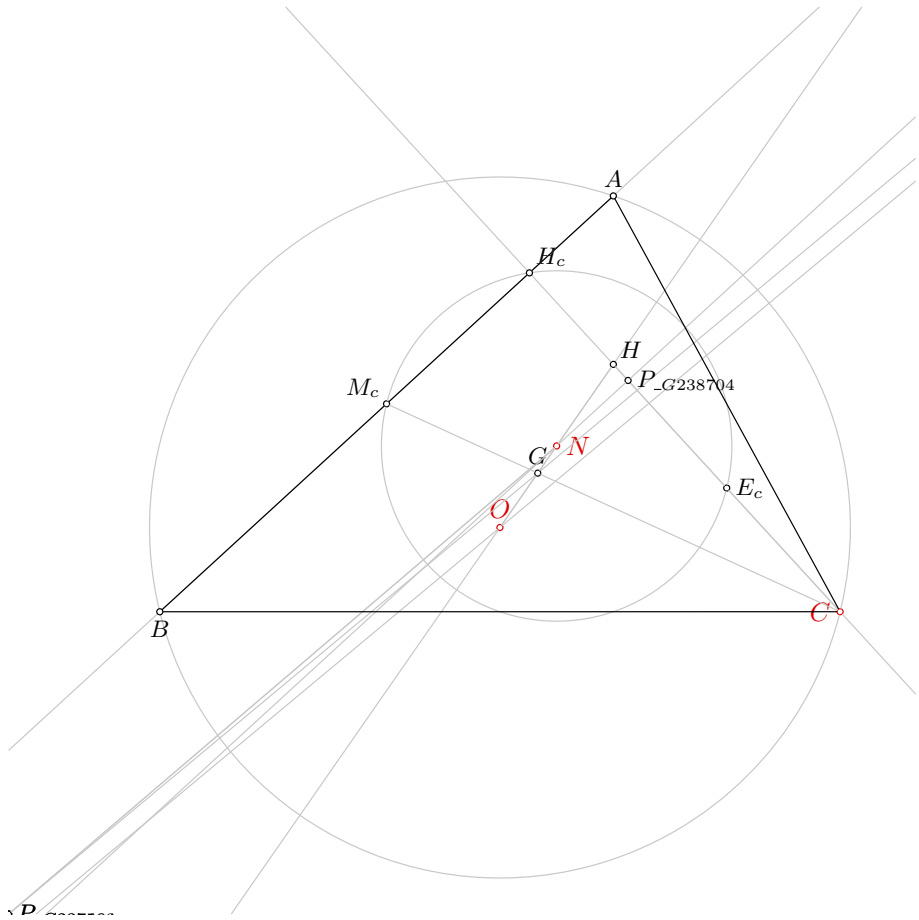

Figure 1: Illustration of the problem 0743

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; line h_{c} and circle k(N,M_{a})
    intersect; points M_{c} and N are not the same; points C and O are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points C and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving C=C

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 0 terms.

Time Complexity: Time spent by the prover is 0.031 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving O=$\_O$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving C=C

NDG conditions are:

$S_{P\_G239032NO} \neq S_{P^0_{L\_G239001}NO}$ i.e., lines $P\_G239032P^0_{L\_G239001}$ and NO are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 1

Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving C=C

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving O=$\_O$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $C{=}C$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.4.2 Proving $N{=}\_N$

Proving failed

4.4.3 Proving $O{=}\_O$

Proving failed

Problem 744

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 744: Given a point C, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 745

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 745: Given a point C, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 746

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 746: Given a point C, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 747

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 747: Given a point E_a, a point E_b and a point E_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point E_b, construct a line $m(E_aE_b)$ (rule W14); % DET: points E_a and E_b are not the same;

2. Using the point E_a and the point E_c, construct a line $m(E_aE_c)$ (rule W14); % DET: points E_a and E_c are not the same;

3. Using the line $m(E_aE_c)$ and the line $m(E_aE_b)$, construct a point N (rule W03); % NDG: lines $m(E_aE_c)$ and $m(E_aE_b)$ are not parallel % DET: lines $m(E_aE_c)$ and $m(E_aE_b)$ are not the same;

4. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;

5. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;

6. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;

7. Using the point E_c and the point M_b, construct a line $m(CH_a)$ (rule W02); % DET: points E_c and M_b are not the same;

8. Using the point E_a and the line $m(CH_a)$, construct a line h_a (rule W16); ;

9. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;

10. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;

11. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H_a, construct a point H (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H_a and H must be different;

12. Using the point H and the point E_a, construct a point A (rule W01); ;

13. Using the point E_b and the point H, construct a point B (rule W01); ;

14. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: line h_a and circle $k(E_b, B)$ intersect; points H_a and E_b are not the same; line h_a and circle $k(N, M_a)$ intersect; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same; lines $m(E_aE_c)$ and $m(E_aE_b)$ are not parallel.

Determination conditions: points H_a and H must be different; points E_a and H_a must be different; points E_c and M_b are not the same; points E_b and M_b must be different; points E_b and N are not the same; lines $m(E_aE_c)$ and $m(E_aE_b)$ are not the same; points E_a and E_c are not the same; points E_a and E_b are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W14,W16]

Lemmas used: [D28,D29,D3,D30,D32,D5,D8,GD02,GL01,GL03,GL04,GL09,L17,L19,L21,L22,L23,L24,L44,L45

Solving time: 24.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{b} 50 56.36
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{b}
cmark_r E_{c}
color 0 0 0
fontsize 8

% DET: points E_{a} and E_{b} are not the same
% Constructing bisector m(E_{a}E_{b}) of the segment E_{a}E_{b}
med m(E_{a}E_{b}) E_{a} E_{b}

color 200 200 200
drawline m(E_{a}E_{b})
color 0 0 0

color 200 200 200
drawsegment E_{a} E_{b}
color 0 0 0
```

```
% DET: points E_{a} and E_{c} are not the same
% Constructing bisector m(E_{a}E_{c}) of the segment E_{a}E_{c}
med m(E_{a}E_{c}) E_{a} E_{c}

color 200 200 200
drawline m(E_{a}E_{c})
color 0 0 0

color 200 200 200
drawsegment E_{a} E_{c}
color 0 0 0


% NDG: lines m(E_{a}E_{c}) and m(E_{a}E_{b}) are not parallel% DET: lines m(E_{a}E_{c}) and m(E_{a}
    E_{b}) are not the same
% Constructing a point N which belongs to line m(E_{a}E_{c}) and line m(E_{a}E_{b})
intersec N m(E_{a}E_{c}) m(E_{a}E_{b})
cmark_r N


% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}


% DET: points E_{c} and M_{b} are not the same
% Constructing a line m(CH_{a}) which passes through point E_{c} and point M_{b}
line m(CH_{a}) E_{c} M_{b}

color 200 200 200
drawline m(CH_{a})
color 0 0 0
```

```
% Constructing a line h_{a} which contains the point E_{a} and is parallel to the line m(CH_{a})
parallel h_{a} E_{a} m(CH_{a})

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G77888} which is a foot of the point N on the line h_{a}
foot P_{\_G77888} N h_{a}
cmark_r P_{\_G77888}
color 200 200 200
drawline N P_{\_G77888}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G77888}
sim H_{a} P_{\_G77888} E_{a}
cmark_r H_{a}


% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H_{a} and H must be different
% Constructing a point P_{\_G78192} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G78192} E_{b} h_{a}
cmark_r P_{\_G78192}
color 200 200 200
drawline E_{b} P_{\_G78192}
color 0 0 0

% Constructing a point H which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    78192}
sim H P_{\_G78192} H_{a}
cmark_rt H



% Constructing a point A such that HA/HE_{a}=2
towards A H E_{a} 2
cmark_t A
```

```
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line h_{a} and circle k(E_{b},B) intersect; points H_{a} and E_{b} are
     not the same; line h_{a} and circle k(N,M_{a}) intersect; line m(H_{a}H_{c}) and circle k(N,M
    _{a}) intersect; points E_{a} and N are not the same; lines m(E_{a}E_{c}) and m(E_{a}E_{b}) are
     not parallel
% Determination conditions: points H_{a} and H must be different; points E_{a} and H_{a} must be
    different; points E_{c} and M_{b} are not the same; points E_{b} and M_{b} must be different;
    points E_{b} and N are not the same; lines m(E_{a}E_{c}) and m(E_{a}E_{b}) are not the same;
    points E_{a} and E_{c} are not the same; points E_{a} and E_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving E_b=_E_b

Proving failed

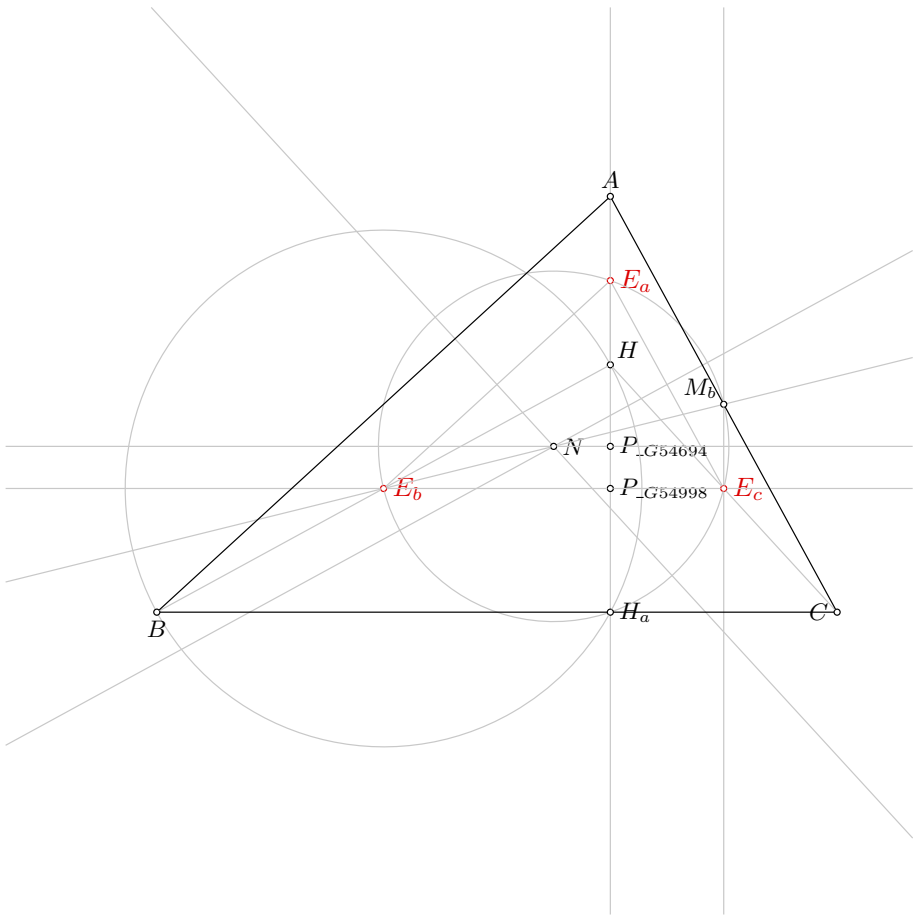

Figure 1: Illustration of the problem 0747

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving E_b=_E_b

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving E_b=_E_b

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 748

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 748: Given a point E_a, a point E_b and a point G, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 749

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 749: Given a point E_a, a point E_b and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H, construct a point A (rule W01); ;
2. Using the point E_b and the point H, construct a point B (rule W01); ;
3. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
4. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
5. Using the point H and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H and E_a are not the same;
6. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
7. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
8. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
9. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
10. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same.

Non-degenerate conditions: lines b and h_c are not parallel; line c and circle $k(E_a, A)$ intersect; line h_b and circle $k(E_a, A)$ intersect; points H and E_a are not the same.

Determination conditions: lines b and h_c are not the same; points H_c and H are not the same; points A and H_c must be different; points H_b and A are not the same; points H and H_b must be different; points A and B are not the same; points E_b and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D29,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 12.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{b} 50 56.36
point H 80 72.73

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{b}
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% NDG: points H and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
circle k(E_{a},A) E_{a} H

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G112031} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G112031} E_{a} h_{b}
cmark_r P_{\_G112031}
color 200 200 200
drawline E_{a} P_{\_G112031}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    112031}
sim H_{b} P_{\_G112031} H
cmark_l H_{b}


% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G112269} which is a foot of the point E_{a} on the line c
foot P_{\_G112269} E_{a} c
cmark_r P_{\_G112269}
color 200 200 200
drawline E_{a} P_{\_G112269}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    112269}
sim H_{c} P_{\_G112269} A
cmark_rt H_{c}
```

```
% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line c and circle k(E_{a},A)
    intersect; line h_{b} and circle k(E_{a},A) intersect; points H and E_{a} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H_{c} and H are not the same
    ; points A and H_{c} must be different; points H_{b} and A are not the same; points H and H_{b}
     must be different; points A and B are not the same; points E_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving H=_H

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

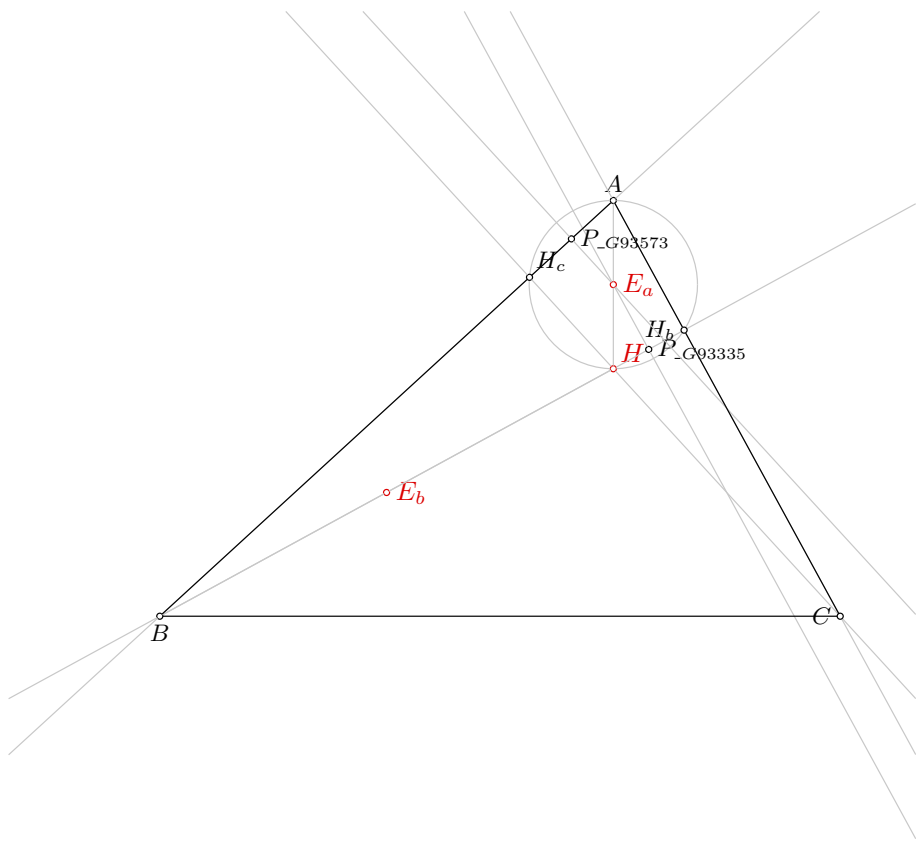

Figure 1: Illustration of the problem 0749

4.2.2 Proving E_b=_E_b

Proving failed

4.2.3 Proving H=_H

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving E_b=_E_b

Proving failed

4.3.3 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 1916 terms.

Time Complexity: Time spent by the prover is 1.640 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving H=_H

Proving failed

Problem 750

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 750: Given a point E_a, a point E_b and a point H_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;
3. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H_a, construct a point H (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H_a and H must be different;
4. Using the point H and the point E_a, construct a point A (rule W01); ;
5. Using the point E_b and the point H, construct a point B (rule W01); ;
6. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
7. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
8. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
9. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
10. Using the line a and the line h_c, construct a point C (rule W03); % NDG: lines a and h_c are not parallel % DET: lines a and h_c are not the same.

Non-degenerate conditions: lines a and h_c are not parallel; line c and circle $k(E_b, B)$ intersect; line h_a and circle $k(E_b, B)$ intersect; points H_a and E_b are not the same.

Determination conditions: lines a and h_c are not the same; points H and H_c are not the same; points B and H_c must be different; points A and B are not the same; points H_a and B are not the same; points H_a and H must be different; points E_a and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 9.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{b} 50 56.36
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{b}
cmark_r H_{a}
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H_{a} and H must be different
% Constructing a point P_{\_G139857} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G139857} E_{b} h_{a}
cmark_r P_{\_G139857}
color 200 200 200
drawline E_{b} P_{\_G139857}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    139857}
sim H P_{\_G139857} H_{a}
cmark_rt H



% Constructing a point A such that HA/HE_{a}=2
towards A H E_{a} 2
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G140294} which is a foot of the point E_{b} on the line c
foot P_{\_G140294} E_{b} c
cmark_r P_{\_G140294}
color 200 200 200
drawline E_{b} P_{\_G140294}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    140294}
sim H_{c} P_{\_G140294} B
```

```
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines a and h_{c} are not parallel% DET: lines a and h_{c} are not the same
% Constructing a point C which belongs to line a and line h_{c}
intersec C a h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{c} are not parallel; line c and circle k(E_{b},B)
    intersect; line h_{a} and circle k(E_{b},B) intersect; points H_{a} and E_{b} are not the same
% Determination conditions: lines a and h_{c} are not the same; points H and H_{c} are not the same
    ; points B and H_{c} must be different; points A and B are not the same; points H_{a} and B are
     not the same; points H_{a} and H must be different; points E_{a} and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving H_a=_H_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

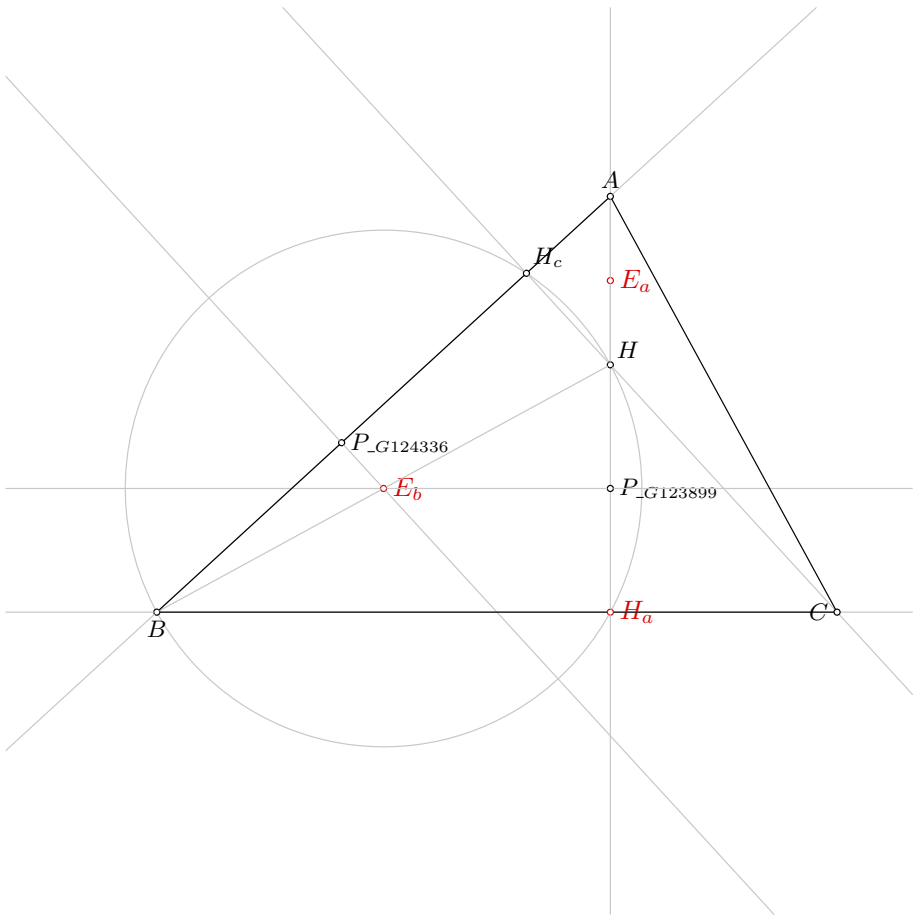

Figure 1: Illustration of the problem 0750

4.2.2 Proving E_b=_E_b

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving E_b=_E_b

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 751

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 751: Given a point E_a, a point E_b and a point H_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Using the point H_b and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_b and E_a are not the same;
3. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H_b, construct a point H (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H_b and H must be different;
4. Using the point H and the point E_a, construct a point A (rule W01); ;
5. Using the point E_b and the point H, construct a point B (rule W01); ;
6. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
7. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
8. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
9. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
10. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same.

Non-degenerate conditions: lines b and h_c are not parallel; line c and circle $k(E_a, A)$ intersect; line h_b and circle $k(E_a, A)$ intersect; points H_b and E_a are not the same.

Determination conditions: lines b and h_c are not the same; points H and H_c are not the same; points A and H_c must be different; points A and B are not the same; points H_b and A are not the same; points H_b and H must be different; points E_b and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D29,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 9.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{b} 50 56.36
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{b}
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{b} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{b}
circle k(E_{a},A) E_{a} H_{b}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H_{b} and H must be different
% Constructing a point P_{\_G167915} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G167915} E_{a} h_{b}
cmark_r P_{\_G167915}
color 200 200 200
drawline E_{a} P_{\_G167915}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    167915}
sim H P_{\_G167915} H_{b}
cmark_rt H



% Constructing a point A such that HA/HE_{a}=2
towards A H E_{a} 2
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G168352} which is a foot of the point E_{a} on the line c
foot P_{\_G168352} E_{a} c
cmark_r P_{\_G168352}
color 200 200 200
drawline E_{a} P_{\_G168352}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    168352}
sim H_{c} P_{\_G168352} A
```

```
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line c and circle k(E_{a},A)
    intersect; line h_{b} and circle k(E_{a},A) intersect; points H_{b} and E_{a} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H and H_{c} are not the same
    ; points A and H_{c} must be different; points A and B are not the same; points H_{b} and A are
     not the same; points H_{b} and H must be different; points E_{b} and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving E_b=_E_b

Proving failed

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

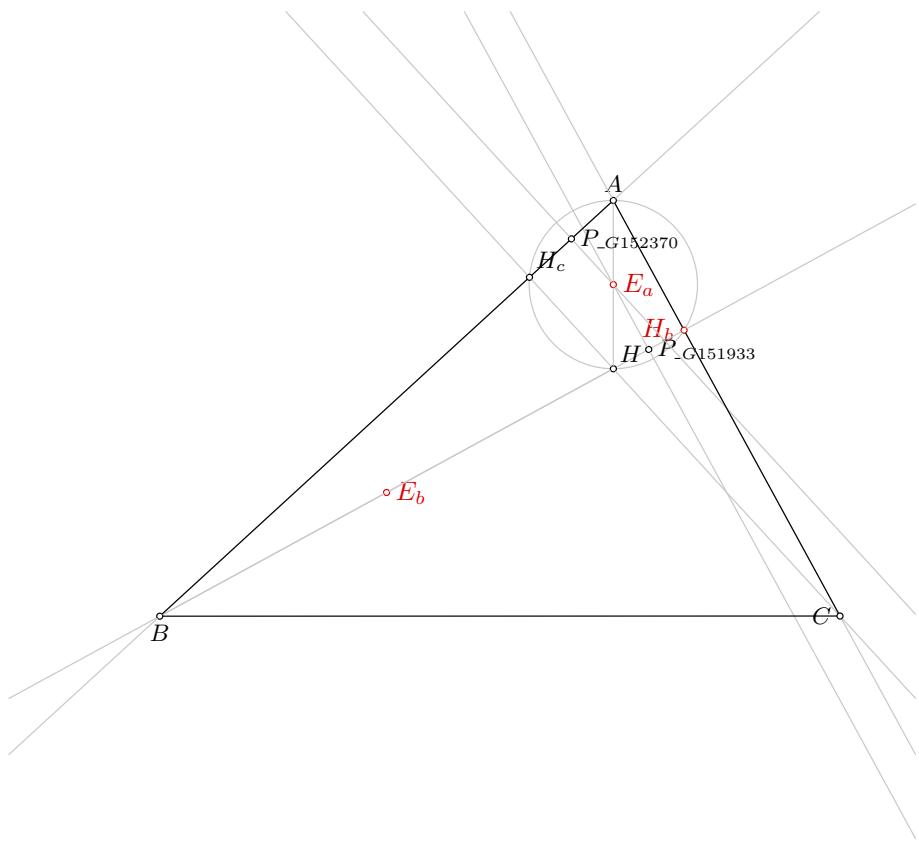

Figure 1: Illustration of the problem 0751

4.2.2 Proving E_b=_E_b

Proving failed

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving E_b=_E_b

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 752

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 752: Given a point E_a, a point E_b and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
2. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
3. Using the circle $k(E_a, A)$, the circle $k(E_b, B)$, the point H_c, the point E_a and the point E_b, construct a point H (rule W08); % NDG: circles $k(E_a, A)$ and $k(E_b, B)$ intersect % DET: circles $k(E_a, A)$ and $k(E_b, B)$ are not the same; points H_c and H must be different;
4. Using the point H and the point E_a, construct a point A (rule W01); ;
5. Using the point E_b and the point H, construct a point B (rule W01); ;
6. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
7. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
8. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
9. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
10. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; circles $k(E_a, A)$ and $k(E_b, B)$ intersect; points H_c and E_b are not the same; points H_c and E_a are not the same.

Determination conditions: lines h_c and b are not the same; points A and H_b are not the same; points H and H_b must be different; points H_c and H are not the same; points E_b and H are not the same; circles $k(E_a, A)$ and $k(E_b, B)$ are not the same; points H_c and H must be different.

Rules used: [W01,W02,W03,W05,W06,W08]

Lemmas used: [D10,D28,D29,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48,L49,L51]

Solving time: 10.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{b} 50 56.36
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{b}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: circles k(E_{a},A) and k(E_{b},B) intersect% DET: circles k(E_{a},A) and k(E_{b},B) are not
    the same; points H_{c} and H must be different
% Constructing a line L_{\_G198894} which passes through point E_{a} and point E_{b}
line L_{\_G198894} E_{a} E_{b}
```

```
color 200 200 200
drawline L_{\_G198894}
color 0 0 0


% Constructing a point H which is an image of the point H_{c} in the symmetry to point/line L_{\_G
    198894}
sim H L_{\_G198894} H_{c}
cmark_rt H



% Constructing a point A such that HA/HE_{a}=2
towards A H E_{a} 2
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G199311} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G199311} E_{a} h_{b}
cmark_r P_{\_G199311}
color 200 200 200
drawline E_{a} P_{\_G199311}
```

```
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    199311}
sim H_{b} P_{\_G199311} H
cmark_l H_{b}


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; circles k(E_{a},A) and k(E_{b},B) intersect; points H_{c} and E_{b} are not the same
    ; points H_{c} and E_{a} are not the same
% Determination conditions: lines h_{c} and b are not the same; points A and H_{b} are not the same
    ; points H and H_{b} must be different; points H_{c} and H are not the same; points E_{b} and H
     are not the same; circles k(E_{a},A) and k(E_{b},B) are not the same; points H_{c} and H must
    be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving E_b=_E_b

Proving failed

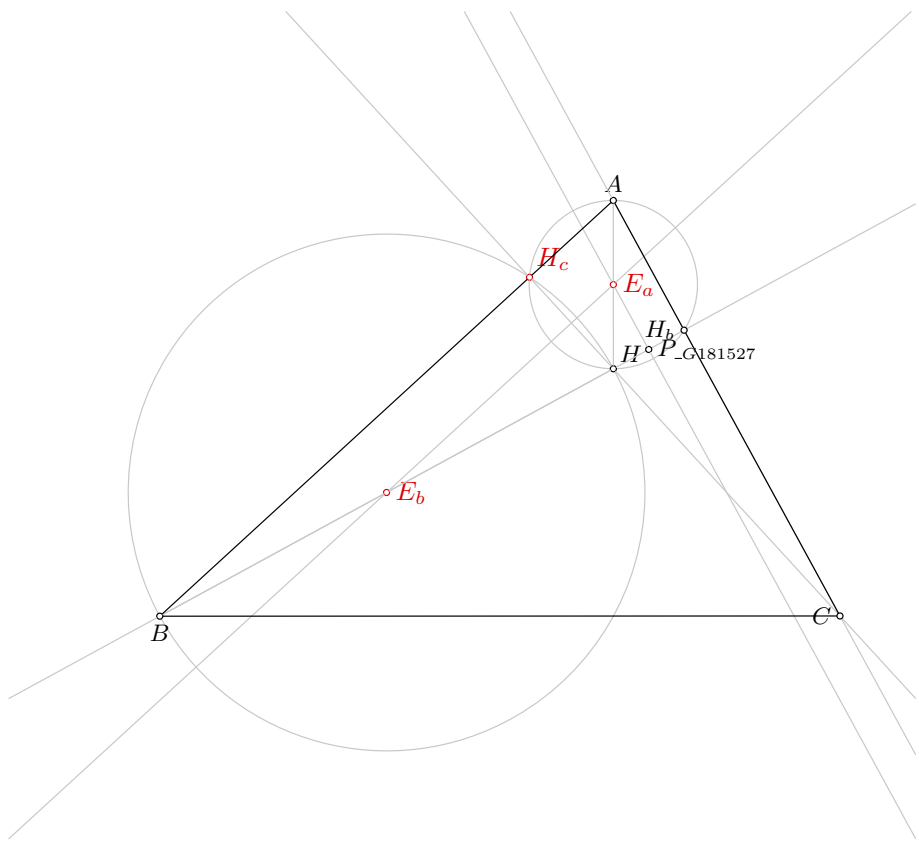

Figure 1: Illustration of the problem 0752

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving E_b=_E_b

Proving failed

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving E_b=_E_b

Proving failed

4.3.3 Proving H_c=_H_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 753

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 753: Given a point E_a, a point E_b and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 754

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 754: Given a point E_a, a point M_a and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
2. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;
3. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;
4. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
5. Choose freely a point E_b on the circle $k(N, M_a)$ (rule WOncircle);
6. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
8. Choose freely a point A (rule free);
9. Using the point A and the point E_a, construct a point H (rule W01); ;
10. Using the point A and the point M_b, construct a point C (rule W01); ;
11. Using the point E_b and the point H, construct a point B (rule W01); .

Non-degenerate conditions: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel.

Determination conditions: points E_b and M_b must be different; points E_b and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points E_a and M_a are not the same.

Rules used: [W01,W02,W03,W05a,W06,W14,WOncircle1,free]

Lemmas used: [D22,D28,D29,D32,GD02,GL01,GL03,GL04,L17,L19,L20,L21,L22,L23,L38,L39,L44,L45,L47,L48

Solving time: 200.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point M_{a} 65 40
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r M_{a}
cmark_r E_{b}
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0


% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N
```

```
% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{b} on the circle with center N through point E_{a}
oncircle E_{b} N E_{a}
cmark_r E_{b}
color 200 200 200
drawcircle N E_{a}
color 0 0 0


% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
```

```
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; points E_{a} and N
     are not the same; lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel
% Determination conditions: points E_{b} and M_{b} must be different; points E_{b} and N are not
    the same; lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the same; points E_{a} and M_{a} are
    not the same; points E_{a} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 15 terms.

Time Complexity: Time spent by the prover is 0.32 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_b=_E_b

Proving failed

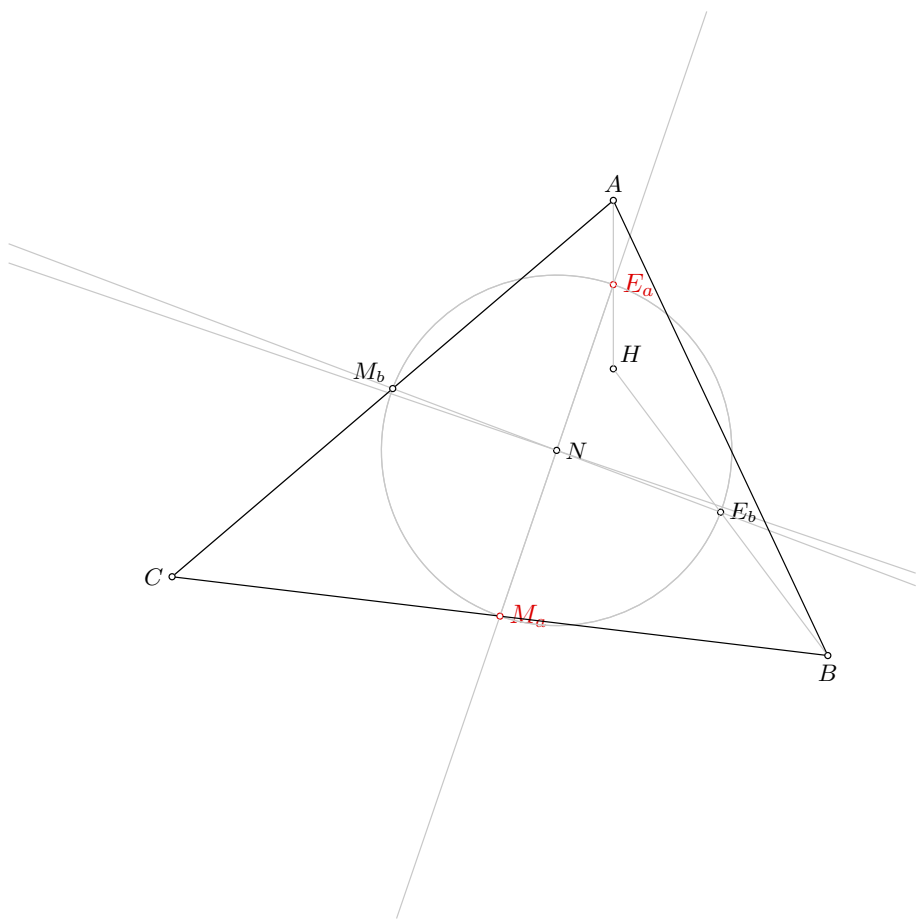

Figure 1: Illustration of the problem 0754

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving M_a=_M_a

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving M_a=_M_a

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 755

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 755: Given a point E_b, a point M_b and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
2. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;
3. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;
4. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
5. Choose freely a point E_a on the circle $k(N, M_a)$ (rule WOncircle);
6. Choose freely a point A (rule free);
7. Using the point A and the point E_a, construct a point H (rule W01); ;
8. Using the point A and the point M_b, construct a point C (rule W01); ;
9. Using the point E_b and the point H, construct a point B (rule W01); .

Non-degenerate conditions: points E_b and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel.

Determination conditions: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points E_b and M_b are not the same.

Rules used: [W01,W02,W03,W06,W14,WOncircle1,free]

Lemmas used: [D22,D28,D29,D32,GD02,GL01,GL03,GL04,L17,L19,L21,L23,L44,L45,L50,L51]

Solving time: 198.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point M_{b} 95 67.5
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_lt M_{b}
cmark_r E_{a}
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0


% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% Choosing randomly a point E_{a} on the circle with center N through point E_{b}
oncircle E_{a} N E_{b}
cmark_r E_{a}
color 200 200 200
drawcircle N E_{b}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points E_{b} and N are not the same; lines m(E_{b}M_{b}) and m(H_{a}H
    _{c}) are not parallel
% Determination conditions: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the same; points E_{b}
    and M_{b} are not the same; points E_{b} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

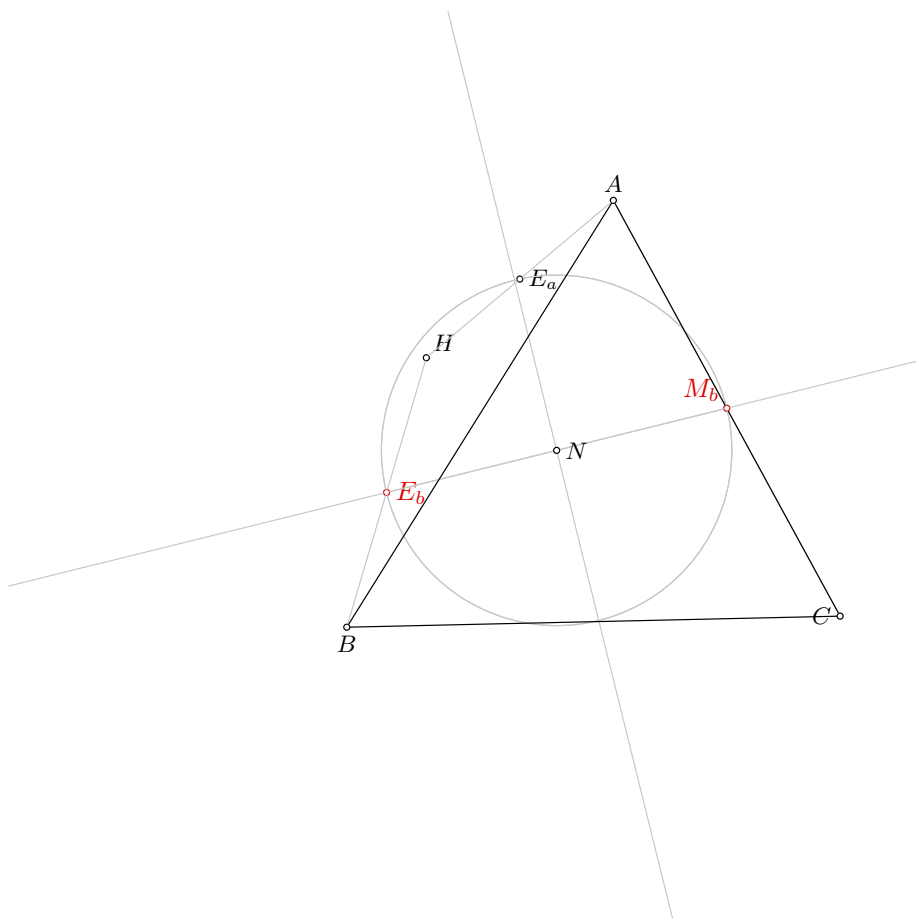

Figure 1: Illustration of the problem 0755

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.049 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving M_b=_M_b

NDG conditions are:

$S_{M^0_{m(E_bM_b)}E_bM_b} \neq S_{T^1_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^0_{m(E_bM_b)}T^1_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 42

Time spent by the prover: 0.000 seconds

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving E_a=_E_a

Proving failed

Problem 756

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 756: Given a point E_a, a point E_b and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_c, construct a line $m(BH_a)$ (rule W02); % DET: points E_b and M_c are not the same;

2. Using the point E_a and the point E_b, construct a line $m(E_aE_b)$ (rule W14); % DET: points E_a and E_b are not the same;

3. Using the point E_a and the point M_c, construct a line $m(E_aM_c)$ (rule W14); % DET: points E_a and M_c are not the same;

4. Using the line $m(E_aM_c)$ and the line $m(E_aE_b)$, construct a point N (rule W03); % NDG: lines $m(E_aM_c)$ and $m(E_aE_b)$ are not parallel % DET: lines $m(E_aM_c)$ and $m(E_aE_b)$ are not the same;

5. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;

6. Using the point E_a and the line $m(BH_a)$, construct a line h_a (rule W16); ;

7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;

8. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;

9. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H_a, construct a point H (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H_a and H must be different;

10. Using the point H and the point E_a, construct a point A (rule W01); ;
11. Using the point E_b and the point H, construct a point B (rule W01); ;
12. Using the point N and the point H, construct a point G (rule W01); ;
13. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: line h_a and circle $k(E_b, B)$ intersect; points H_a and E_b are not the same; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same; lines $m(E_aM_c)$ and $m(E_aE_b)$ are not parallel.

Determination conditions: points H_a and H must be different; points E_a and H_a must be different; lines $m(E_aM_c)$ and $m(E_aE_b)$ are not the same; points E_a and M_c are not the same; points E_a and E_b are not the same; points E_b and M_c are not the same.

Rules used: [W01,W02,W03,W05,W06,W14,W16]

Lemmas used: [D28,D29,D3,D32,D5,D8,GD02,GL01,GL03,GL04,GL09,L16,L18,L19,L22,L23,L40,L42,L49,L50

Solving time: 25.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{b} 50 56.36
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{b}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{c} are not the same
% Constructing a line m(BH_{a}) which passes through point E_{b} and point M_{c}
line m(BH_{a}) E_{b} M_{c}

color 200 200 200
drawline m(BH_{a})
color 0 0 0



% DET: points E_{a} and E_{b} are not the same
% Constructing bisector m(E_{a}E_{b}) of the segment E_{a}E_{b}
med m(E_{a}E_{b}) E_{a} E_{b}

color 200 200 200
drawline m(E_{a}E_{b})
color 0 0 0
```

```
color 200 200 200
drawsegment E_{a} E_{b}
color 0 0 0


% DET: points E_{a} and M_{c} are not the same
% Constructing bisector m(E_{a}M_{c}) of the segment E_{a}M_{c}
med m(E_{a}M_{c}) E_{a} M_{c}

color 200 200 200
drawline m(E_{a}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{c}
color 0 0 0


% NDG: lines m(E_{a}M_{c}) and m(E_{a}E_{b}) are not parallel% DET: lines m(E_{a}M_{c}) and m(E_{a}
    E_{b}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{c}) and line m(E_{a}E_{b})
intersec N m(E_{a}M_{c}) m(E_{a}E_{b})
cmark_r N


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Constructing a line h_{a} which contains the point E_{a} and is parallel to the line m(BH_{a})
parallel h_{a} E_{a} m(BH_{a})

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G49750} which is a foot of the point N on the line h_{a}
foot P_{\_G49750} N h_{a}
cmark_r P_{\_G49750}
color 200 200 200
drawline N P_{\_G49750}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G49750}
sim H_{a} P_{\_G49750} E_{a}
```

```
cmark_r H_{a}


% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H_{a} and H must be different
% Constructing a point P_{\_G50054} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G50054} E_{b} h_{a}
cmark_r P_{\_G50054}
color 200 200 200
drawline E_{b} P_{\_G50054}
color 0 0 0

% Constructing a point H which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    50054}
sim H P_{\_G50054} H_{a}
cmark_rt H



% Constructing a point A such that HA/HE_{a}=2
towards A H E_{a} 2
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a line L_{\_G50316} which passes through point N and point H
line L_{\_G50316} N H

color 200 200 200
drawline L_{\_G50316}
color 0 0 0


% Constructing a point P_{\_G50417} with coordinates (0,0)
```

```
point P_{\_G50417} 0 0
cmark_r P_{\_G50417}

% Constructing a point P_{\_G50341} such that NP_{\_G50341}/NP_{\_G50417}=-1
towards P_{\_G50341} N P_{\_G50417} -1
cmark_r P_{\_G50341}
color 200 200 200
drawsegment P_{\_G50417} P_{\_G50341}
color 0 0 0

% Constructing a point P_{\_G50386} such that NP_{\_G50386}/NP_{\_G50417}=3
towards P_{\_G50386} N P_{\_G50417} 3
cmark_r P_{\_G50386}
color 200 200 200
drawsegment N P_{\_G50386}
color 0 0 0

% Constructing a line L_{\_G50347} which passes through point H and point P_{\_G50386}
line L_{\_G50347} H P_{\_G50386}

color 200 200 200
drawline L_{\_G50347}
color 0 0 0


% Constructing a line L_{\_G50310} which contains the point P_{\_G50341} and is parallel to the
    line L_{\_G50347}
parallel L_{\_G50310} P_{\_G50341} L_{\_G50347}

color 200 200 200
drawline L_{\_G50310}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G50310} and line L_{\_G50316}
intersec G L_{\_G50310} L_{\_G50316}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line h_{a} and circle k(E_{b},B) intersect; points H_{a} and E_{b} are
     not the same; line h_{a} and circle k(N,M_{a}) intersect; points E_{a} and N are not the same;
     lines m(E_{a}M_{c}) and m(E_{a}E_{b}) are not parallel
```

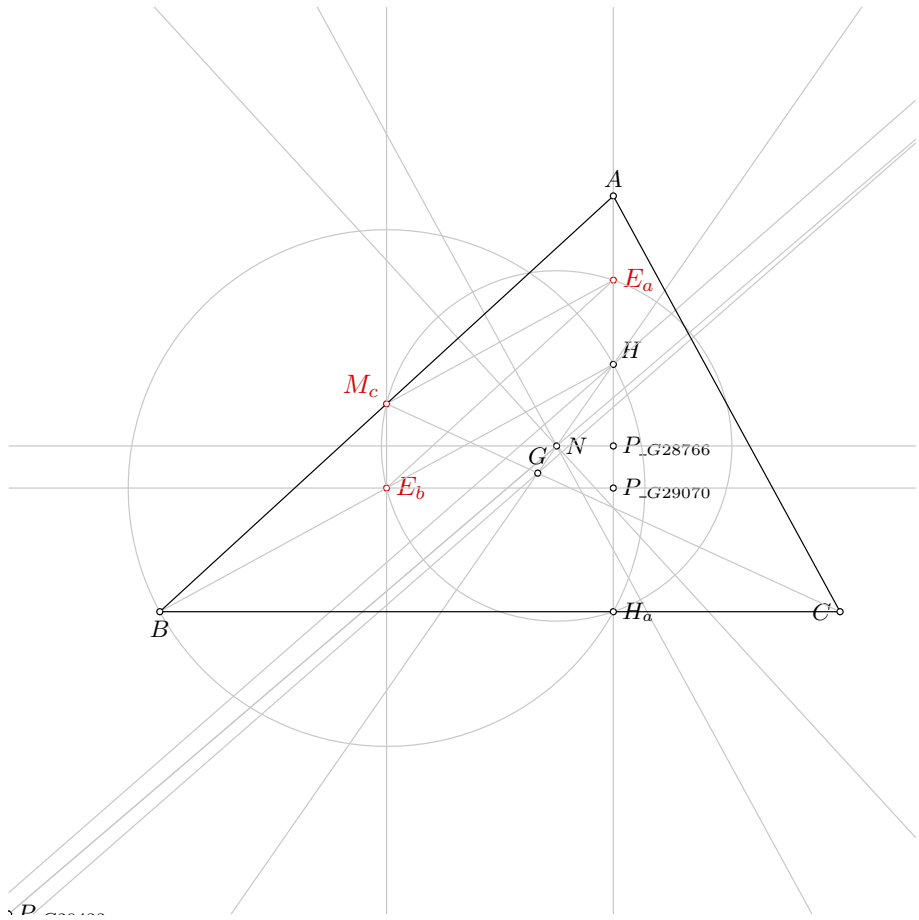

Figure 1: Illustration of the problem 0756

```
% Determination conditions: points H_{a} and H must be different; points E_{a} and H_{a} must be
    different; lines m(E_{a}M_{c}) and m(E_{a}E_{b}) are not the same; points E_{a} and M_{c} are
    not the same; points E_{a} and E_{b} are not the same; points E_{b} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=$\_E_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 5665 terms.

Time Complexity: Time spent by the prover is 14.713 seconds.

NDG conditions Points M_c and E_b are not identical

Points M_c and E_b are not identical

Points M_c and E_b are not identical

Line through points M_c and P_G41616 is not perpendicular to line through points P_G41616 and E_b

Points E_b, P_G41616 and E_a are not collinear

Points A, B and C are not collinear

Line through points B and E_b is not perpendicular to line through points E_b and C

4.1.2 Proving E_b=_E_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 5618 terms.

Time Complexity: Time spent by the prover is 16.115 seconds.

NDG conditions Points M_c and E_b are not identical

Points M_c and E_b are not identical

Points M_c and E_b are not identical

Line through points M_c and E_a is not perpendicular to line through points E_a and E_b

Points E_a and P_G43666 are not identical

Points A, B and C are not collinear

Line through points B and E_b is not perpendicular to line through points E_b and C

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 17 terms.

Time Complexity: Time spent by the prover is 1.111 seconds.

NDG conditions Points M_c and E_b are not identical

Points M_c and E_b are not identical

Points M_c and E_b are not identical

Line through points M_c and P_G45716 is not perpendicular to line through points P_G45716 and E_b

Points P_G45716 and E_a are not identical

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving E_b=_E_b

Proving failed

4.2.3 Proving M_c=_M_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving E_b=_E_b

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_b=_E_b

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 757

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 757: Given a point E_b, a point N and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
2. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
3. Choose freely a point E_a on the circle $k(N, M_a)$ (rule WOncircle);
4. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
5. Choose freely a point A (rule free);
6. Using the point A and the point E_a, construct a point H (rule W01); ;
7. Using the point A and the point M_b, construct a point C (rule W01); ;
8. Using the point E_b and the point H, construct a point B (rule W01); .

Non-degenerate conditions: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: points E_b and M_b must be different; points E_b and N are not the same.

Rules used: [W01,W02,W05a,W06,WOncircle1,free]

Lemmas used: [D22,D28,D29,D32,GD02,GL01,GL03,GL04,L17,L19,L21,L23,L44,L45,L50,L51]

Solving time: 155.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point N 72.5 61.93
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r N
cmark_r E_{a}
color 0 0 0
fontsize 8

% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{a} on the circle with center N through point E_{b}
oncircle E_{a} N E_{b}
cmark_r E_{a}
color 200 200 200
drawcircle N E_{b}
color 0 0 0


% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}



% Constructing a free point A
point A 80 95
```

```
cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; points E_{b} and N
     are not the same
% Determination conditions: points E_{b} and M_{b} must be different; points E_{b} and N are not
    the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

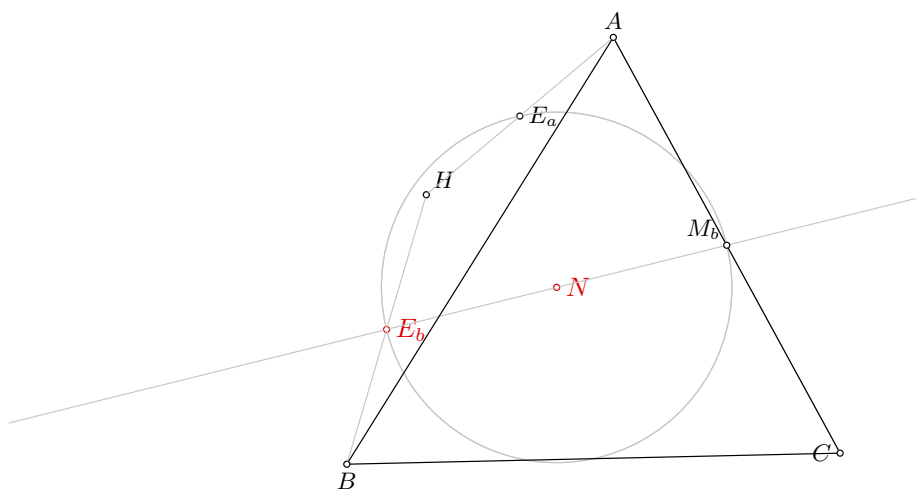

Figure 1: Illustration of the problem 0757

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_a=_E_a

Proving failed

Problem 758

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 758: Given a point E_a, a point E_b and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 759

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 759: Given a point E_a, a point E_b and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 760

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 760: Given a point E_a, a point E_b and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 761

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 761: Given a point E_a, a point E_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 762

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 762: Given a point E_a, a point E_c and a point G, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 763

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 763: Given a point E_a, a point E_c and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H, construct a point A (rule W01); ;
2. Using the point E_c and the point H, construct a point C (rule W01); ;
3. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
4. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
5. Using the point H and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H and E_a are not the same;
6. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H and H_c must be different;
7. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
8. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
9. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
10. Using the line c and the line h_b, construct a point B (rule W03); % NDG: lines c and h_b are not parallel % DET: lines c and h_b are not the same.

Non-degenerate conditions: lines c and h_b are not parallel; line b and circle $k(E_a, A)$ intersect; line h_c and circle $k(E_a, A)$ intersect; points H and E_a are not the same.

Determination conditions: lines c and h_b are not the same; points H_b and H are not the same; points A and H_b must be different; points H_c and A are not the same; points H and H_c must be different; points A and C are not the same; points E_c and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D3,D30,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 12.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{c} 95 56.36
point H 80 72.73

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{c}
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% NDG: points H and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
circle k(E_{a},A) E_{a} H

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G129738} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G129738} E_{a} h_{c}
cmark_r P_{\_G129738}
color 200 200 200
drawline E_{a} P_{\_G129738}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    129738}
sim H_{c} P_{\_G129738} H
cmark_rt H_{c}


% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G129976} which is a foot of the point E_{a} on the line b
foot P_{\_G129976} E_{a} b
cmark_r P_{\_G129976}
color 200 200 200
drawline E_{a} P_{\_G129976}
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    129976}
sim H_{b} P_{\_G129976} A
cmark_l H_{b}
```

```
% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines c and h_{b} are not parallel% DET: lines c and h_{b} are not the same
% Constructing a point B which belongs to line c and line h_{b}
intersec B c h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{b} are not parallel; line b and circle k(E_{a},A)
    intersect; line h_{c} and circle k(E_{a},A) intersect; points H and E_{a} are not the same
% Determination conditions: lines c and h_{b} are not the same; points H_{b} and H are not the same
    ; points A and H_{b} must be different; points H_{c} and A are not the same; points H and H_{c}
     must be different; points A and C are not the same; points E_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H=_H

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

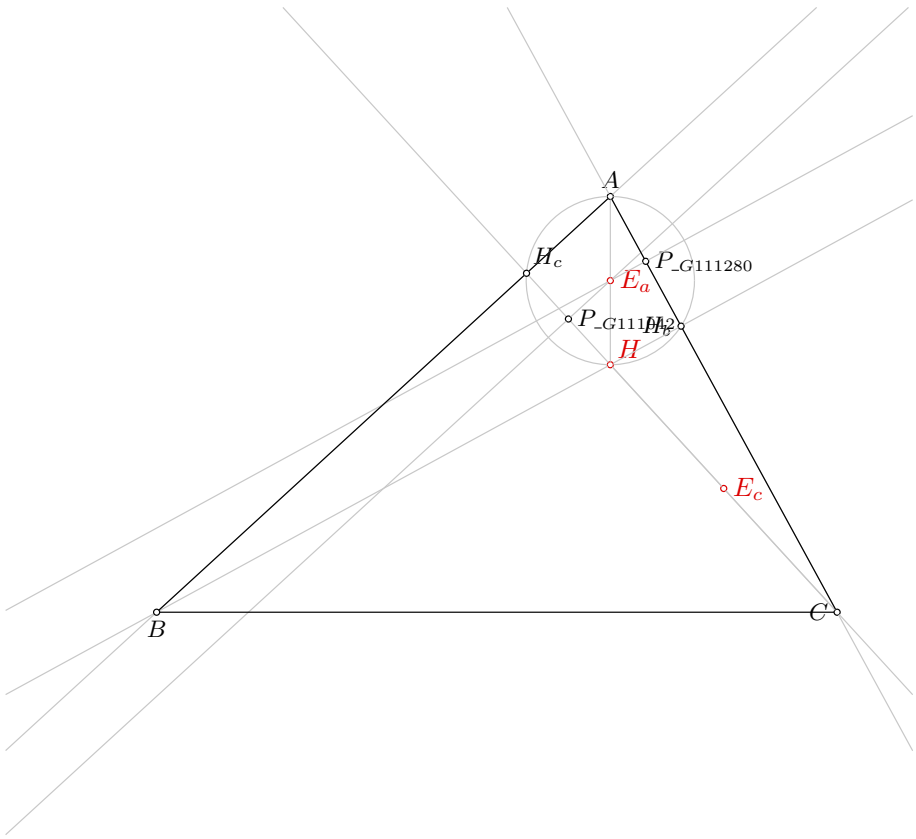

Figure 1: Illustration of the problem 0763

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving H=_H

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 2174 terms.

Time Complexity: Time spent by the prover is 1.800 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving H=_H

Proving failed

Problem 764

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 764: Given a point E_a, a point E_c and a point H_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;
3. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H_a, construct a point H (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H_a and H must be different;
4. Using the point H and the point E_a, construct a point A (rule W01); ;
5. Using the point E_c and the point H, construct a point C (rule W01); ;
6. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
7. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
8. Using the circle $k(E_c, C)$, the line b, the point E_c and the point C, construct a point H_b (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points C and H_b must be different;
9. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
10. Using the line a and the line h_b, construct a point B (rule W03); % NDG: lines a and h_b are not parallel % DET: lines a and h_b are not the same.

Non-degenerate conditions: lines a and h_b are not parallel; line b and circle $k(E_c, C)$ intersect; line h_a and circle $k(E_c, C)$ intersect; points H_a and E_c are not the same.

Determination conditions: lines a and h_b are not the same; points H and H_b are not the same; points C and H_b must be different; points A and C are not the same; points H_a and C are not the same; points H_a and H must be different; points E_a and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D28,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 9.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{c} 95 56.36
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{c}
cmark_r H_{a}
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H_{a} and H must be different
% Constructing a point P_{\_G159129} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G159129} E_{c} h_{a}
cmark_r P_{\_G159129}
color 200 200 200
drawline E_{c} P_{\_G159129}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    159129}
sim H P_{\_G159129} H_{a}
cmark_rt H



% Constructing a point A such that HA/HE_{a}=2
towards A H E_{a} 2
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points C and H_{b} must be different
% Constructing a point P_{\_G159566} which is a foot of the point E_{c} on the line b
foot P_{\_G159566} E_{c} b
cmark_r P_{\_G159566}
color 200 200 200
drawline E_{c} P_{\_G159566}
color 0 0 0

% Constructing a point H_{b} which is an image of the point C in the symmetry to point/line P_{\_G
    159566}
sim H_{b} P_{\_G159566} C
```

```
cmark_l H_{b}


% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines a and h_{b} are not parallel% DET: lines a and h_{b} are not the same
% Constructing a point B which belongs to line a and line h_{b}
intersec B a h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{b} are not parallel; line b and circle k(E_{c},C)
    intersect; line h_{a} and circle k(E_{c},C) intersect; points H_{a} and E_{c} are not the same
% Determination conditions: lines a and h_{b} are not the same; points H and H_{b} are not the same
    ; points C and H_{b} must be different; points A and C are not the same; points H_{a} and C are
     not the same; points H_{a} and H must be different; points E_{a} and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H_a=_H_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

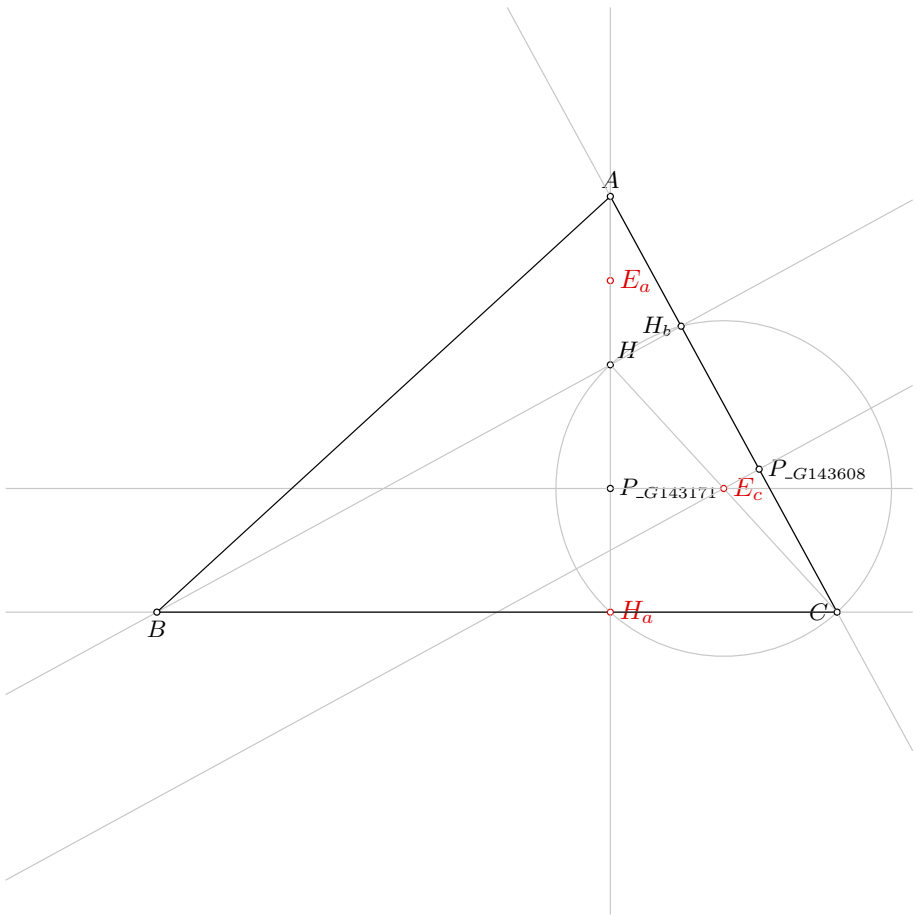

Figure 1: Illustration of the problem 0764

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 765

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 765: Given a point E_a, a point E_c and a point H_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_b and E_a are not the same;
2. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
3. Using the circle $k(E_a, A)$, the circle $k(E_c, C)$, the point H_b, the point E_a and the point E_c, construct a point H (rule W08); % NDG: circles $k(E_a, A)$ and $k(E_c, C)$ intersect % DET: circles $k(E_a, A)$ and $k(E_c, C)$ are not the same; points H_b and H must be different;
4. Using the point H and the point E_a, construct a point A (rule W01); ;
5. Using the point E_c and the point H, construct a point C (rule W01); ;
6. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
7. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
8. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H and H_c must be different;
9. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;
10. Using the line h_b and the line c, construct a point B (rule W03); % NDG: lines h_b and c are not parallel % DET: lines h_b and c are not the same.

Non-degenerate conditions: lines h_b and c are not parallel; line h_c and circle $k(E_a, A)$ intersect; circles $k(E_a, A)$ and $k(E_c, C)$ intersect; points H_b and E_c are not the same; points H_b and E_a are not the same.

Determination conditions: lines h_b and c are not the same; points A and H_c are not the same; points H and H_c must be different; points H_b and H are not the same; points E_c and H are not the same; circles $k(E_a, A)$ and $k(E_c, C)$ are not the same; points H_b and H must be different.

Rules used: [W01,W02,W03,W05,W06,W08]

Lemmas used: [D10,D28,D3,D30,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48,L52,L53]

Solving time: 10.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{c} 95 56.36
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{c}
cmark_l H_{b}
color 0 0 0
fontsize 8

% NDG: points H_{b} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{b}
circle k(E_{a},A) E_{a} H_{b}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: circles k(E_{a},A) and k(E_{c},C) intersect% DET: circles k(E_{a},A) and k(E_{c},C) are not
    the same; points H_{b} and H must be different
% Constructing a line L_{\_G189475} which passes through point E_{a} and point E_{c}
line L_{\_G189475} E_{a} E_{c}
```

```
color 200 200 200
drawline L_{\_G189475}
color 0 0 0


% Constructing a point H which is an image of the point H_{b} in the symmetry to point/line L_{\_G
    189475}
sim H L_{\_G189475} H_{b}
cmark_rt H



% Constructing a point A such that HA/HE_{a}=2
towards A H E_{a} 2
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G189892} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G189892} E_{a} h_{c}
cmark_r P_{\_G189892}
color 200 200 200
drawline E_{a} P_{\_G189892}
```

```
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    189892}
sim H_{c} P_{\_G189892} H
cmark_rt H_{c}


% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{b} and c are not parallel% DET: lines h_{b} and c are not the same
% Constructing a point B which belongs to line h_{b} and line c
intersec B h_{b} c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and c are not parallel; line h_{c} and circle k(E_{a},A)
    intersect; circles k(E_{a},A) and k(E_{c},C) intersect; points H_{b} and E_{c} are not the same
    ; points H_{b} and E_{a} are not the same
% Determination conditions: lines h_{b} and c are not the same; points A and H_{c} are not the same
    ; points H and H_{c} must be different; points H_{b} and H are not the same; points E_{c} and H
     are not the same; circles k(E_{a},A) and k(E_{c},C) are not the same; points H_{b} and H must
    be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving E_c=_E_c

Proving failed

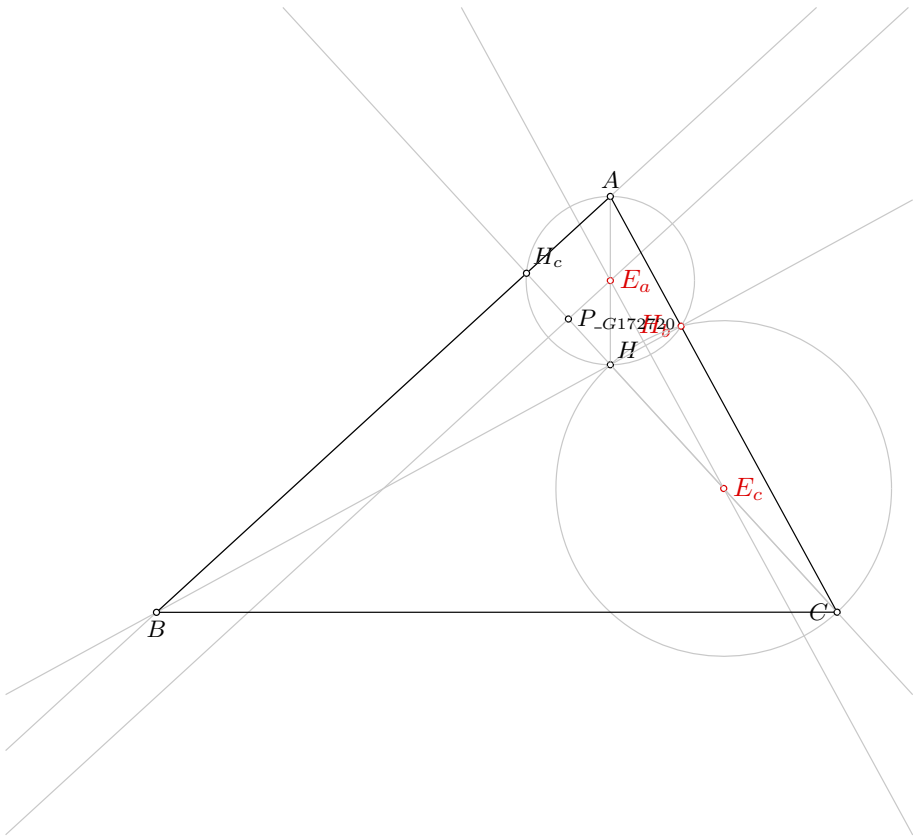

Figure 1: Illustration of the problem 0765

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 766

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 766: Given a point E_a, a point E_c and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
3. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H_c, construct a point H (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H_c and H must be different;
4. Using the point H and the point E_a, construct a point A (rule W01); ;
5. Using the point E_c and the point H, construct a point C (rule W01); ;
6. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
7. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
8. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
9. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
10. Using the line c and the line h_b, construct a point B (rule W03); % NDG: lines c and h_b are not parallel % DET: lines c and h_b are not the same.

Non-degenerate conditions: lines c and h_b are not parallel; line b and circle $k(E_a, A)$ intersect; line h_c and circle $k(E_a, A)$ intersect; points H_c and E_a are not the same.

Determination conditions: lines c and h_b are not the same; points H and H_b are not the same; points A and H_b must be different; points A and C are not the same; points H_c and A are not the same; points H_c and H must be different; points E_c and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D28,D3,D30,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 9.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{c} 95 56.36
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{c}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H_{c} and H must be different
% Constructing a point P_{\_G218523} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G218523} E_{a} h_{c}
cmark_r P_{\_G218523}
color 200 200 200
drawline E_{a} P_{\_G218523}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    218523}
sim H P_{\_G218523} H_{c}
cmark_rt H



% Constructing a point A such that HA/HE_{a}=2
towards A H E_{a} 2
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G218960} which is a foot of the point E_{a} on the line b
foot P_{\_G218960} E_{a} b
cmark_r P_{\_G218960}
color 200 200 200
drawline E_{a} P_{\_G218960}
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    218960}
sim H_{b} P_{\_G218960} A
```

```
cmark_l H_{b}


% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines c and h_{b} are not parallel% DET: lines c and h_{b} are not the same
% Constructing a point B which belongs to line c and line h_{b}
intersec B c h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{b} are not parallel; line b and circle k(E_{a},A)
    intersect; line h_{c} and circle k(E_{a},A) intersect; points H_{c} and E_{a} are not the same
% Determination conditions: lines c and h_{b} are not the same; points H and H_{b} are not the same
    ; points A and H_{b} must be different; points A and C are not the same; points H_{c} and A are
     not the same; points H_{c} and H must be different; points E_{c} and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

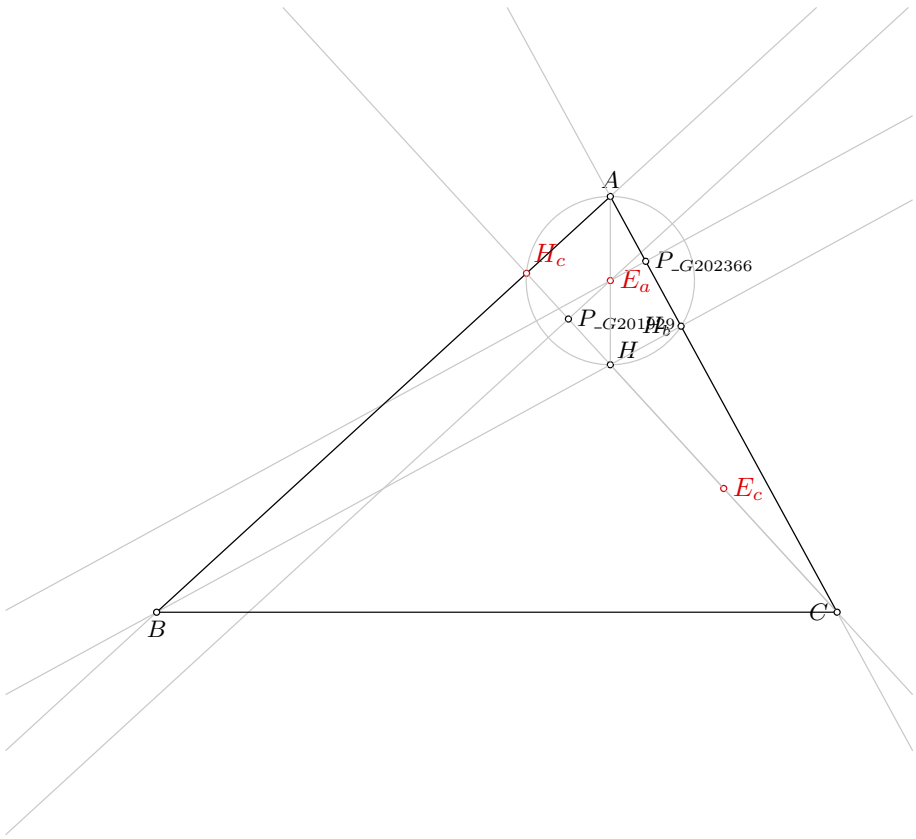

Figure 1: Illustration of the problem 0766

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving H_c=_H_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 767

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 767: Given a point E_a, a point E_c and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 768

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 768: Given a point E_a, a point M_a and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
2. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;
3. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;
4. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
5. Choose freely a point E_c on the circle $k(N, M_a)$ (rule WOncircle);
6. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
8. Choose freely a point A (rule free);
9. Using the point A and the point E_a, construct a point H (rule W01); ;
10. Using the point A and the point M_c, construct a point B (rule W01); ;
11. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel.

Determination conditions: points E_c and M_c must be different; points E_c and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points E_a and M_a are not the same.

Rules used: [W01,W02,W03,W05a,W06,W14,WOncircle1,free]

Lemmas used: [D20,D28,D30,D32,GD02,GL01,GL03,GL04,L18,L19,L20,L21,L22,L24,L38,L39,L41,L42,L47,L48

Solving time: 199.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point M_{a} 65 40
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r M_{a}
cmark_r E_{c}
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0


% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N
```

```
% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% Choosing randomly a point E_{c} on the circle with center N through point E_{a}
oncircle E_{c} N E_{a}
cmark_r E_{c}
color 200 200 200
drawcircle N E_{a}
color 0 0 0


% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
```

```
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect; points E_{a} and N
     are not the same; lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel
% Determination conditions: points E_{c} and M_{c} must be different; points E_{c} and N are not
    the same; lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the same; points E_{a} and M_{a} are
    not the same; points E_{a} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 15 terms.

Time Complexity: Time spent by the prover is 0.326 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_c=_E_c

Proving failed

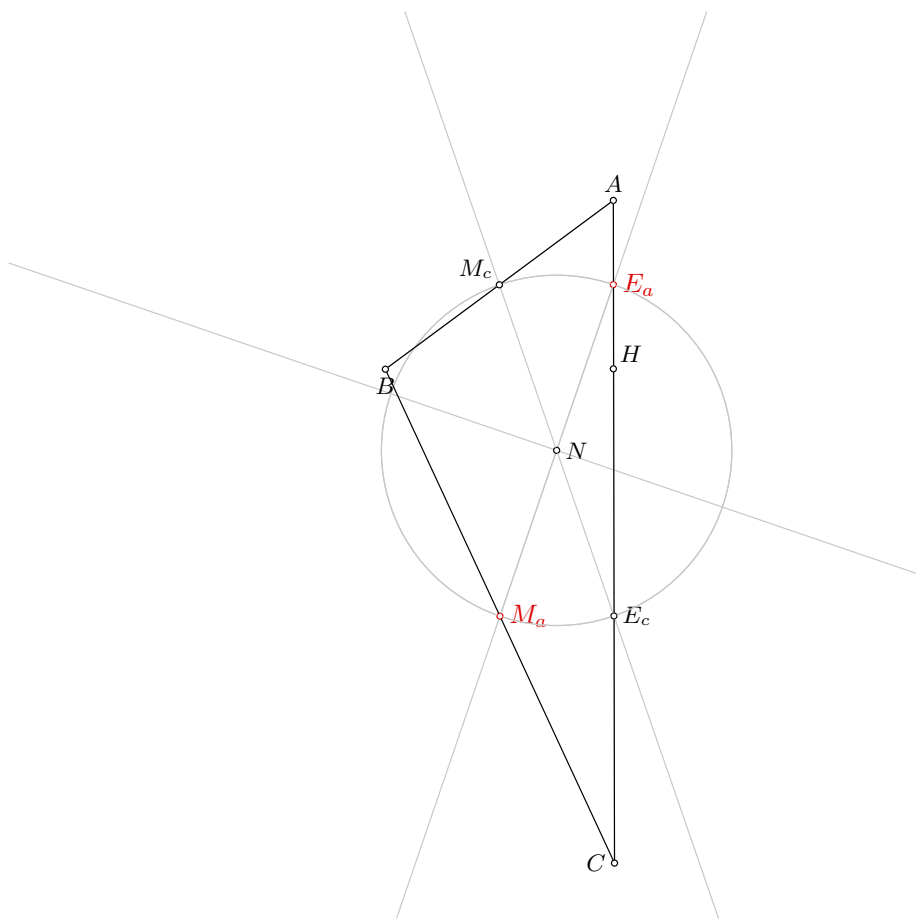

Figure 1: Illustration of the problem 0768

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving M_a=_M_a

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving M_a=_M_a

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 769

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 769: Given a point E_a, a point E_c and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_b, construct a line $m(CH_a)$ (rule W02); % DET: points E_c and M_b are not the same;

2. Using the point E_a and the point E_c, construct a line $m(E_aE_c)$ (rule W14); % DET: points E_a and E_c are not the same;

3. Using the point E_a and the point M_b, construct a line $m(E_aM_b)$ (rule W14); % DET: points E_a and M_b are not the same;

4. Using the line $m(E_aM_b)$ and the line $m(E_aE_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_b)$ and $m(E_aE_c)$ are not parallel % DET: lines $m(E_aM_b)$ and $m(E_aE_c)$ are not the same;

5. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;

6. Using the point E_a and the line $m(CH_a)$, construct a line h_a (rule W16); ;

7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;

8. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;

9. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H_a, construct a point H (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H_a and H must be different;

10. Using the point H and the point E_a, construct a point A (rule W01); ;
11. Using the point E_c and the point H, construct a point C (rule W01); ;
12. Using the point N and the point H, construct a point G (rule W01); ;
13. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: line h_a and circle $k(E_c, C)$ intersect; points H_a and E_c are not the same; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same; lines $m(E_aM_b)$ and $m(E_aE_c)$ are not parallel.

Determination conditions: points H_a and H must be different; points E_a and H_a must be different; lines $m(E_aM_b)$ and $m(E_aE_c)$ are not the same; points E_a and M_b are not the same; points E_a and E_c are not the same; points E_c and M_b are not the same.

Rules used: [W01,W02,W03,W05,W06,W14,W16]

Lemmas used: [D28,D3,D30,D32,D5,D8,GD02,GL01,GL03,GL04,GL09,L16,L17,L19,L22,L24,L44,L52,L54,L56

Solving time: 25.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point E_{c} 95 56.36
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r E_{c}
cmark_lt M_{b}
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{b} are not the same
% Constructing a line m(CH_{a}) which passes through point E_{c} and point M_{b}
line m(CH_{a}) E_{c} M_{b}

color 200 200 200
drawline m(CH_{a})
color 0 0 0



% DET: points E_{a} and E_{c} are not the same
% Constructing bisector m(E_{a}E_{c}) of the segment E_{a}E_{c}
med m(E_{a}E_{c}) E_{a} E_{c}

color 200 200 200
drawline m(E_{a}E_{c})
color 0 0 0
```

```
color 200 200 200
drawsegment E_{a} E_{c}
color 0 0 0


% DET: points E_{a} and M_{b} are not the same
% Constructing bisector m(E_{a}M_{b}) of the segment E_{a}M_{b}
med m(E_{a}M_{b}) E_{a} M_{b}

color 200 200 200
drawline m(E_{a}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{b}
color 0 0 0


% NDG: lines m(E_{a}M_{b}) and m(E_{a}E_{c}) are not parallel% DET: lines m(E_{a}M_{b}) and m(E_{a}
    E_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{b}) and line m(E_{a}E_{c})
intersec N m(E_{a}M_{b}) m(E_{a}E_{c})
cmark_r N


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Constructing a line h_{a} which contains the point E_{a} and is parallel to the line m(CH_{a})
parallel h_{a} E_{a} m(CH_{a})

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G50558} which is a foot of the point N on the line h_{a}
foot P_{\_G50558} N h_{a}
cmark_r P_{\_G50558}
color 200 200 200
drawline N P_{\_G50558}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G50558}
sim H_{a} P_{\_G50558} E_{a}
```

```
cmark_r H_{a}


% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H_{a} and H must be different
% Constructing a point P_{\_G50862} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G50862} E_{c} h_{a}
cmark_r P_{\_G50862}
color 200 200 200
drawline E_{c} P_{\_G50862}
color 0 0 0

% Constructing a point H which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    50862}
sim H P_{\_G50862} H_{a}
cmark_rt H



% Constructing a point A such that HA/HE_{a}=2
towards A H E_{a} 2
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a line L_{\_G51124} which passes through point N and point H
line L_{\_G51124} N H

color 200 200 200
drawline L_{\_G51124}
color 0 0 0


% Constructing a point P_{\_G51225} with coordinates (0,0)
```

```
point P_{\_G51225} 0 0
cmark_r P_{\_G51225}

% Constructing a point P_{\_G51149} such that NP_{\_G51149}/NP_{\_G51225}=-1
towards P_{\_G51149} N P_{\_G51225} -1
cmark_r P_{\_G51149}
color 200 200 200
drawsegment P_{\_G51225} P_{\_G51149}
color 0 0 0

% Constructing a point P_{\_G51194} such that NP_{\_G51194}/NP_{\_G51225}=3
towards P_{\_G51194} N P_{\_G51225} 3
cmark_r P_{\_G51194}
color 200 200 200
drawsegment N P_{\_G51194}
color 0 0 0

% Constructing a line L_{\_G51155} which passes through point H and point P_{\_G51194}
line L_{\_G51155} H P_{\_G51194}

color 200 200 200
drawline L_{\_G51155}
color 0 0 0


% Constructing a line L_{\_G51118} which contains the point P_{\_G51149} and is parallel to the
    line L_{\_G51155}
parallel L_{\_G51118} P_{\_G51149} L_{\_G51155}

color 200 200 200
drawline L_{\_G51118}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G51118} and line L_{\_G51124}
intersec G L_{\_G51118} L_{\_G51124}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line h_{a} and circle k(E_{c},C) intersect; points H_{a} and E_{c} are
     not the same; line h_{a} and circle k(N,M_{a}) intersect; points E_{a} and N are not the same;
     lines m(E_{a}M_{b}) and m(E_{a}E_{c}) are not parallel
```

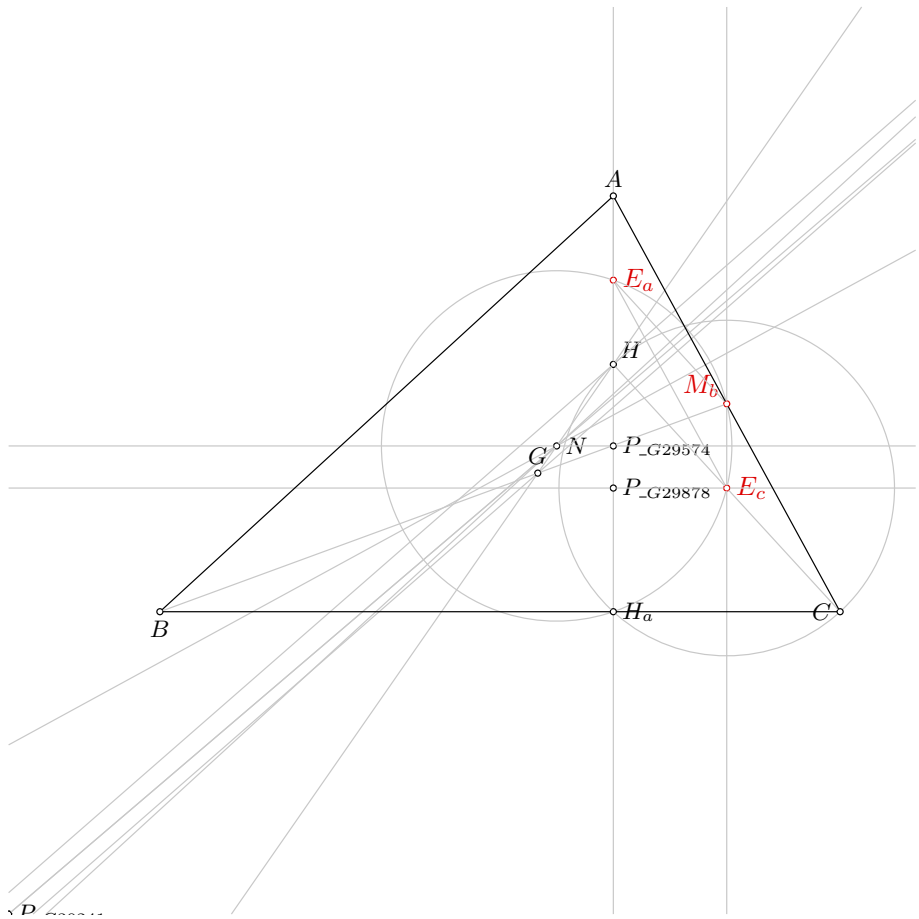

Figure 1: Illustration of the problem 0769

```
% Determination conditions: points H_{a} and H must be different; points E_{a} and H_{a} must be
    different; lines m(E_{a}M_{b}) and m(E_{a}E_{c}) are not the same; points E_{a} and M_{b} are
    not the same; points E_{a} and E_{c} are not the same; points E_{c} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 5665 terms.

Time Complexity: Time spent by the prover is 14.946 seconds.

NDG conditions Points M_b and E_c are not identical

Points M_b and E_c are not identical

Points M_b and E_c are not identical

Line through points M_b and P_G42424 is not perpendicular to line through points P_G42424 and E_c

Points E_c, P_G42424 and E_a are not collinear

Points A, B and C are not collinear

Line through points E_c and B is not perpendicular to line through points B and E_a

4.1.2 Proving E_c=$\_E_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 5618 terms.

Time Complexity: Time spent by the prover is 15.75 seconds.

NDG conditions Points M_b and E_c are not identical

Points M_b and E_c are not identical

Points M_b and E_c are not identical

Line through points P_G44474 and M_b is not perpendicular to line through points M_b and E_a

Points P_G44474 and E_a are not identical

Points A, B and C are not collinear

Line through points E_c and B is not perpendicular to line through points B and E_a

4.1.3 Proving M_b=$\_M_b$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 17 terms.

Time Complexity: Time spent by the prover is 1.147 seconds.

NDG conditions Points M_b and E_c are not identical

Points M_b and E_c are not identical

Points M_b and E_c are not identical

Line through points M_b and P_G46524 is not perpendicular to line through points P_G46524 and E_c

Points E_c, P_G46524 and E_a are not collinear

4.2 GCLC - Area method

4.2.1 Proving E_a=$\_E_a$

Proving failed

4.2.2 Proving E_c=$\_E_c$

Proving failed

4.2.3 Proving M_b=$\_M_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=$\_E_a$

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving M_b=_M_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 770

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 770: Given a point E_c, a point M_c and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
2. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;
3. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;
4. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
5. Choose freely a point E_a on the circle $k(N, M_a)$ (rule WOncircle);
6. Choose freely a point A (rule free);
7. Using the point A and the point E_a, construct a point H (rule W01); ;
8. Using the point A and the point M_c, construct a point B (rule W01); ;
9. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: points E_c and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points E_c and M_c are not the same.

Rules used: [W01,W02,W03,W06,W14,WOncircle1,free]

Lemmas used: [D20,D28,D30,D32,GD02,GL01,GL03,GL04,L18,L19,L20,L24,L41,L42,L53,L54]

Solving time: 200.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point M_{c} 50 67.5
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_lt M_{c}
cmark_r E_{a}
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0


% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% Choosing randomly a point E_{a} on the circle with center N through point E_{c}
oncircle E_{a} N E_{c}
cmark_r E_{a}
color 200 200 200
drawcircle N E_{c}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points E_{c} and N are not the same; lines m(E_{c}M_{c}) and m(H_{b}H
    _{a}) are not parallel
% Determination conditions: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and M_{c} are not the same; points E_{c} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

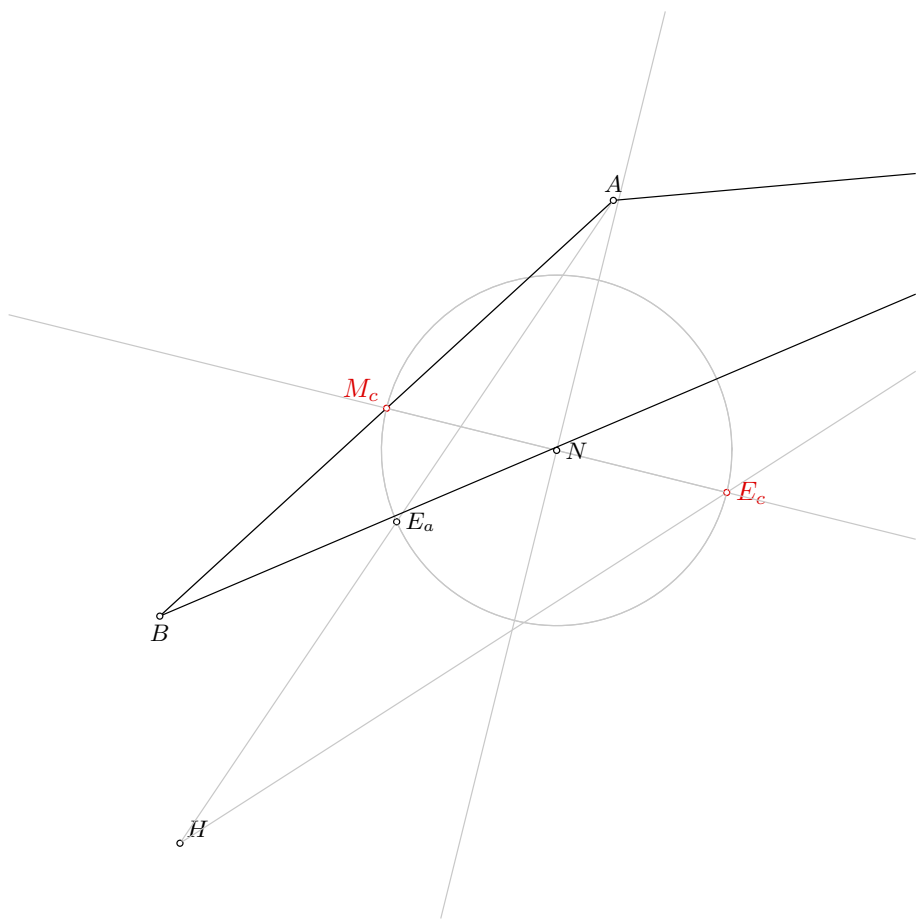

Figure 1: Illustration of the problem 0770

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.051 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving M_c=_M_c

NDG conditions are:

$S_{M^0_{m(E_cM_c)}E_cM_c} \neq S_{T^1_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^0_{m(E_cM_c)}T^1_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving E_a=_E_a

Proving failed

Problem 771

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 771: Given a point E_c, a point N and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
2. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
3. Choose freely a point E_a on the circle $k(N, M_a)$ (rule WOncircle);
4. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
5. Choose freely a point A (rule free);
6. Using the point A and the point E_a, construct a point H (rule W01); ;
7. Using the point A and the point M_c, construct a point B (rule W01); ;
8. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: points E_c and M_c must be different; points E_c and N are not the same.

Rules used: [W01,W02,W05a,W06,WOncircle1,free]

Lemmas used: [D20,D28,D30,D32,GD02,GL01,GL03,GL04,L18,L19,L20,L24,L41,L42,L53,L54]

Solving time: 148.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point N 72.5 61.93
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_r N
cmark_r E_{a}
color 0 0 0
fontsize 8

% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{a} on the circle with center N through point E_{c}
oncircle E_{a} N E_{c}
cmark_r E_{a}
color 200 200 200
drawcircle N E_{c}
color 0 0 0


% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}



% Constructing a free point A
point A 80 95
```

```
cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect; points E_{c} and N
     are not the same
% Determination conditions: points E_{c} and M_{c} must be different; points E_{c} and N are not
    the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

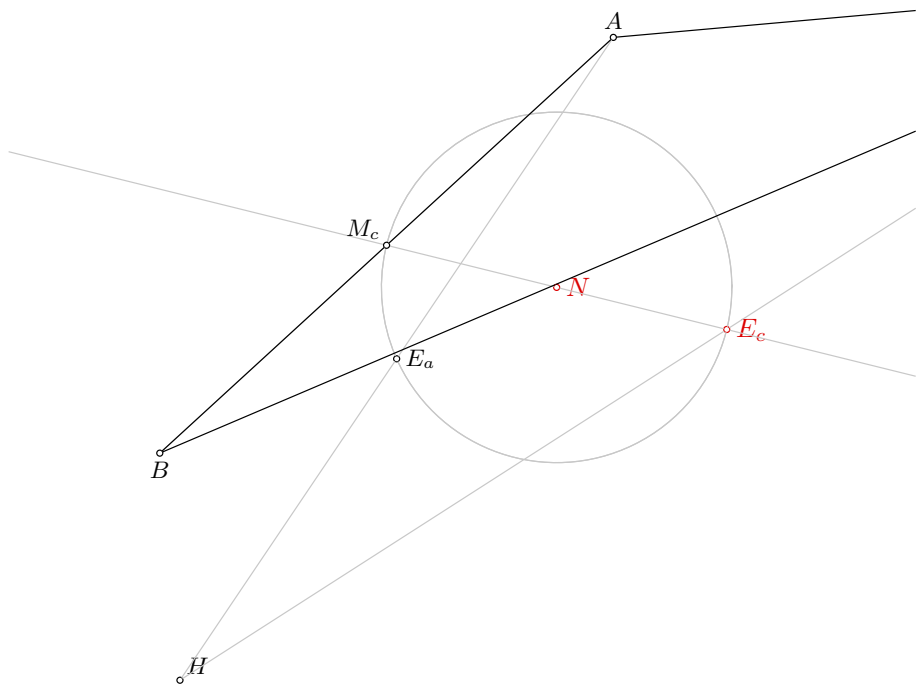

Figure 1: Illustration of the problem 0771

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_a=_E_a

Proving failed

Problem 772

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 772: Given a point E_a, a point E_c and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 773

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 773: Given a point E_a, a point E_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 774

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 774: Given a point E_a, a point E_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 775

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 775: Given a point E_a, a point E_c and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 776

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 776: Given a point E_a, a point G and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H, construct a point A (rule W01); ;
2. Using the point G and the point H, construct a point N (rule W01); ;
3. Using the point G and the point H, construct a point O (rule W01); ;
4. Using the point G and the point A, construct a point M_a (rule W01); ;
5. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
6. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points E_a and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L16,L19,L22,L55,L58]

Solving time: 7.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point G 70 58.33
point H 80 72.73

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_t G
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point N such that GN/GH=0.25
towards N G H 0.25
cmark_r N
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a point M_{a} such that GM_{a}/GA=-0.5
```

```
towards M_{a} G A -0.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G152129} which is a foot of the point N on the line h_{a}
foot P_{\_G152129} N h_{a}
cmark_r P_{\_G152129}
color 200 200 200
drawline N P_{\_G152129}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G152129}
sim H_{a} P_{\_G152129} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points E_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points E_{a} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving H=_H

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving H=_H

Proving failed

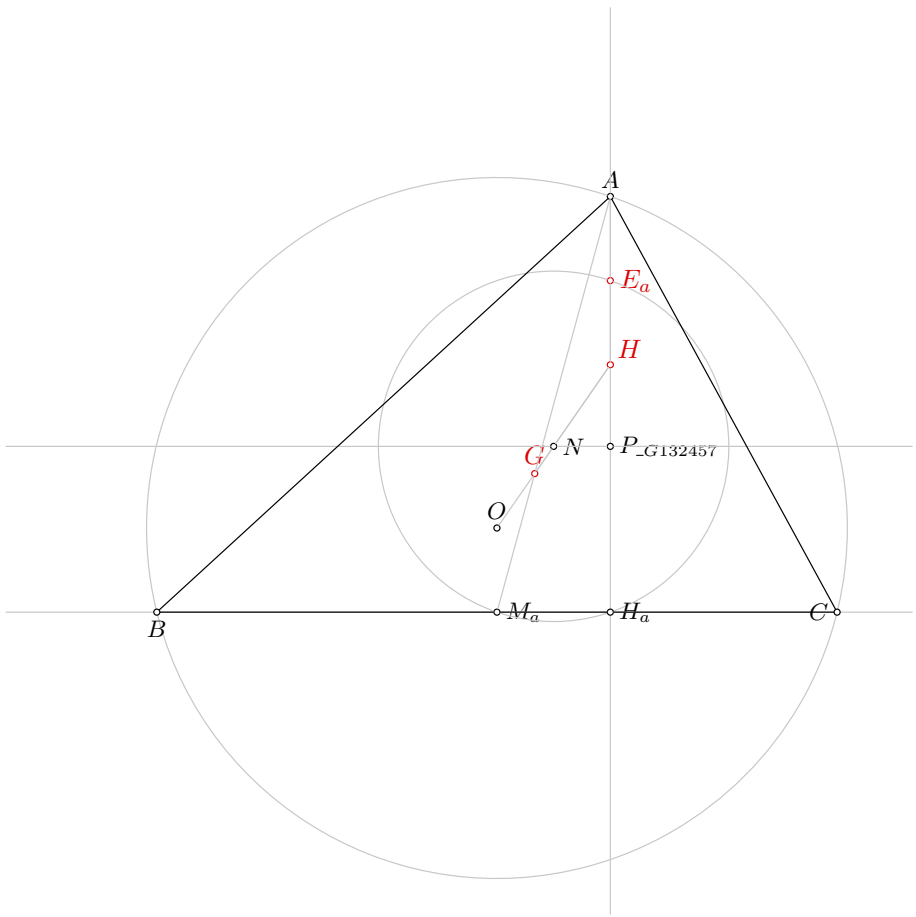

Figure 1: Illustration of the problem 0776

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving H=_H

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving H=_H

Proving failed

Problem 777

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 777: Given a point E_a, a point G and a point H_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Using the point H_a and the line h_a, construct a line a (rule W10a); ;
3. Using the point G, the line h_a and the point E_a, construct a line $h_{G,-1/2}(h_a)$ (rule W15); ;
4. Using the line $h_{G,-1/2}(h_a)$ and the line a, construct a point M_a (rule W03); % NDG: lines $h_{G,-1/2}(h_a)$ and a are not parallel % DET: lines $h_{G,-1/2}(h_a)$ and a are not the same;
5. Using the point M_a and the point G, construct a point A (rule W01); ;
6. Using the point E_a and the point A, construct a point H (rule W01); ;
7. Using the point G and the point H, construct a point O (rule W01); ;
8. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
9. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; lines $h_{G,-1/2}(h_a)$ and a are not parallel.

Determination conditions: lines $h_{G,-1/2}(h_a)$ and a are not the same; points E_a and H_a are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W15]

Lemmas used: [D21,D26,D28,D3,D5,D8,GD01,GL02,GL03,GL04,GL09,L11,L12,L55,L58]

Solving time: 4.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point G 70 58.33
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_t G
cmark_r H_{a}
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Constructing a line a which is perpendicular to line h_{a} and which passes through point H_{a}
perp a H_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0




% Constructing a point P_{\_G178374} such that GP_{\_G178374}/GE_{a}=-0.5
towards P_{\_G178374} G E_{a} -0.5
cmark_r P_{\_G178374}
color 200 200 200
drawsegment E_{a} P_{\_G178374}
color 0 0 0

% Constructing a line h_{G,-1/2}(h_{a}) which contains the point P_{\_G178374} and is parallel to
    the line h_{a}
parallel h_{G,-1/2}(h_{a}) P_{\_G178374} h_{a}

color 200 200 200
drawline h_{G,-1/2}(h_{a})
color 0 0 0
```

```
% NDG: lines h_{G,-1/2}(h_{a}) and a are not parallel% DET: lines h_{G,-1/2}(h_{a}) and a are not
    the same
% Constructing a point M_{a} which belongs to line h_{G,-1/2}(h_{a}) and line a
intersec M_{a} h_{G,-1/2}(h_{a}) a
cmark_r M_{a}



% Constructing a point A such that M_{a}A/M_{a}G=3
towards A M_{a} G 3
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0



% Constructing a point H such that E_{a}H/E_{a}A=-1
towards H E_{a} A -1
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

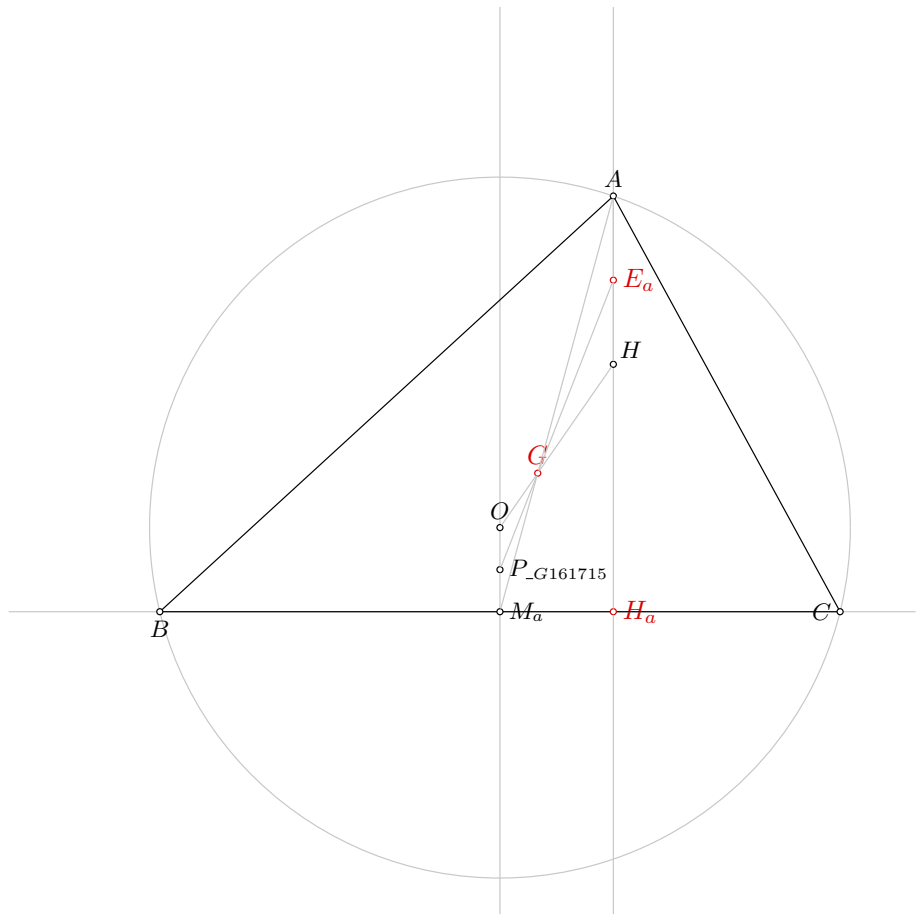

Figure 1: Illustration of the problem 0777

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    lines h_{G,-1/2}(h_{a}) and a are not parallel
% Determination conditions: lines h_{G,-1/2}(h_{a}) and a are not the same; points E_{a} and H_{a}
    are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving H_a=_H_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 778

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 778: Given a point E_a, a point G and a point H_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 779

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 779: Given a point E_a, a point G and a point H_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 780

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 780: Given a point E_a, a point G and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 781

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 781: Given a point E_a, a point G and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point M_a, construct a point A (rule W01); ;
2. Using the point E_a and the point A, construct a point H (rule W01); ;
3. Using the point G and the point H, construct a point N (rule W01); ;
4. Using the point G and the point H, construct a point O (rule W01); ;
5. Using the point E_a and the point A, construct a line h_a (rule W02); % DET: points E_a and A are not the same;
6. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points E_a and A are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L16,L19,L22,L55,L58]

Solving time: 7.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point G 70 58.33
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_t G
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point A such that GA/GM_{a}=-2
towards A G M_{a} -2
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0



% Constructing a point H such that E_{a}H/E_{a}A=-1
towards H E_{a} A -1
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point N such that GN/GH=0.25
towards N G H 0.25
cmark_r N
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
```

```
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points E_{a} and A are not the same
% Constructing a line h_{a} which passes through point E_{a} and point A
line h_{a} E_{a} A

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G215460} which is a foot of the point N on the line h_{a}
foot P_{\_G215460} N h_{a}
cmark_r P_{\_G215460}
color 200 200 200
drawline N P_{\_G215460}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G215460}
sim H_{a} P_{\_G215460} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points E_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points E_{a} and A are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving M_a=_M_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

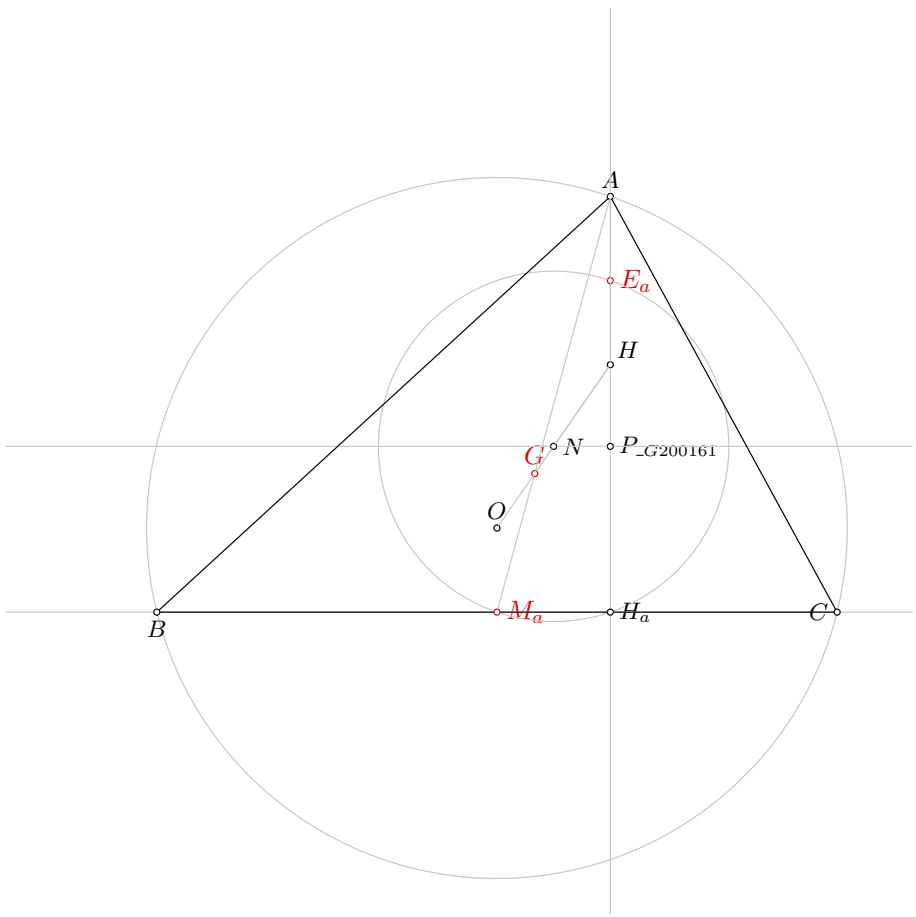

Figure 1: Illustration of the problem 0781

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 782

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 782: Given a point E_a, a point G and a point M_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 783

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 783: Given a point E_a, a point G and a point M_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 784

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 784: Given a point E_a, a point G and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point N, construct a point H (rule W01); ;
2. Using the point E_a and the point H, construct a point A (rule W01); ;
3. Using the point G and the point N, construct a point O (rule W01); ;
4. Using the point G and the point A, construct a point M_a (rule W01); ;
5. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
6. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points E_a and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L19,L22,L55]

Solving time: 7.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point G 70 58.33
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_t G
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point O such that GO/GN=-2
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0



% Constructing a point M_{a} such that GM_{a}/GA=-0.5
```

```
towards M_{a} G A -0.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G20467} which is a foot of the point N on the line h_{a}
foot P_{\_G20467} N h_{a}
cmark_r P_{\_G20467}
color 200 200 200
drawline N P_{\_G20467}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G20467}
sim H_{a} P_{\_G20467} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points E_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points E_{a} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving N=_N

Proving failed

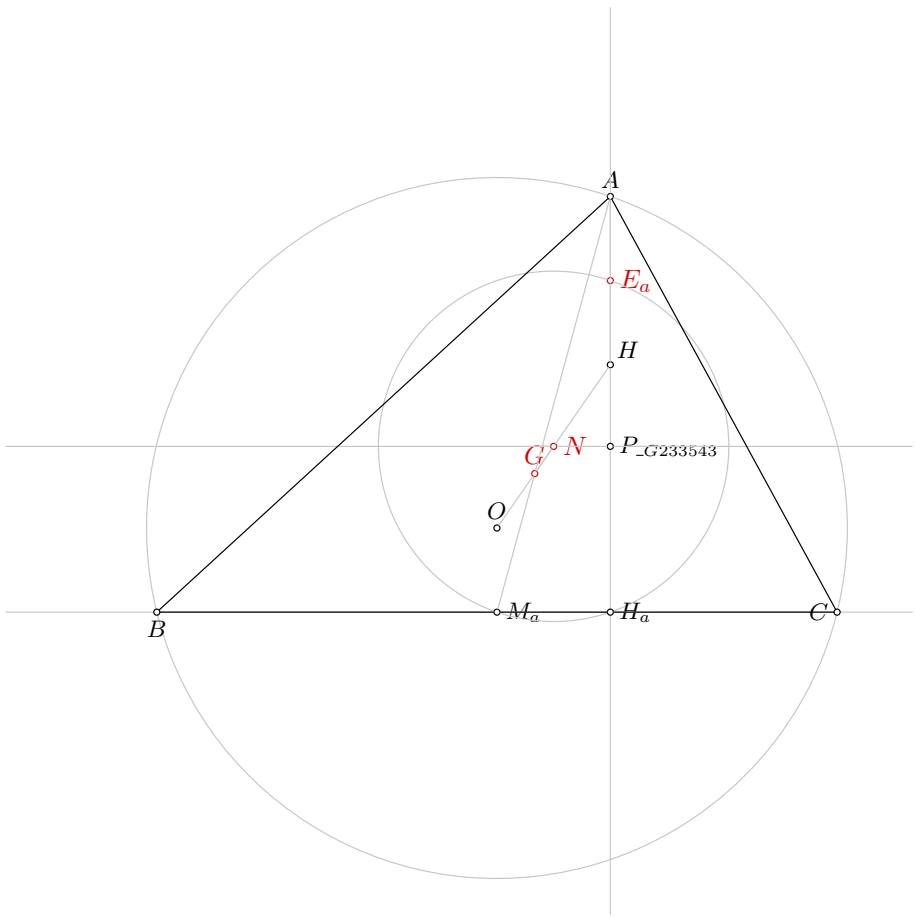

Figure 1: Illustration of the problem 0784

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 785

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 785: Given a point E_a, a point G and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point O, construct a point N (rule W01); ;
2. Using the point G and the point O, construct a point H (rule W01); ;
3. Using the point E_a and the point H, construct a point A (rule W01); ;
4. Using the point G and the point A, construct a point M_a (rule W01); ;
5. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
6. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points E_a and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L19,L22,L55,L58]

Solving time: 7.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point G 70 58.33
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_t G
cmark_t O
color 0 0 0
fontsize 8


% Constructing a point N such that GN/GO=-0.5
towards N G O -0.5
cmark_r N
color 200 200 200
drawsegment O N
color 0 0 0



% Constructing a point H such that GH/GO=-2
towards H G O -2
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point M_{a} such that GM_{a}/GA=-0.5
```

```
towards M_{a} G A -0.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G50952} which is a foot of the point N on the line h_{a}
foot P_{\_G50952} N h_{a}
cmark_r P_{\_G50952}
color 200 200 200
drawline N P_{\_G50952}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G50952}
sim H_{a} P_{\_G50952} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points E_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points E_{a} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving O=_O

Proving failed

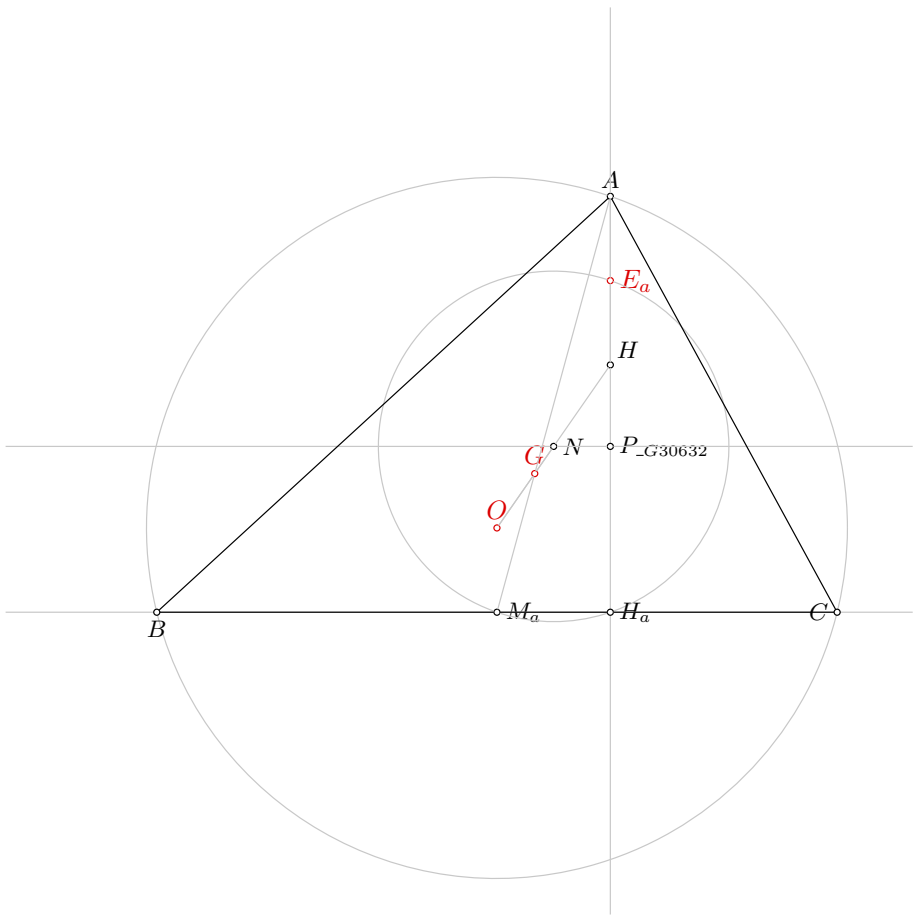

Figure 1: Illustration of the problem 0785

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 786

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 786: Given a point E_a, a point G and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 787

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 787: Given a point E_a, a point G and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 788

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 788: Given a point E_a, a point G and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 789

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 789: Given a point H, a point H_a and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point H_a, construct a line h_a (rule W02); % DET: points H and H_a are not the same;
2. Choose freely a point E_a on the line h_a (rule WOnline1) ;
3. Using the point E_a and the point H, construct a point A (rule W01); ;
4. Using the point H and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H and E_a are not the same;
5. Using the point H_a and the line h_a, construct a line a (rule W10a); ;
6. Choose freely a point B on the line a (rule WOnline2);
7. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
8. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
9. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
10. Using the line a and the line b, construct a point C (rule W03); % NDG: lines a and b are not parallel % DET: lines a and b are not the same.

Non-degenerate conditions: lines a and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; points H and E_a are not the same.

Determination conditions: lines a and b are not the same; points A and H_b are not the same; points H and H_b must be different; points B and H are not the same; points H and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,WOnline1,WOnline2]

Lemmas used: [D28,D3,D5,D6,D8,D9,GD01,GD02,GL03,GL04,L46,L47]

Solving time: 169.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{a} 80 40
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_rt H
cmark_r H_{a}
cmark_r E_{a}
color 0 0 0
fontsize 8

% DET: points H and H_{a} are not the same
% Constructing a line h_{a} which passes through point H and point H_{a}
line h_{a} H H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Choosing randomly a point E_{a} on the line HH_{a}
online E_{a} H H_{a}
cmark_r E_{a}
color 200 200 200
drawline H H_{a}
color 0 0 0



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0
```

```
% NDG: points H and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
circle k(E_{a},A) E_{a} H

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0




% Constructing a line a which is perpendicular to line h_{a} and which passes through point H_{a}
perp a H_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0




% Generating random value V[_G85554]
random V[_G85554]


% Calculating value V[_G85575] using formula V[_G85554]*20
expression V[_G85575] { V[_G85554]*20 }


% Constructing a point B which is a point for which holds H_{a}B = V[_G85575] and angle E_{a}H_{a}B
     = 90
turtle B E_{a} H_{a} 90 V[_G85575]
cmark_b B


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G85847} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G85847} E_{a} h_{b}
cmark_r P_{\_G85847}
color 200 200 200
drawline E_{a} P_{\_G85847}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    85847}
sim H_{b} P_{\_G85847} H
```

```
cmark_l H_{b}


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines a and b are not parallel% DET: lines a and b are not the same
% Constructing a point C which belongs to line a and line b
intersec C a b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; points H and E_{a} are not the same
% Determination conditions: lines a and b are not the same; points A and H_{b} are not the same;
    points H and H_{b} must be different; points B and H are not the same; points H and H_{a} are
    not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 61 terms.

Time Complexity: Time spent by the prover is 0.534 seconds.

NDG conditions Points B and H are not identical

Points B and H are not identical

Line through points H_b and H is not perpendicular to line through points H and A

Line through points C and B is not perpendicular to line through points B and H_a

Line through points A and H is not perpendicular to line through points H and B

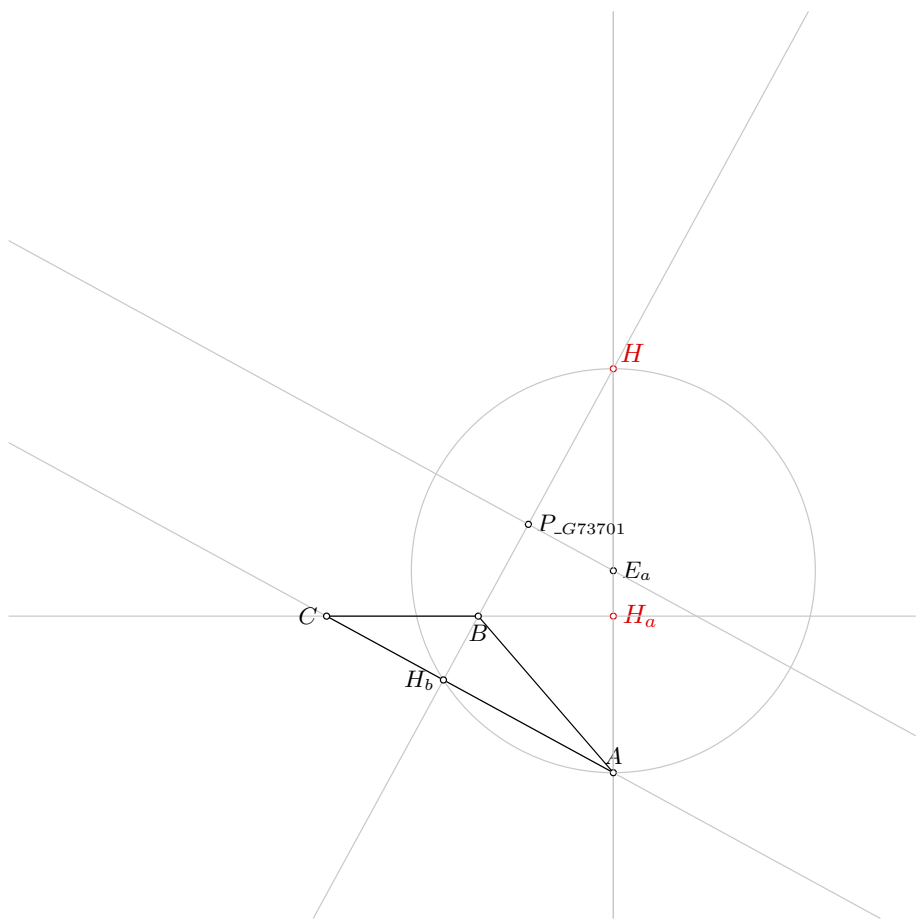

Figure 1: Illustration of the problem 0789

4.1.2 Proving H_a=_H_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.152 seconds.

NDG conditions Points B and H are not identical

Points B and H are not identical

Line through points H_b and H is not perpendicular to line through points H and A

Line through points C and B is not perpendicular to line through points B and H_a

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving H_a=_H_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 16 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.3 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 13 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4.2 Proving H_a=_H_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.080 seconds.There are no ndg conditions.

4.4.3 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.090 seconds.There are no ndg conditions.

Problem 790

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 790: Given a point H, a point H_b and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
2. Using the point H_b and the line h_b, construct a line b (rule W10a); ;
3. Using the point H, the line b and the point H_b, construct a line $h_{H,1/2}(b)$ (rule W15); ;
4. Choose freely a point E_a on the line $h_{H,1/2}(b)$ (rule WOnline4);
5. Using the point E_a and the point H, construct a point A (rule W01); ;
6. Using the point H and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H and E_a are not the same;
7. Choose freely a point B on the line h_b (rule WOnline1) ;
8. Using the point B and the point A, construct a line c (rule W02); % DET: points B and A are not the same;
9. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
10. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
11. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same.

Non-degenerate conditions: lines b and h_c are not parallel; line c and circle $k(E_a, A)$ intersect; points H and E_a are not the same.

Determination conditions: lines b and h_c are not the same; points H_c and H are not the same; points A and H_c must be different; points B and A are not the same; points H and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,W15,WOnline1,WOnline4]

Lemmas used: [D10,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,L3,L46,L48]

Solving time: 682.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{b} 89.36 77.83
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_rt H
cmark_l H_{b}
cmark_r E_{a}
color 0 0 0
fontsize 8

% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0




% Constructing a line b which is perpendicular to line h_{b} and which passes through point H_{b}
perp b H_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0




% Constructing a point P_{\_G113122} such that HP_{\_G113122}/HH_{b}=0.5
towards P_{\_G113122} H H_{b} 0.5
cmark_r P_{\_G113122}
color 200 200 200
drawsegment H H_{b}
color 0 0 0
```

```
% Constructing a line h_{H,1/2}(b) which contains the point P_{\_G113122} and is parallel to the
    line b
parallel h_{H,1/2}(b) P_{\_G113122} b

color 200 200 200
drawline h_{H,1/2}(b)
color 0 0 0




% Constructing a point P_{\_G113429} such that HP_{\_G113429}/HH_{b}=0.5
towards P_{\_G113429} H H_{b} 0.5
cmark_r P_{\_G113429}
color 200 200 200
drawsegment H H_{b}
color 0 0 0

% Generating random value V[_G113368]
random V[_G113368]


% Calculating value V[_G113389] using formula V[_G113368]*20
expression V[_G113389] { V[_G113368]*20 }


% Constructing a point E_{a} which is a point for which holds P_{\_G113429}E_{a} = V[_G113389] and
    angle HP_{\_G113429}E_{a} = 90
turtle E_{a} H P_{\_G113429} 90 V[_G113389]
cmark_r E_{a}



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0


% NDG: points H and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
circle k(E_{a},A) E_{a} H

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0




% Choosing randomly a point B on the line HH_{b}
online B H H_{b}
cmark_b B
color 200 200 200
```

```
drawline H H_{b}
color 0 0 0


% DET: points B and A are not the same
% Constructing a line c which passes through point B and point A
line c B A

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G113994} which is a foot of the point E_{a} on the line c
foot P_{\_G113994} E_{a} c
cmark_r P_{\_G113994}
color 200 200 200
drawline E_{a} P_{\_G113994}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    113994}
sim H_{c} P_{\_G113994} A
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line c and circle k(E_{a},A)
    intersect; points H and E_{a} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H_{c} and H are not the same
    ; points A and H_{c} must be different; points B and A are not the same; points H and H_{b} are
     not the same
```

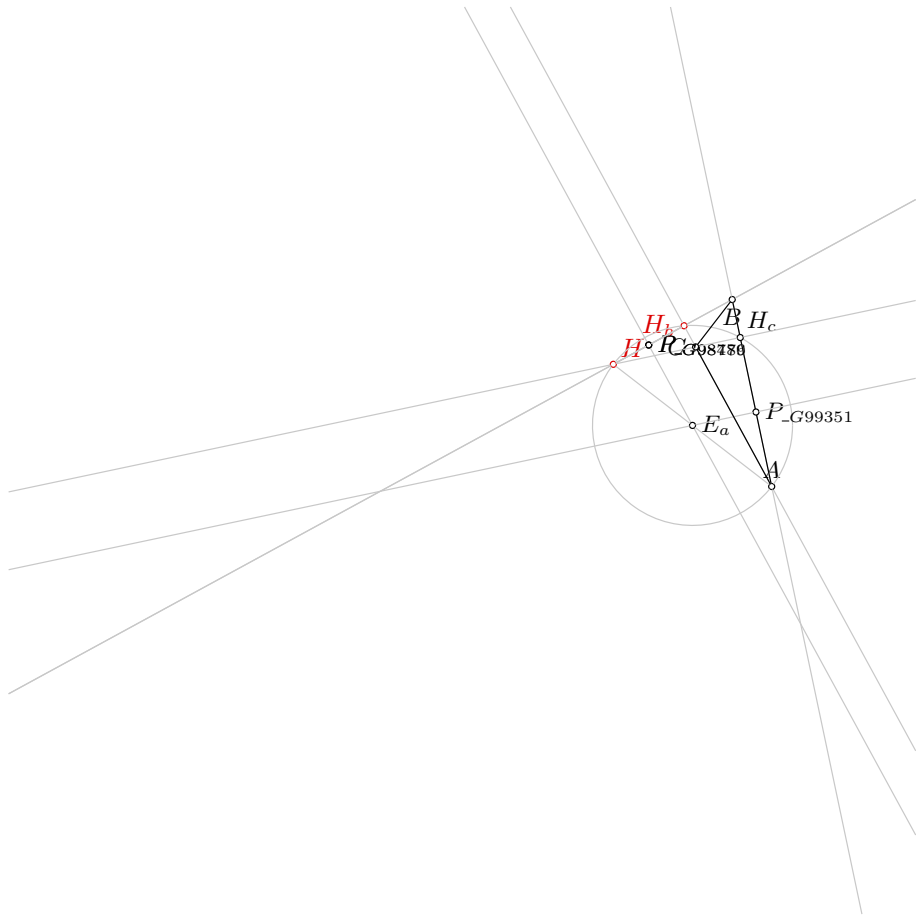

Figure 1: Illustration of the problem 0790

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving E_a=_E_a

Proving failed

Problem 791

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 791: Given a point H, a point H_c and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
2. Using the point H_c and the line h_c, construct a line c (rule W10a); ;
3. Using the point H, the line c and the point H_c, construct a line $h_{H,1/2}(c)$ (rule W15); ;
4. Choose freely a point E_a on the line $h_{H,1/2}(c)$ (rule WOnline4);
5. Using the point E_a and the point H, construct a point A (rule W01); ;
6. Using the point H and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H and E_a are not the same;
7. Choose freely a point B on the line c (rule WOnline1) ;
8. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
9. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
10. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
11. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; points H and E_a are not the same.

Determination conditions: lines h_c and b are not the same; points A and H_b are not the same; points H and H_b must be different; points B and H are not the same; points H and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,W15,WOnline1,WOnline4]

Lemmas used: [D10,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,L3,L46,L47]

Solving time: 695.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{c} 68.91 84.83
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_rt H
cmark_rt H_{c}
cmark_r E_{a}
color 0 0 0
fontsize 8

% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0




% Constructing a line c which is perpendicular to line h_{c} and which passes through point H_{c}
perp c H_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0




% Constructing a point P_{\_G142117} such that HP_{\_G142117}/HH_{c}=0.5
towards P_{\_G142117} H H_{c} 0.5
cmark_r P_{\_G142117}
color 200 200 200
drawsegment H H_{c}
color 0 0 0
```

```
% Constructing a line h_{H,1/2}(c) which contains the point P_{\_G142117} and is parallel to the
    line c
parallel h_{H,1/2}(c) P_{\_G142117} c

color 200 200 200
drawline h_{H,1/2}(c)
color 0 0 0




% Constructing a point P_{\_G142424} such that HP_{\_G142424}/HH_{c}=0.5
towards P_{\_G142424} H H_{c} 0.5
cmark_r P_{\_G142424}
color 200 200 200
drawsegment H H_{c}
color 0 0 0

% Generating random value V[_G142363]
random V[_G142363]


% Calculating value V[_G142384] using formula V[_G142363]*20
expression V[_G142384] { V[_G142363]*20 }


% Constructing a point E_{a} which is a point for which holds P_{\_G142424}E_{a} = V[_G142384] and
    angle HP_{\_G142424}E_{a} = 90
turtle E_{a} H P_{\_G142424} 90 V[_G142384]
cmark_r E_{a}



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0


% NDG: points H and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
circle k(E_{a},A) E_{a} H

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0




% Choosing randomly a point B on the line H_{c}A
online B H_{c} A
cmark_b B
color 200 200 200
```

```
drawline H_{c} A
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G142989} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G142989} E_{a} h_{b}
cmark_r P_{\_G142989}
color 200 200 200
drawline E_{a} P_{\_G142989}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    142989}
sim H_{b} P_{\_G142989} H
cmark_l H_{b}


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; points H and E_{a} are not the same
% Determination conditions: lines h_{c} and b are not the same; points A and H_{b} are not the same
    ; points H and H_{b} must be different; points B and H are not the same; points H and H_{c} are
     not the same
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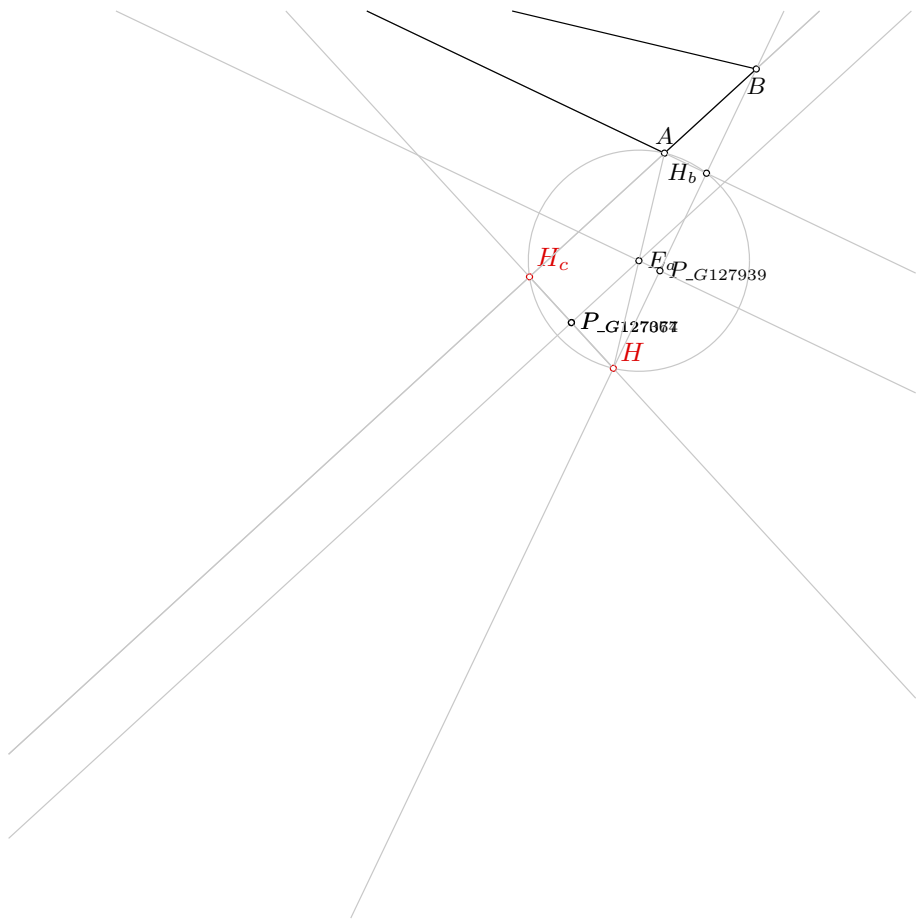

Figure 1: Illustration of the problem 0791

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Construction steps:

- Free point H
- Free point H_c
- Line h_c through two points H and H_c
- Line c through point H_c perpendicular to line h_c
- Segment division point $P_{\_G137153}$ of segment HH_c with division coefficient 1.0

- Line $h_{H,1/2}(c)$ through point $P\_{G137153}$ parallel with line c
- Segment division point $P\_{G137285}$ of segment HH_c with division coefficient -0.5
- Line $L\_{G137288}$ through point $P\_{G137285}$ parallel with line $h_{H,1/2}(c)$
- Random point E_a from line $L\_{G137288}$
- Segment division point A of segment E_aH with division coefficient -0.5
- Circle $k(E_a, A)$ with center E_a and one point H
- Random point B from line c
- Line h_b through two points B and H
- Line footPointPerpLine118 through point E_a perpendicular to line h_b
- Intersection point $P\_{G137547}$ of point sets footPointPerpLine118 and h_b
- Cental symmetric point H_b of point H with respect to center of symmetry $P\_{G137547}$
- Line b through two points A and H_b
- Intersection point C of point sets h_c and b
- Line $\_b$ through two points A and C
- Line $\_a$ through two points B and C
- Line $\_h_a$ through point A perpendicular to line $\_a$
- Line $\_h_b$ through point B perpendicular to line $\_b$
- Intersection point $\_H$ of point sets $\_h_a$ and $\_h_b$
- Line $\_c$ through two points A and B
- Line $\_h_c$ through point C perpendicular to line $\_c$
- Intersection point $\_H_c$ of point sets $\_c$ and $\_h_c$

Theorem statement:

- Points H and $\_H$ are identical

Info: Attempting to add the construction of new random point tempPoint-447$h_{H,1/2}(c)$ necessary for completion of construction of line $L\_{G137288}$

Warrning: Generated new random point tempPoint-447$h_{H,1/2}(c)$ on line $h_{H,1/2}(c)$ in order to complete the construction of parallel line $L\_{G137288}$

Validation result: Theorem protocol is valid.

NDG conditions Point H has been assigned following coordinates: (0, 0)

4.1.2 Proving H_c=$\_H_c$

Construction steps:

- Free point H
- Free point H_c
- Line h_c through two points H and H_c
- Line c through point H_c perpendicular to line h_c
- Segment division point $P\_{G138448}$ of segment HH_c with division coefficient 1.0
- Line $h_{H,1/2}(c)$ through point $P\_{G138448}$ parallel with line c
- Segment division point $P\_{G138580}$ of segment HH_c with division coefficient -0.5
- Line $L\_{G138583}$ through point $P\_{G138580}$ parallel with line $h_{H,1/2}(c)$
- Random point E_a from line $L\_{G138583}$

- Segment division point A of segment E_aH with division coefficient -0.5
- Circle $k(E_a, A)$ with center E_a and one point H
- Random point B from line c
- Line h_b through two points B and H
- Line footPointPerpLine609 through point E_a perpendicular to line h_b
- Intersection point $P_{\_G138842}$ of point sets footPointPerpLine609 and h_b
- Cental symmetric point H_b of point H with respect to center of symmetry $P_{\_G138842}$
- Line b through two points A and H_b
- Intersection point C of point sets h_c and b
- Line $\_b$ through two points A and C
- Line $\_a$ through two points B and C
- Line $\_h_a$ through point A perpendicular to line $\_a$
- Line $\_h_b$ through point B perpendicular to line $\_b$
- Intersection point $\_H$ of point sets $\_h_a$ and $\_h_b$
- Line $\_c$ through two points A and B
- Line $\_h_c$ through point C perpendicular to line $\_c$
- Intersection point $\_H_c$ of point sets $\_c$ and $\_h_c$

Theorem statement:

- Points H_c and $\_H_c$ are identical

Info: Attempting to add the construction of new random point tempPoint-639$h_{H,1/2}(c)$ necessary for completion of construction of line $L_{\_G138583}$

Warrning: Generated new random point tempPoint-639$h_{H,1/2}(c)$ on line $h_{H,1/2}(c)$ in order to complete the construction of parallel line $L_{\_G138583}$

Validation result: Theorem protocol is valid.

NDG conditions Point H has been assigned following coordinates: (0, 0)

4.1.3 Proving E_a=$\_E_a$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=$\_H$

Proving failed

4.2.2 Proving H_c=$\_H_c$

Proving failed

4.2.3 Proving E_a=$\_E_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=$\_H$

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving E_a=_E_a

Proving failed

Problem 792

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 792: Given a point E_a, a point H and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 793

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 793: Given a point E_a, a point H and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H, construct a point A (rule W01); ;
2. Using the point M_a and the point A, construct a point G (rule W01); ;
3. Using the point H and the point G, construct a point N (rule W01); ;
4. Using the point H and the point G, construct a point O (rule W01); ;
5. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
6. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points E_a and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L16,L19,L22,L55,L58]

Solving time: 6.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H 80 72.73
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a line L_{\_G174241} which passes through point M_{a} and point A
line L_{\_G174241} M_{a} A

color 200 200 200
drawline L_{\_G174241}
color 0 0 0


% Constructing a point P_{\_G174342} with coordinates (0,0)
point P_{\_G174342} 0 0
cmark_r P_{\_G174342}

% Constructing a point P_{\_G174266} such that M_{a}P_{\_G174266}/M_{a}P_{\_G174342}=1
towards P_{\_G174266} M_{a} P_{\_G174342} 1
cmark_r P_{\_G174266}
color 200 200 200
drawsegment M_{a} P_{\_G174266}
color 0 0 0
```

```
% Constructing a point P_{\_G174311} such that M_{a}P_{\_G174311}/M_{a}P_{\_G174342}=3
towards P_{\_G174311} M_{a} P_{\_G174342} 3
cmark_r P_{\_G174311}
color 200 200 200
drawsegment M_{a} P_{\_G174311}
color 0 0 0

% Constructing a line L_{\_G174272} which passes through point A and point P_{\_G174311}
line L_{\_G174272} A P_{\_G174311}

color 200 200 200
drawline L_{\_G174272}
color 0 0 0


% Constructing a line L_{\_G174235} which contains the point P_{\_G174266} and is parallel to the
    line L_{\_G174272}
parallel L_{\_G174235} P_{\_G174266} L_{\_G174272}

color 200 200 200
drawline L_{\_G174235}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G174235} and line L_{\_G174241}
intersec G L_{\_G174235} L_{\_G174241}
cmark_t G



% Constructing a point N such that HN/HG=0.75
towards N H G 0.75
cmark_r N
color 200 200 200
drawsegment H G
color 0 0 0



% Constructing a point O such that HO/HG=1.5
towards O H G 1.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G175261} which is a foot of the point N on the line h_{a}
foot P_{\_G175261} N h_{a}
cmark_r P_{\_G175261}
color 200 200 200
drawline N P_{\_G175261}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G175261}
sim H_{a} P_{\_G175261} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

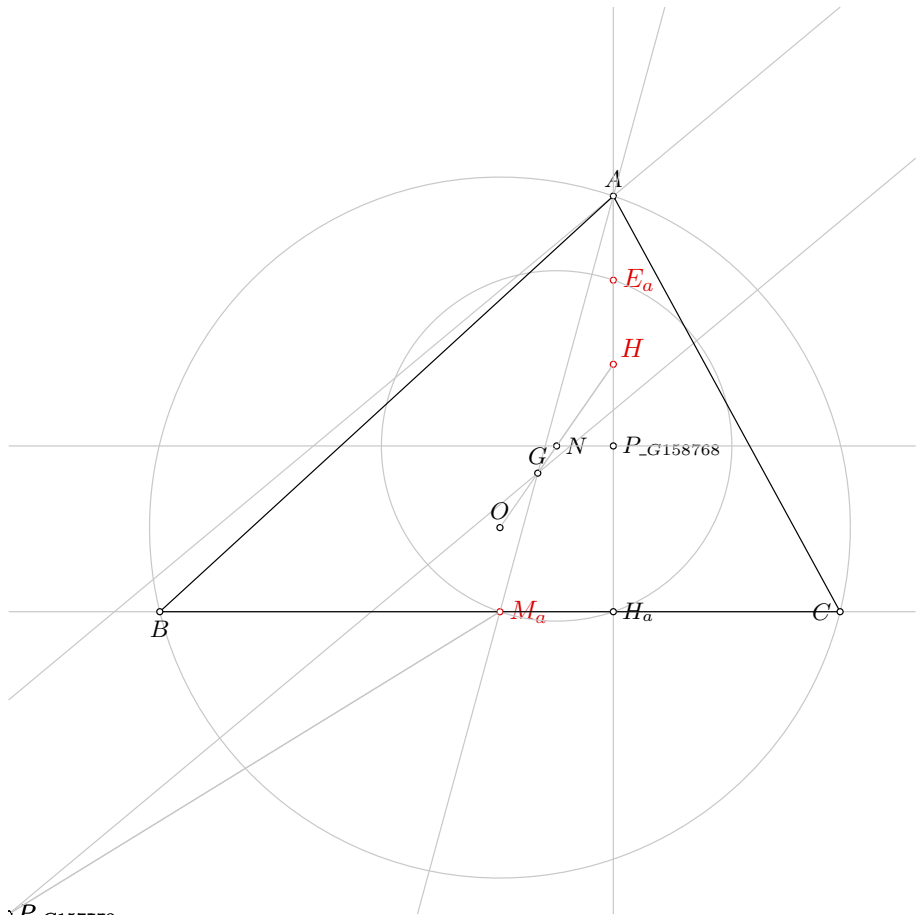

Figure 1: Illustration of the problem 0793

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points E_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points E_{a} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving M_a=_M_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 794

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 794: Given a point E_a, a point H and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H, construct a point A (rule W01); ;
2. Using the point M_b and the point A, construct a point C (rule W01); ;
3. Using the point H and the point C, construct a line h_c (rule W02); % DET: points H and C are not the same;
4. Using the point M_b and the point A, construct a line b (rule W02); % DET: points M_b and A are not the same;
5. Using the point H and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H and E_a are not the same;
6. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H and H_c must be different;
7. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
8. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
9. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
10. Using the line c and the line h_b, construct a point B (rule W03); % NDG: lines c and h_b are not parallel % DET: lines c and h_b are not the same.

Non-degenerate conditions: lines c and h_b are not parallel; line b and circle $k(E_a, A)$ intersect; line h_c and circle $k(E_a, A)$ intersect; points H and E_a are not the same.

Determination conditions: lines c and h_b are not the same; points H_b and H are not the same; points A and H_b must be different; points H_c and A are not the same; points H and H_c must be different; points M_b and A are not the same; points H and C are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D22,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 12.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H 80 72.73
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point C such that M_{b}C/M_{b}A=-1
towards C M_{b} A -1
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points H and C are not the same
% Constructing a line h_{c} which passes through point H and point C
line h_{c} H C

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% DET: points M_{b} and A are not the same
% Constructing a line b which passes through point M_{b} and point A
line b M_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: points H and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
circle k(E_{a},A) E_{a} H

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G201375} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G201375} E_{a} h_{c}
cmark_r P_{\_G201375}
color 200 200 200
drawline E_{a} P_{\_G201375}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    201375}
sim H_{c} P_{\_G201375} H
cmark_rt H_{c}


% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G201613} which is a foot of the point E_{a} on the line b
foot P_{\_G201613} E_{a} b
cmark_r P_{\_G201613}
color 200 200 200
drawline E_{a} P_{\_G201613}
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    201613}
sim H_{b} P_{\_G201613} A
cmark_l H_{b}
```

```
% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines c and h_{b} are not parallel% DET: lines c and h_{b} are not the same
% Constructing a point B which belongs to line c and line h_{b}
intersec B c h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{b} are not parallel; line b and circle k(E_{a},A)
    intersect; line h_{c} and circle k(E_{a},A) intersect; points H and E_{a} are not the same
% Determination conditions: lines c and h_{b} are not the same; points H_{b} and H are not the same
    ; points A and H_{b} must be different; points H_{c} and A are not the same; points H and H_{c}
     must be different; points M_{b} and A are not the same; points H and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.105 seconds.

NDG conditions There are no NDG conditions for this theorem

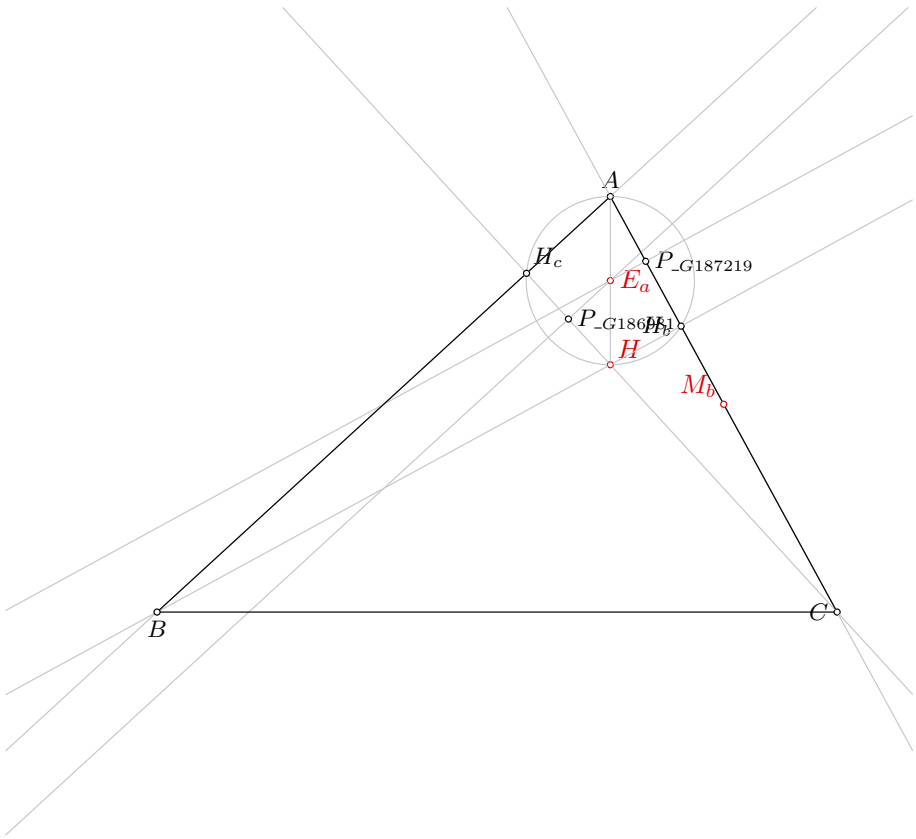

Figure 1: Illustration of the problem 0794

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving M_b=_M_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 1656 terms.

Time Complexity: Time spent by the prover is 10.570 seconds.There are no ndg conditions.

4.3.2 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 333 terms.

Time Complexity: Time spent by the prover is 0.600 seconds.There are no ndg conditions.

4.3.3 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 795

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 795: Given a point E_a, a point H and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H, construct a point A (rule W01); ;
2. Using the point M_c and the point A, construct a point B (rule W01); ;
3. Using the point H and the point B, construct a line h_b (rule W02); % DET: points H and B are not the same;
4. Using the point M_c and the point A, construct a line c (rule W02); % DET: points M_c and A are not the same;
5. Using the point H and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H and E_a are not the same;
6. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
7. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
8. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
9. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
10. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same.

Non-degenerate conditions: lines b and h_c are not parallel; line c and circle $k(E_a, A)$ intersect; line h_b and circle $k(E_a, A)$ intersect; points H and E_a are not the same.

Determination conditions: lines b and h_c are not the same; points H_c and H are not the same; points A and H_c must be different; points H_b and A are not the same; points H and H_b must be different; points M_c and A are not the same; points H and B are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D20,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 12.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H 80 72.73
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point B such that M_{c}B/M_{c}A=-1
towards B M_{c} A -1
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points H and B are not the same
% Constructing a line h_{b} which passes through point H and point B
line h_{b} H B

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% DET: points M_{c} and A are not the same
% Constructing a line c which passes through point M_{c} and point A
line c M_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: points H and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
circle k(E_{a},A) E_{a} H

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G227720} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G227720} E_{a} h_{b}
cmark_r P_{\_G227720}
color 200 200 200
drawline E_{a} P_{\_G227720}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    227720}
sim H_{b} P_{\_G227720} H
cmark_l H_{b}


% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G227958} which is a foot of the point E_{a} on the line c
foot P_{\_G227958} E_{a} c
cmark_r P_{\_G227958}
color 200 200 200
drawline E_{a} P_{\_G227958}
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    227958}
sim H_{c} P_{\_G227958} A
cmark_rt H_{c}
```

```
% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line c and circle k(E_{a},A)
    intersect; line h_{b} and circle k(E_{a},A) intersect; points H and E_{a} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H_{c} and H are not the same
    ; points A and H_{c} must be different; points H_{b} and A are not the same; points H and H_{b}
     must be different; points M_{c} and A are not the same; points H and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.101 seconds.

NDG conditions There are no NDG conditions for this theorem

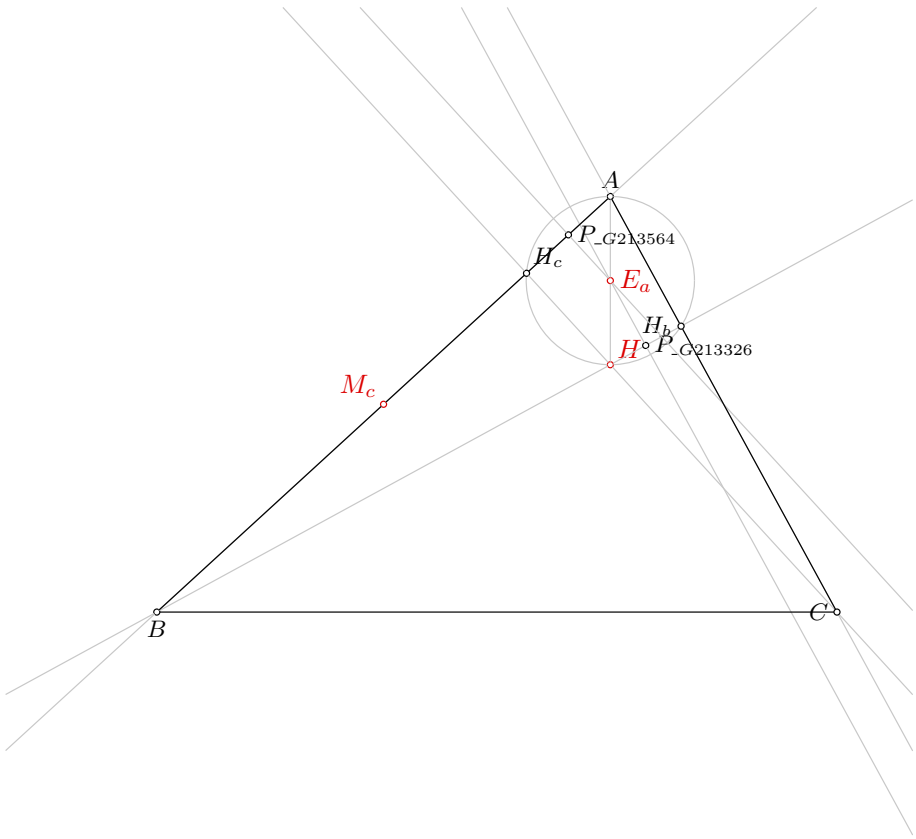

Figure 1: Illustration of the problem 0795

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving M_c=_M_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 2602 terms.

Time Complexity: Time spent by the prover is 14.030 seconds.There are no ndg conditions.

4.3.2 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 494 terms.

Time Complexity: Time spent by the prover is 0.690 seconds.There are no ndg conditions.

4.3.3 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 796

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 796: Given a point E_a, a point H and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H, construct a point A (rule W01); ;
2. Using the point H and the point N, construct a point O (rule W01); ;
3. Using the point H and the point N, construct a point G (rule W01); ;
4. Using the point A and the point G, construct a point M_a (rule W01); ;
5. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
6. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points E_a and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L16,L19,L22,L55]

Solving time: 7.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H 80 72.73
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G28409} which passes through point H and point N
line L_{\_G28409} H N

color 200 200 200
drawline L_{\_G28409}
color 0 0 0


% Constructing a point P_{\_G28510} with coordinates (0,0)
point P_{\_G28510} 0 0
```

```
cmark_r P_{\_G28510}

% Constructing a point P_{\_G28434} such that HP_{\_G28434}/HP_{\_G28510}=4
towards P_{\_G28434} H P_{\_G28510} 4
cmark_r P_{\_G28434}
color 200 200 200
drawsegment H P_{\_G28434}
color 0 0 0

% Constructing a point P_{\_G28479} such that HP_{\_G28479}/HP_{\_G28510}=3
towards P_{\_G28479} H P_{\_G28510} 3
cmark_r P_{\_G28479}
color 200 200 200
drawsegment H P_{\_G28479}
color 0 0 0

% Constructing a line L_{\_G28440} which passes through point N and point P_{\_G28479}
line L_{\_G28440} N P_{\_G28479}

color 200 200 200
drawline L_{\_G28440}
color 0 0 0


% Constructing a line L_{\_G28403} which contains the point P_{\_G28434} and is parallel to the
    line L_{\_G28440}
parallel L_{\_G28403} P_{\_G28434} L_{\_G28440}

color 200 200 200
drawline L_{\_G28403}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G28403} and line L_{\_G28409}
intersec G L_{\_G28403} L_{\_G28409}
cmark_t G



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G29346} which is a foot of the point N on the line h_{a}
foot P_{\_G29346} N h_{a}
cmark_r P_{\_G29346}
color 200 200 200
drawline N P_{\_G29346}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G29346}
sim H_{a} P_{\_G29346} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

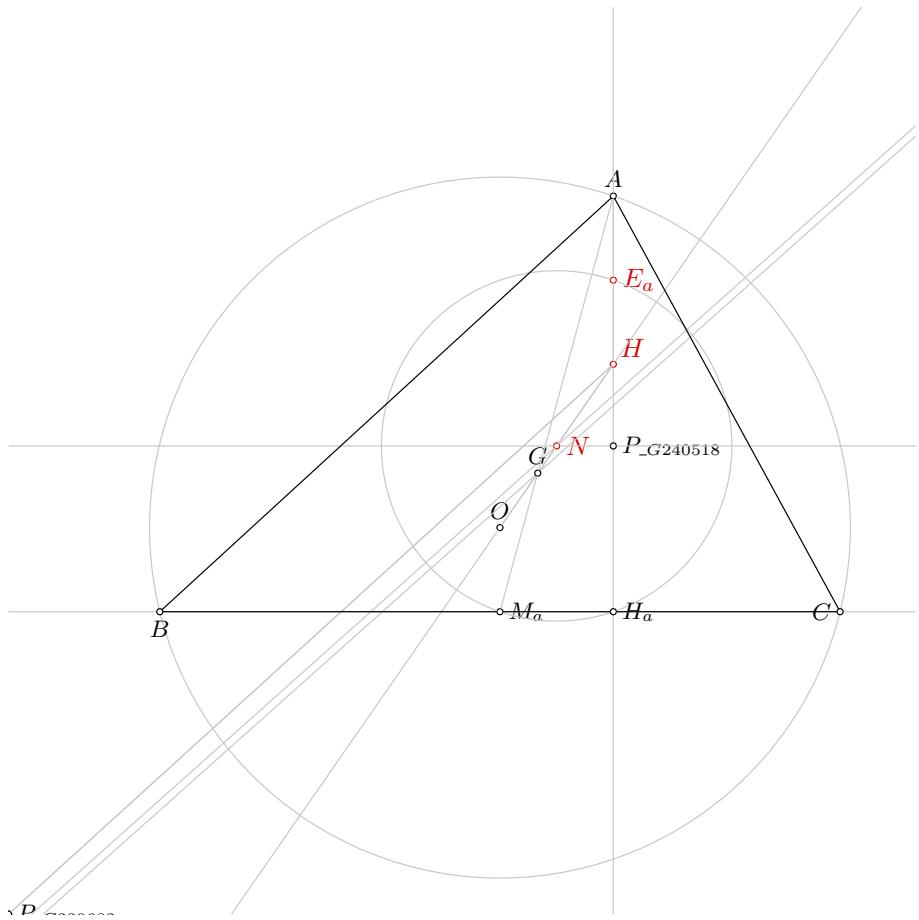

Figure 1: Illustration of the problem 0796

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points E_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points E_{a} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 797

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 797: Given a point E_a, a point H and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H, construct a point A (rule W01); ;
2. Using the point H and the point O, construct a point N (rule W01); ;
3. Using the point H and the point O, construct a point G (rule W01); ;
4. Using the point A and the point G, construct a point M_a (rule W01); ;
5. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
6. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points E_a and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L19,L22,L55,L58]

Solving time: 7.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H 80 72.73
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H
cmark_t O
color 0 0 0
fontsize 8


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point N such that HN/HO=0.5
towards N H O 0.5
cmark_r N
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G60697} which passes through point H and point O
line L_{\_G60697} H O

color 200 200 200
drawline L_{\_G60697}
color 0 0 0


% Constructing a point P_{\_G60798} with coordinates (0,0)
point P_{\_G60798} 0 0
```

```
cmark_r P_{\_G60798}

% Constructing a point P_{\_G60722} such that HP_{\_G60722}/HP_{\_G60798}=2
towards P_{\_G60722} H P_{\_G60798} 2
cmark_r P_{\_G60722}
color 200 200 200
drawsegment H P_{\_G60722}
color 0 0 0

% Constructing a point P_{\_G60767} such that HP_{\_G60767}/HP_{\_G60798}=3
towards P_{\_G60767} H P_{\_G60798} 3
cmark_r P_{\_G60767}
color 200 200 200
drawsegment H P_{\_G60767}
color 0 0 0

% Constructing a line L_{\_G60728} which passes through point O and point P_{\_G60767}
line L_{\_G60728} O P_{\_G60767}

color 200 200 200
drawline L_{\_G60728}
color 0 0 0


% Constructing a line L_{\_G60691} which contains the point P_{\_G60722} and is parallel to the
    line L_{\_G60728}
parallel L_{\_G60691} P_{\_G60722} L_{\_G60728}

color 200 200 200
drawline L_{\_G60691}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G60691} and line L_{\_G60697}
intersec G L_{\_G60691} L_{\_G60697}
cmark_t G



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G61634} which is a foot of the point N on the line h_{a}
foot P_{\_G61634} N h_{a}
cmark_r P_{\_G61634}
color 200 200 200
drawline N P_{\_G61634}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G61634}
sim H_{a} P_{\_G61634} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

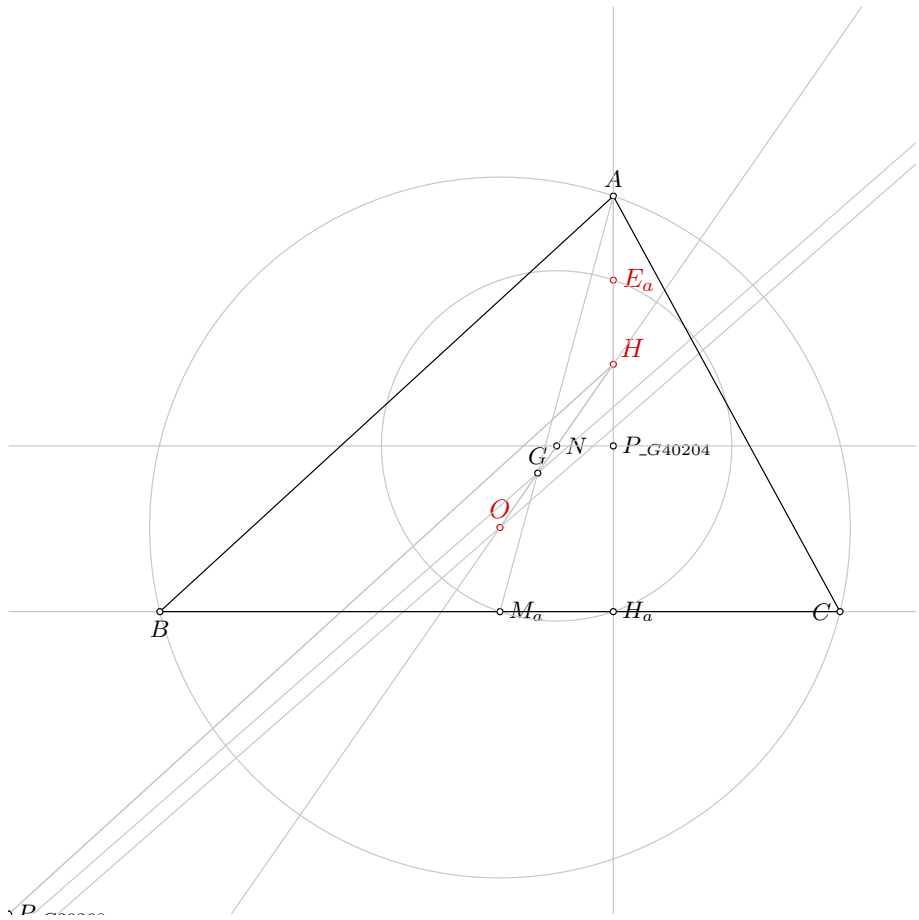

Figure 1: Illustration of the problem 0797

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points E_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points E_{a} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 798

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 798: Given a point E_a, a point H and a point T_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H, construct a point A (rule W01); ;
2. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
3. Using the point T_a and the point A, construct a line s_a (rule W02); % DET: points T_a and A are not the same;
4. Using the point T_a and the line h_a, construct a line a (rule W10a); ;
5. Using the line a and the line h_a, construct a point H_a (rule W03); % NDG: lines a and h_a are not parallel % DET: lines a and h_a are not the same;
6. Using the point H and the point H_a, construct a line $m(HH_a)$ (rule W14); % DET: points H and H_a are not the same;
7. Using the point E_a, the point A, the point T_a, the line s_a and the line h_a, construct a line AO (rule W17); % NDG: points A and T_a are not the same; points E_a and A are not the same % DET: points A and T_a are not the same;
8. Using the point E_a and the line AO, construct a line $m(H_bH_c)$ (rule W16); ;
9. Using the line $m(H_bH_c)$ and the line a, construct a point M_a (rule W03); % NDG: lines $m(H_bH_c)$ and a are not parallel % DET: lines $m(H_bH_c)$ and a are not the same;
10. Using the point M_a and the point A, construct a point G (rule W01); ;
11. Using the point H and the point G, construct a point N (rule W01); ;

12. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;

13. Using the circle $k(N, M_a)$ and the line $m(HH_a)$, construct a point E_b and a point E_c (rule W04); % NDG: line $m(HH_a)$ and circle $k(N, M_a)$ intersect;

14. Using the point E_b and the point H, construct a point B (rule W01); ;

15. Using the point H and the point E_c, construct a point C (rule W01); .

Non-degenerate conditions: line $m(HH_a)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same; lines $m(H_bH_c)$ and a are not parallel; points A and T_a are not the same; points E_a and A are not the same; lines a and h_a are not parallel.

Determination conditions: lines $m(H_bH_c)$ and a are not the same; points A and T_a are not the same; points H and H_a are not the same; lines a and h_a are not the same; points T_a and A are not the same; points E_a and H are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W14,W16,W17]

Lemmas used: [D21,D23,D28,D29,D3,D30,D32,D5,D8,GD01,GD02,GL01,GL03,GL04,GL09,GL17,L104,L16,L2

Solving time: 126.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H 80 72.73
point T_{a} 70.86 40

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H
cmark_rb T_{a}
color 0 0 0
fontsize 8


% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0


% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% DET: points T_{a} and A are not the same
% Constructing a line s_{a} which passes through point T_{a} and point A
line s_{a} T_{a} A

color 200 200 200
drawline s_{a}
color 0 0 0



% Constructing a line a which is perpendicular to line h_{a} and which passes through point T_{a}
perp a T_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines a and h_{a} are not parallel% DET: lines a and h_{a} are not the same
% Constructing a point H_{a} which belongs to line a and line h_{a}
intersec H_{a} a h_{a}
cmark_r H_{a}


% DET: points H and H_{a} are not the same
% Constructing bisector m(HH_{a}) of the segment HH_{a}
med m(HH_{a}) H H_{a}

color 200 200 200
drawline m(HH_{a})
color 0 0 0

color 200 200 200
drawsegment H H_{a}
color 0 0 0


% NDG: points A and T_{a} are not the same; points E_{a} and A are not the same% DET: points A and
    T_{a} are not the same
% Constructing an angle V[_G100231] which is equal to the angle E_{a}AT_{a}
angle_o V[_G100231] E_{a} A T_{a}


% Calculating value angle[_G100310] using formula 1/pow(2,0)*V[_G100231]+0/pow(2,0)*180
expression angle[_G100310] { 1/pow(2,0)*V[_G100231]+0/pow(2,0)*180 }


% Constructing a point P_{\_G100307} which is an image of the point T_{a} in a rotation around the
    point A for the angle 1/pow(2,0)*V[_G100231]+0/pow(2,0)*180
rotate P_{\_G100307} A angle[_G100310] T_{a}
cmark_r P_{\_G100307}
```

```
color 200 200 200
drawarc_p A T_{a} angle[_G100310]
color 0 0 0

% Constructing a line AO which passes through point A and point P_{\_G100307}
line AO A P_{\_G100307}

color 200 200 200
drawline AO
color 0 0 0




% Constructing a line m(H_{b}H_{c}) which contains the point E_{a} and is parallel to the line AO
parallel m(H_{b}H_{c}) E_{a} AO

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: lines m(H_{b}H_{c}) and a are not parallel% DET: lines m(H_{b}H_{c}) and a are not the same
% Constructing a point M_{a} which belongs to line m(H_{b}H_{c}) and line a
intersec M_{a} m(H_{b}H_{c}) a
cmark_r M_{a}



% Constructing a line L_{\_G100832} which passes through point M_{a} and point A
line L_{\_G100832} M_{a} A

color 200 200 200
drawline L_{\_G100832}
color 0 0 0


% Constructing a point P_{\_G100933} with coordinates (0,0)
point P_{\_G100933} 0 0
cmark_r P_{\_G100933}

% Constructing a point P_{\_G100857} such that M_{a}P_{\_G100857}/M_{a}P_{\_G100933}=1
towards P_{\_G100857} M_{a} P_{\_G100933} 1
cmark_r P_{\_G100857}
color 200 200 200
drawsegment M_{a} P_{\_G100857}
color 0 0 0

% Constructing a point P_{\_G100902} such that M_{a}P_{\_G100902}/M_{a}P_{\_G100933}=3
towards P_{\_G100902} M_{a} P_{\_G100933} 3
cmark_r P_{\_G100902}
color 200 200 200
drawsegment M_{a} P_{\_G100902}
color 0 0 0
```

```
% Constructing a line L_{\_G100863} which passes through point A and point P_{\_G100902}
line L_{\_G100863} A P_{\_G100902}

color 200 200 200
drawline L_{\_G100863}
color 0 0 0


% Constructing a line L_{\_G100826} which contains the point P_{\_G100857} and is parallel to the
    line L_{\_G100863}
parallel L_{\_G100826} P_{\_G100857} L_{\_G100863}

color 200 200 200
drawline L_{\_G100826}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G100826} and line L_{\_G100832}
intersec G L_{\_G100826} L_{\_G100832}
cmark_t G



% Constructing a point N such that HN/HG=0.75
towards N H G 0.75
cmark_r N
color 200 200 200
drawsegment H G
color 0 0 0


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(HH_{a}) and circle k(N,M_{a}) intersect
% Constructing points E_{b} and E_{c} which are in intersection of k(N,M_{a}) and m(HH_{a})
intersec2 E_{b} E_{c} k(N,M_{a}) m(HH_{a})
cmark_r E_{b}
cmark_r E_{c}



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0
```

```
% Constructing a point C such that HC/HE_{c}=2
towards C H E_{c} 2
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(HH_{a}) and circle k(N,M_{a}) intersect; points E_{a} and N are
     not the same; lines m(H_{b}H_{c}) and a are not parallel; points A and T_{a} are not the same;
     points E_{a} and A are not the same; lines a and h_{a} are not parallel
% Determination conditions: lines m(H_{b}H_{c}) and a are not the same; points A and T_{a} are not
    the same; points H and H_{a} are not the same; lines a and h_{a} are not the same; points T_{a}
     and A are not the same; points E_{a} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 374 terms.

Time Complexity: Time spent by the prover is 2.654 seconds.

NDG conditions Points T_a and H are not identical

Line through points E_a and A is not perpendicular to line through points A and T_a

Line through points A and H is not perpendicular to line through points H and P_$_{G90148}$

Points A, M_a and P_$_{G90546}$ are not collinear

Points A, H_a and P_$_{G90546}$ are not collinear

Points H and M_a are not identical

Points H and M_a are not identical

Points A, B and C are not collinear

Line through points B and H is not perpendicular to line through points H and C

4.1.2 Proving H=_H

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 326 terms.

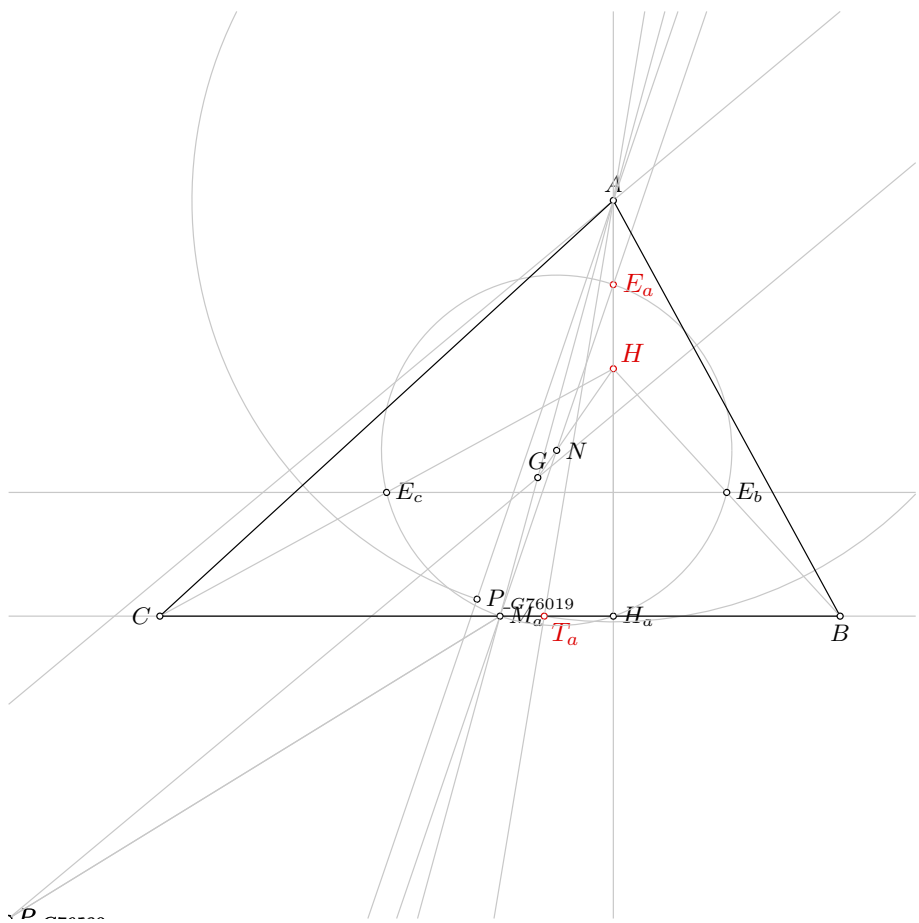

Figure 1: Illustration of the problem 0798

Time Complexity: Time spent by the prover is 2.48 seconds.

NDG conditions Points T_a and H are not identical

Line through points E_a and A is not perpendicular to line through points A and T_a

Line through points A and H is not perpendicular to line through points H and P_G92921

Points A, P_G93319 and M_a are not collinear

Points P_G93319 and E_a are not identical

Points H and M_a are not identical

Points H and M_a are not identical

Points A, B and C are not collinear

Line through points B and H is not perpendicular to line through points H and C

4.1.3 Proving T_a=$\_T_a$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=$\_E_a$

Proving failed

4.2.2 Proving H=$\_H$

Proving failed

4.2.3 Proving T_a=$\_T_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=$\_E_a$

Proving failed

4.3.2 Proving H=$\_H$

Proving failed

4.3.3 Proving T_a=$\_T_a$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=$\_E_a$

Proving failed

4.4.2 Proving H=$\_H$

Proving failed

4.4.3 Proving T_a=$\_T_a$

Proving failed

Problem 799

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 799: Given a point E_a, a point H and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 800

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 800: Given a point E_a, a point H and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 801

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 801: Given a point E_a, a point H_a and a point H_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Using the point H_b and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_b and E_a are not the same;
3. Using the circle $k(E_a, A)$ and the line h_a, construct a point A and a point H (rule W04); % NDG: line h_a and circle $k(E_a, A)$ intersect;
4. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
5. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
6. Using the point H_a and the line h_a, construct a line a (rule W10a); ;
7. Using the line a and the line b, construct a point C (rule W03); % NDG: lines a and b are not parallel % DET: lines a and b are not the same;
8. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; lines a and b are not parallel; line h_a and circle $k(E_a, A)$ intersect; points H_b and E_a are not the same.

Determination conditions: lines h_b and a are not the same; lines a and b are not the same; points H_b and H are not the same; points H_b and A are not the same; points E_a and H_a are not the same.

Rules used: [W02,W03,W04,W06,W10a]
Lemmas used: [D28,D3,D5,D6,D8,D9,GD01,GD02,GL09,L46,L47]
Solving time: 6.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{a} 80 40
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r H_{a}
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{b} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{b}
circle k(E_{a},A) E_{a} H_{b}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line h_{a} and circle k(E_{a},A) intersect
% Constructing points A and H which are in intersection of k(E_{a},A) and h_{a}
intersec2 A H k(E_{a},A) h_{a}
cmark_t A
cmark_rt H


% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
```

```
color 0 0 0



% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0




% Constructing a line a which is perpendicular to line h_{a} and which passes through point H_{a}
perp a H_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines a and b are not parallel% DET: lines a and b are not the same
% Constructing a point C which belongs to line a and line b
intersec C a b
cmark_l C


% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; lines a and b are not parallel;
    line h_{a} and circle k(E_{a},A) intersect; points H_{b} and E_{a} are not the same
% Determination conditions: lines h_{b} and a are not the same; lines a and b are not the same;
    points H_{b} and H are not the same; points H_{b} and A are not the same; points E_{a} and H_{a
    } are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

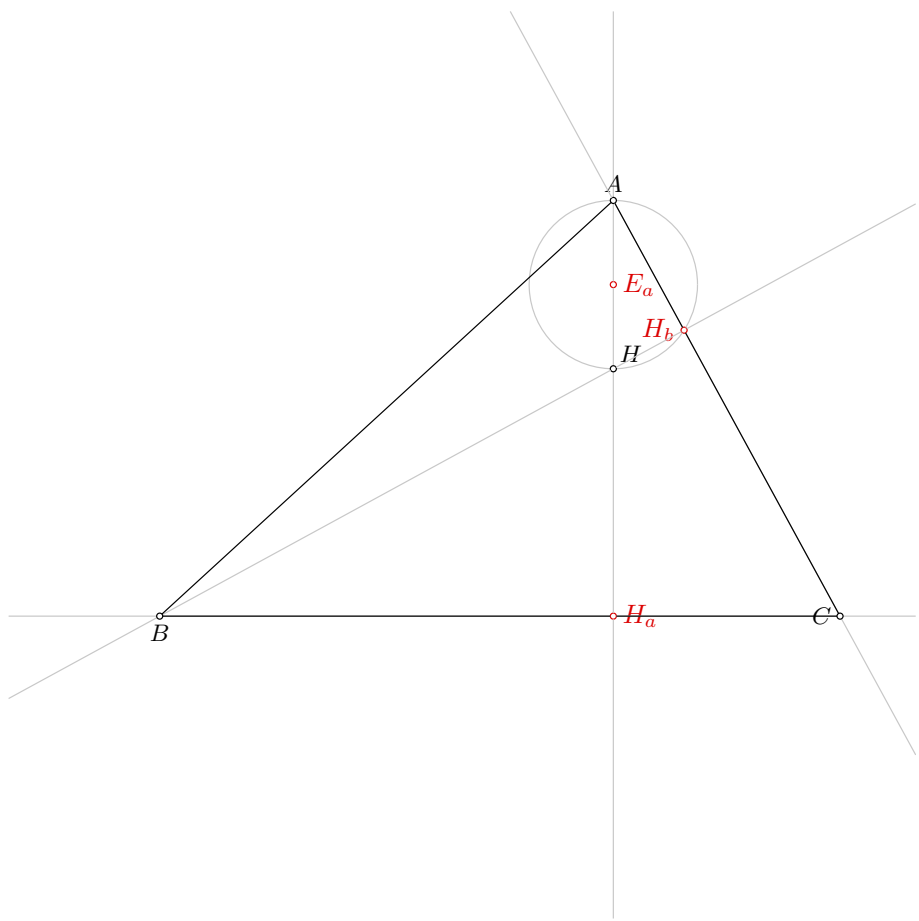

Figure 1: Illustration of the problem 0801

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 42 terms.

Time Complexity: Time spent by the prover is 0.387 seconds.

NDG conditions Line through points H_b and H_a is not perpendicular to line through points H_a and H

Line through points B and C is not parallel with line through points H_a and E_a

Line through points A and H_a is not perpendicular to line through points H_a and C

4.1.2 Proving H_a=_H_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.101 seconds.

NDG conditions Line through points H_b and H_a is not perpendicular to line through points H_a and H

Line through points B and C is not parallel with line through points H_a and E_a

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 65 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.3.2 Proving H_a=_H_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving H_b=_H_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 904 terms.

Time Complexity: Time spent by the prover is 1.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H_a=_H_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving H_b=_H_b

Proving failed

Problem 802

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 802: Given a point E_a, a point H_a and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
3. Using the circle $k(E_a, A)$ and the line h_a, construct a point A and a point H (rule W04); % NDG: line h_a and circle $k(E_a, A)$ intersect;
4. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
5. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
6. Using the point H_a and the line h_a, construct a line a (rule W10a); ;
7. Using the line a and the line c, construct a point B (rule W03); % NDG: lines a and c are not parallel % DET: lines a and c are not the same;
8. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; lines a and c are not parallel; line h_a and circle $k(E_a, A)$ intersect; points H_c and E_a are not the same.

Determination conditions: lines h_c and a are not the same; lines a and c are not the same; points H_c and H are not the same; points H_c and A are not the same; points E_a and H_a are not the same.

Rules used: [W02,W03,W04,W06,W10a]
Lemmas used: [D10,D28,D3,D5,D7,D8,GD01,GD02,GL09,L3,L46,L48]
Solving time: 6.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{a} 80 40
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r H_{a}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line h_{a} and circle k(E_{a},A) intersect
% Constructing points A and H which are in intersection of k(E_{a},A) and h_{a}
intersec2 A H k(E_{a},A) h_{a}
cmark_t A
cmark_rt H


% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
```

```
color 0 0 0



% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0




% Constructing a line a which is perpendicular to line h_{a} and which passes through point H_{a}
perp a H_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines a and c are not parallel% DET: lines a and c are not the same
% Constructing a point B which belongs to line a and line c
intersec B a c
cmark_b B


% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; lines a and c are not parallel;
    line h_{a} and circle k(E_{a},A) intersect; points H_{c} and E_{a} are not the same
% Determination conditions: lines h_{c} and a are not the same; lines a and c are not the same;
    points H_{c} and H are not the same; points H_{c} and A are not the same; points E_{a} and H_{a
    } are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

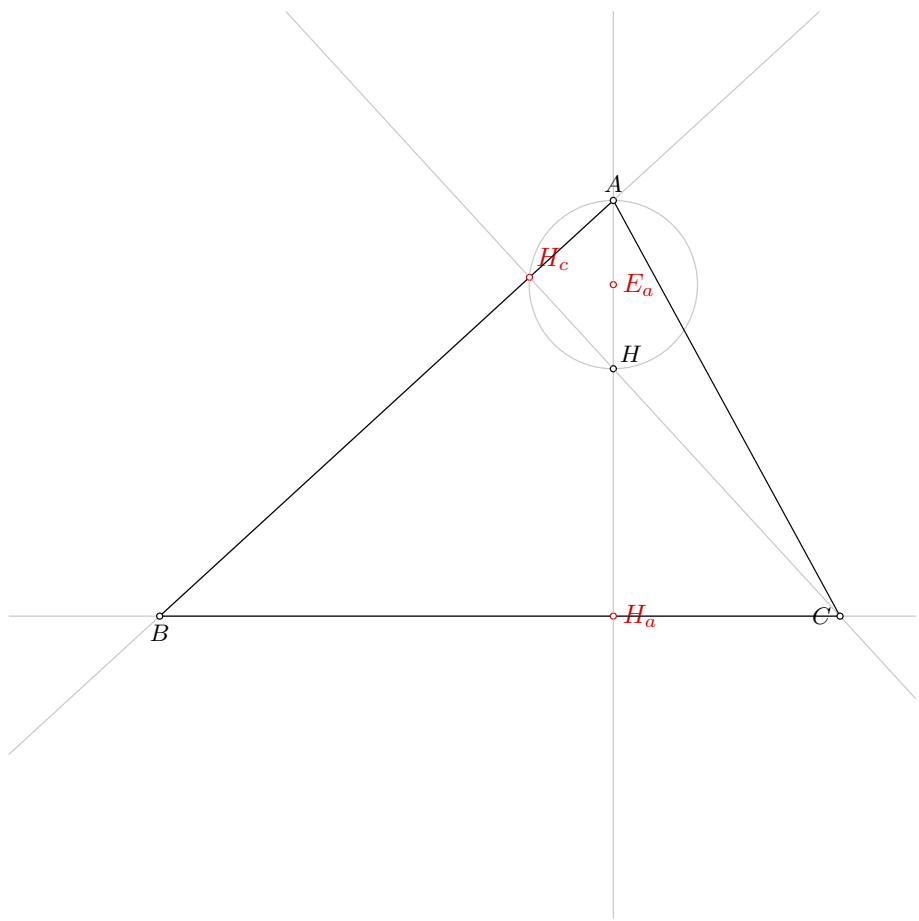

Figure 1: Illustration of the problem 0802

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 42 terms.

Time Complexity: Time spent by the prover is 0.453 seconds.

NDG conditions Point H is not the midpoint of segment with endpoints A and H_c

Line through points B and C is not parallel with line through points H_a and E_a

Line through points A and H_a is not perpendicular to line through points H_a and C

4.1.2 Proving H_a=_H_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.107 seconds.

NDG conditions Point H is not the midpoint of segment with endpoints A and H_c

Line through points B and C is not parallel with line through points H_a and E_a

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 65 terms.

Time Complexity: Time spent by the prover is 0.020 seconds.There are no ndg conditions.

4.3.2 Proving H_a=_H_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving H_c=_H_c

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 395 terms.

Time Complexity: Time spent by the prover is 0.530 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H_a=_H_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving H_c=_H_c

Proving failed

Problem 803

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 803: Given a point E_a, a point H_a and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 804

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 804: Given a point H_a, a point M_a and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
2. Using the point H_a and the line a, construct a line h_a (rule W10b); ;
3. Choose freely a point E_a on the line h_a (rule WOnline2);
4. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
5. Using the point E_a and the point H_a, construct a line $m(E_aH_a)$ (rule W14); % DET: points E_a and H_a are not the same;
6. Using the line $m(E_aH_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aH_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aH_a)$ and $m(H_bH_c)$ are not the same;
7. Choose freely a point A on the line h_a (rule WOnline1) ;
8. Using the point A and the point E_a, construct a point H (rule W01); ;
9. Using the point N and the point H, construct a point O (rule W01); ;
10. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
11. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; lines $m(E_aH_a)$ and $m(H_bH_c)$ are not parallel.

Determination conditions: lines $m(E_aH_a)$ and $m(H_bH_c)$ are not the same; points E_a and H_a are not the same; points E_a and M_a are not the same; points H_a and M_a are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14,WOnline1,WOnline2]

Lemmas used: [D21,D26,D28,D31,D32,D5,D8,GD01,GD02,GL01,GL03,GL04,GL09,L11,L12,L19,L20,L21,L22,

Solving time: 676.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{a} 80 40
point M_{a} 65 40
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_r H_{a}
cmark_r M_{a}
cmark_r E_{a}
color 0 0 0
fontsize 8

% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0




% Constructing a line h_{a} which is perpendicular to line a and which passes through point H_{a}
perp h_{a} H_{a} a

color 200 200 200
drawline h_{a}
color 0 0 0




% Generating random value V[_G179168]
random V[_G179168]


% Calculating value V[_G179189] using formula V[_G179168]*20
expression V[_G179189] { V[_G179168]*20 }
```

```
% Constructing a point E_{a} which is a point for which holds H_{a}E_{a} = V[_G179189] and angle M
    _{a}H_{a}E_{a} = 90
turtle E_{a} M_{a} H_{a} 90 V[_G179189]
cmark_r E_{a}


% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% DET: points E_{a} and H_{a} are not the same
% Constructing bisector m(E_{a}H_{a}) of the segment E_{a}H_{a}
med m(E_{a}H_{a}) E_{a} H_{a}

color 200 200 200
drawline m(E_{a}H_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} H_{a}
color 0 0 0


% NDG: lines m(E_{a}H_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}H_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}H_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}H_{a}) m(H_{b}H_{c})
cmark_r N



% Choosing randomly a point A on the line E_{a}H_{a}
online A E_{a} H_{a}
cmark_t A
color 200 200 200
drawline E_{a} H_{a}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point O such that NO/NH=-1
```

Figure 1: Illustration of the problem 0804

```
towards O N H -1
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    lines m(E_{a}H_{a}) and m(H_{b}H_{c}) are not parallel
% Determination conditions: lines m(E_{a}H_{a}) and m(H_{b}H_{c}) are not the same; points E_{a}
    and H_{a} are not the same; points E_{a} and M_{a} are not the same; points H_{a} and M_{a} are
     not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_a=_H_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 4 terms.

Time Complexity: Time spent by the prover is 0.128 seconds.

NDG conditions Points H and M_a are not identical

Line through points A and H_a is not parallel with line through points B and C

4.1.2 Proving M_a=_M_a

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_a=_H_a

Proving failed

4.2.2 Proving M_a=_M_a

Proving failed

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_a=_H_a

Proving failed

4.3.2 Proving M_a=_M_a

Proving failed

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_a=_H_a

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving E_a=_E_a

Proving failed

Problem 805

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 805: Given a point E_a, a point H_a and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Using the point H_a and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points H_a and M_b are not the same;
3. Using the circle $k(M_b, C)$, the line h_a, the point M_b and the point H_a, construct a point A (rule W05); % NDG: line h_a and circle $k(M_b, C)$ intersect % DET: points H_a and A must be different;
4. Using the point A and the point E_a, construct a point H (rule W01); ;
5. Using the point M_b and the point A, construct a point C (rule W01); ;
6. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
7. Using the point H and the point C, construct a line h_c (rule W02); % DET: points H and C are not the same;
8. Using the circle $k(M_b, C)$, the line h_c, the point M_b and the point C, construct a point H_c (rule W05); % NDG: line h_c and circle $k(M_b, C)$ intersect % DET: points C and H_c must be different;
9. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;
10. Using the line a and the line c, construct a point B (rule W03); % NDG: lines a and c are not parallel % DET: lines a and c are not the same.

Non-degenerate conditions: lines a and c are not parallel; line h_c and circle $k(M_b, C)$ intersect; line h_a and circle $k(M_b, C)$ intersect; points H_a and M_b are not the same.

Determination conditions: lines a and c are not the same; points A and H_c are not the same; points C and H_c must be different; points H and C are not the same; points H_a and C are not the same; points H_a and A must be different; points E_a and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D22,D28,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L43,L44,L45]

Solving time: 8.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{a} 80 40
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r H_{a}
cmark_lt M_{b}
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{a} and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point H
    _{a}
circle k(M_{b},C) M_{b} H_{a}

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: line h_{a} and circle k(M_{b},C) intersect% DET: points H_{a} and A must be different
% Constructing a point P_{\_G203423} which is a foot of the point M_{b} on the line h_{a}
foot P_{\_G203423} M_{b} h_{a}
cmark_r P_{\_G203423}
color 200 200 200
drawline M_{b} P_{\_G203423}
color 0 0 0
```

```
% Constructing a point A which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    203423}
sim A P_{\_G203423} H_{a}
cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that M_{b}C/M_{b}A=-1
towards C M_{b} A -1
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% DET: points H and C are not the same
% Constructing a line h_{c} which passes through point H and point C
line h_{c} H C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{c} and circle k(M_{b},C) intersect% DET: points C and H_{c} must be different
% Constructing a point P_{\_G203860} which is a foot of the point M_{b} on the line h_{c}
foot P_{\_G203860} M_{b} h_{c}
cmark_r P_{\_G203860}
color 200 200 200
drawline M_{b} P_{\_G203860}
color 0 0 0

% Constructing a point H_{c} which is an image of the point C in the symmetry to point/line P_{\_G
    203860}
sim H_{c} P_{\_G203860} C
```

```
cmark_rt H_{c}


% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines a and c are not parallel% DET: lines a and c are not the same
% Constructing a point B which belongs to line a and line c
intersec B a c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and c are not parallel; line h_{c} and circle k(M_{b},C)
    intersect; line h_{a} and circle k(M_{b},C) intersect; points H_{a} and M_{b} are not the same
% Determination conditions: lines a and c are not the same; points A and H_{c} are not the same;
    points C and H_{c} must be different; points H and C are not the same; points H_{a} and C are
    not the same; points H_{a} and A must be different; points E_{a} and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.12 seconds.

NDG conditions There are no NDG conditions for this theorem

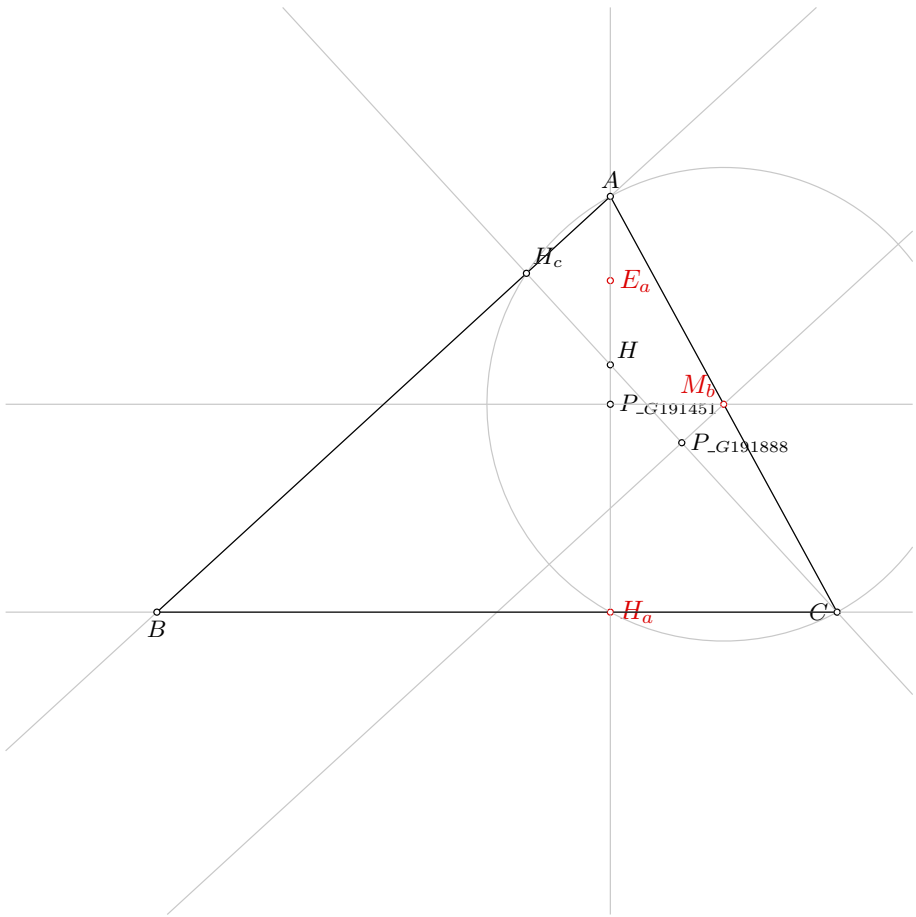

Figure 1: Illustration of the problem 0805

4.2 GCLC - Area method

4.2.1 Proving E_a=$\_E_a$

Proving failed

4.2.2 Proving H_a=$\_H_a$

Proving failed

4.2.3 Proving M_b=$\_M_b$

NDG conditions are:

$S_{H_aAH_c} \neq S_{CAH_c}$ i.e., lines H_aC and AH_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=$\_E_a$

Proving failed

4.3.2 Proving H_a=$\_H_a$

Proving failed

4.3.3 Proving M_b=$\_M_b$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=$\_E_a$

Proving failed

4.4.2 Proving H_a=$\_H_a$

Proving failed

4.4.3 Proving M_b=$\_M_b$

Proving failed

Problem 806

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 806: Given a point E_a, a point H_a and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Using the point H_a and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points H_a and M_c are not the same;
3. Using the circle $k(M_c, A)$, the line h_a, the point M_c and the point H_a, construct a point A (rule W05); % NDG: line h_a and circle $k(M_c, A)$ intersect % DET: points H_a and A must be different;
4. Using the point A and the point E_a, construct a point H (rule W01); ;
5. Using the point M_c and the point A, construct a point B (rule W01); ;
6. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
7. Using the point H and the point B, construct a line h_b (rule W02); % DET: points H and B are not the same;
8. Using the circle $k(M_c, A)$, the line h_b, the point M_c and the point B, construct a point H_b (rule W05); % NDG: line h_b and circle $k(M_c, A)$ intersect % DET: points B and H_b must be different;
9. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
10. Using the line a and the line b, construct a point C (rule W03); % NDG: lines a and b are not parallel % DET: lines a and b are not the same.

Non-degenerate conditions: lines a and b are not parallel; line h_b and circle $k(M_c, A)$ intersect; line h_a and circle $k(M_c, A)$ intersect; points H_a and M_c are not the same.

Determination conditions: lines a and b are not the same; points A and H_b are not the same; points B and H_b must be different; points H and B are not the same; points H_a and B are not the same; points H_a and A must be different; points E_a and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D20,D28,D3,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L40,L41,L42]

Solving time: 8.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{a} 80 40
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r H_{a}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{a} and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point H
    _{a}
circle k(M_{c},A) M_{c} H_{a}

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: line h_{a} and circle k(M_{c},A) intersect% DET: points H_{a} and A must be different
% Constructing a point P_{\_G227404} which is a foot of the point M_{c} on the line h_{a}
foot P_{\_G227404} M_{c} h_{a}
cmark_r P_{\_G227404}
color 200 200 200
drawline M_{c} P_{\_G227404}
color 0 0 0
```

```
% Constructing a point A which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    227404}
sim A P_{\_G227404} H_{a}
cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that M_{c}B/M_{c}A=-1
towards B M_{c} A -1
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% DET: points H and B are not the same
% Constructing a line h_{b} which passes through point H and point B
line h_{b} H B

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{b} and circle k(M_{c},A) intersect% DET: points B and H_{b} must be different
% Constructing a point P_{\_G227841} which is a foot of the point M_{c} on the line h_{b}
foot P_{\_G227841} M_{c} h_{b}
cmark_r P_{\_G227841}
color 200 200 200
drawline M_{c} P_{\_G227841}
color 0 0 0

% Constructing a point H_{b} which is an image of the point B in the symmetry to point/line P_{\_G
    227841}
sim H_{b} P_{\_G227841} B
```

```
cmark_l H_{b}


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines a and b are not parallel% DET: lines a and b are not the same
% Constructing a point C which belongs to line a and line b
intersec C a b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and b are not parallel; line h_{b} and circle k(M_{c},A)
    intersect; line h_{a} and circle k(M_{c},A) intersect; points H_{a} and M_{c} are not the same
% Determination conditions: lines a and b are not the same; points A and H_{b} are not the same;
    points B and H_{b} must be different; points H and B are not the same; points H_{a} and B are
    not the same; points H_{a} and A must be different; points E_{a} and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.112 seconds.

NDG conditions There are no NDG conditions for this theorem

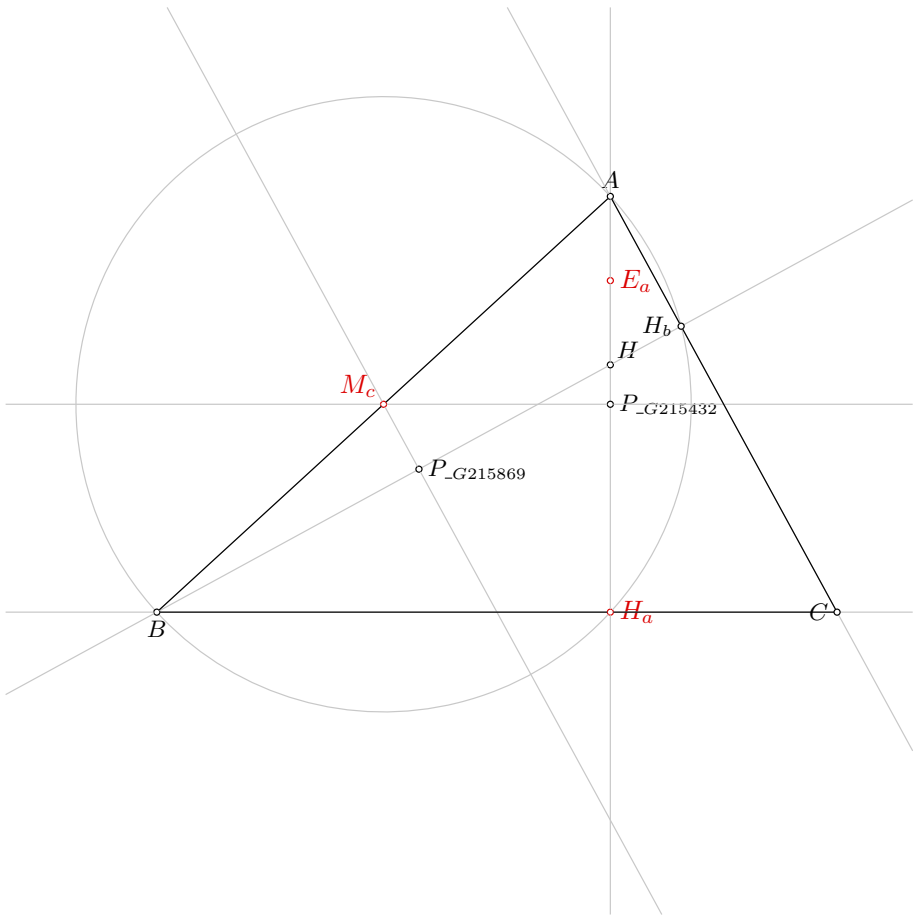

Figure 1: Illustration of the problem 0806

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving M_c=_M_c

NDG conditions are:

$S_{H_aAH_b} \neq S_{BAH_b}$ i.e., lines H_aB and AH_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 807

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 807: Given a point H_a, a point N and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;
2. Choose freely a point E_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
4. Using the point E_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and N are not the same;
5. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point E_a, construct a point M_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_a and M_a must be different;
6. Using the point M_a and the point H_a, construct a line a (rule W02); % DET: points M_a and H_a are not the same;
7. Choose freely a point A on the line h_a (rule WOnline1) ;
8. Using the point A and the point E_a, construct a point H (rule W01); ;
9. Using the point N and the point H, construct a point O (rule W01); ;
10. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
11. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points H_a and N are not the same.

Determination conditions: points M_a and H_a are not the same; points E_a and M_a must be different; points E_a and N are not the same; points E_a and H_a are not the same.

Rules used: [W01,W02,W04,W05a,W06,WOncircle1,WOnline1]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GD02,GL01,GL03,GL04,GL09,L11,L12,L19,L20,L21,L

Solving time: 568.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{a} 80 40
point N 72.5 61.93
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_r H_{a}
cmark_r N
cmark_r E_{a}
color 0 0 0
fontsize 8

% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{a} on the circle with center N through point H_{a}
oncircle E_{a} N H_{a}
cmark_r E_{a}
color 200 200 200
drawcircle N H_{a}
color 0 0 0


% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% DET: points E_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point N
line m(H_{b}H_{c}) E_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{a} and M_{a} must be
    different
% Constructing a point M_{a} which is an image of the point E_{a} in the symmetry to point/line N
sim M_{a} N E_{a}
cmark_r M_{a}


% DET: points M_{a} and H_{a} are not the same
% Constructing a line a which passes through point M_{a} and point H_{a}
line a M_{a} H_{a}

color 200 200 200
drawline a
color 0 0 0




% Choosing randomly a point A on the line E_{a}H_{a}
online A E_{a} H_{a}
cmark_t A
color 200 200 200
drawline E_{a} H_{a}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point O such that NO/NH=-1
towards O N H -1
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
```

Figure 1: Illustration of the problem 0807

```
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect; points H_{a} and N are not the same
% Determination conditions: points M_{a} and H_{a} are not the same; points E_{a} and M_{a} must be
     different; points E_{a} and N are not the same; points E_{a} and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_a=_H_a

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_a=_H_a

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_a=_H_a

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_a=_H_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_a=_E_a

Proving failed

Problem 808

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 808: Given a point E_a, a point H_a and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
2. Using the point H_a and the line h_a, construct a line a (rule W10a); ;
3. Using the point O and the line a, construct a line m_a (rule W10b); ;
4. Using the line m_a and the line a, construct a point M_a (rule W03); % NDG: lines m_a and a are not parallel % DET: lines m_a and a are not the same;
5. Using the point M_a and the point E_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and E_a are not the same;
6. Using the point E_a and the point H_a, construct a line $m(E_aH_a)$ (rule W14); % DET: points E_a and H_a are not the same;
7. Using the line $m(E_aH_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aH_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aH_a)$ and $m(H_bH_c)$ are not the same;
8. Using the point O and the point N, construct a point H (rule W01); ;
9. Using the point E_a and the point H, construct a point A (rule W01); ;
10. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
11. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; lines $m(E_aH_a)$ and $m(H_bH_c)$ are not parallel; lines m_a and a are not parallel.

Determination conditions: lines $m(E_aH_a)$ and $m(H_bH_c)$ are not the same; points E_a and H_a are not the same; points M_a and E_a are not the same; lines m_a and a are not the same; points E_a and H_a are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W10b,W14]

Lemmas used: [D1,D11,D21,D26,D28,D3,D31,D32,D5,D8,GD01,GD02,GL01,GL03,GL04,GL09,L11,L12,L19,L

Solving time: 3.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{a} 80 40
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r H_{a}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Constructing a line a which is perpendicular to line h_{a} and which passes through point H_{a}
perp a H_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0




% Constructing a line m_{a} which is perpendicular to line a and which passes through point O
perp m_{a} O a

color 200 200 200
drawline m_{a}
color 0 0 0
```

```
% NDG: lines m_{a} and a are not parallel% DET: lines m_{a} and a are not the same
% Constructing a point M_{a} which belongs to line m_{a} and line a
intersec M_{a} m_{a} a
cmark_r M_{a}


% DET: points M_{a} and E_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point E_{a}
line m(H_{b}H_{c}) M_{a} E_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% DET: points E_{a} and H_{a} are not the same
% Constructing bisector m(E_{a}H_{a}) of the segment E_{a}H_{a}
med m(E_{a}H_{a}) E_{a} H_{a}

color 200 200 200
drawline m(E_{a}H_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} H_{a}
color 0 0 0


% NDG: lines m(E_{a}H_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}H_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}H_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}H_{a}) m(H_{b}H_{c})
cmark_r N



% Constructing a point H such that OH/ON=2
towards H O N 2
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0
```

```
% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    lines m(E_{a}H_{a}) and m(H_{b}H_{c}) are not parallel; lines m_{a} and a are not parallel
% Determination conditions: lines m(E_{a}H_{a}) and m(H_{b}H_{c}) are not the same; points E_{a}
    and H_{a} are not the same; points M_{a} and E_{a} are not the same; lines m_{a} and a are not
    the same; points E_{a} and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving O=_O

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 130 terms.

Time Complexity: Time spent by the prover is 0.717 seconds.

NDG conditions Points _M_a and E_a are not identical

Points B, C and E_a are not collinear

Point H_a is not the midpoint of segment with endpoints A and B

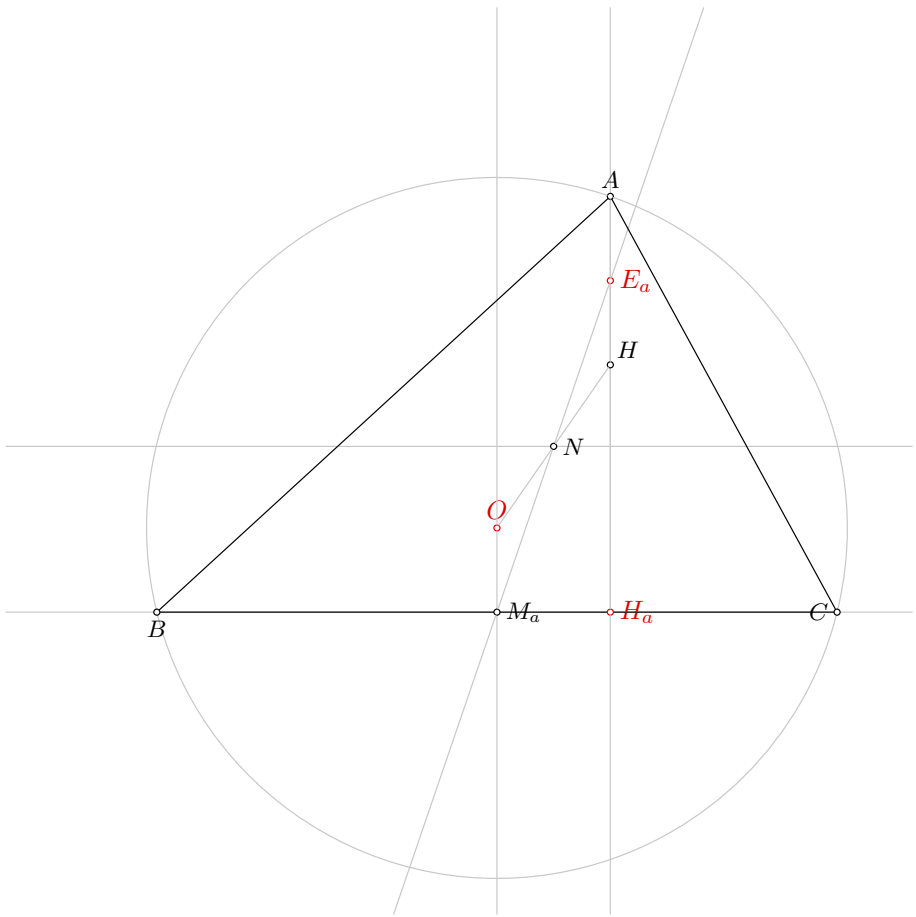

Figure 1: Illustration of the problem 0808

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 311 terms.

Time Complexity: Time spent by the prover is 0.520 seconds.There are no ndg conditions.

4.3.2 Proving H_a=_H_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 15 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 1065 terms.

Time Complexity: Time spent by the prover is 2.280 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 809

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 809: Given a point H_a, a point T_a and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point T_a, construct a line a (rule W02); % DET: points H_a and T_a are not the same;
2. Using the point H_a and the line a, construct a line h_a (rule W10b); ;
3. Choose freely a point E_a on the line h_a (rule WOnline2);
4. Choose freely a point A on the line h_a (rule WOnline1) ;
5. Using the point A and the point E_a, construct a point H (rule W01); ;
6. Using the point A and the point T_a, construct a line s_a (rule W02); % DET: points A and T_a are not the same;
7. Using the point E_a, the point A, the point T_a, the line s_a and the line h_a, construct a line AO (rule W17); % NDG: points A and T_a are not the same; points E_a and A are not the same % DET: points A and T_a are not the same;
8. Using the point E_a and the line AO, construct a line $m(H_bH_c)$ (rule W16); ;
9. Using the line $m(H_bH_c)$ and the line a, construct a point M_a (rule W03); % NDG: lines $m(H_bH_c)$ and a are not parallel % DET: lines $m(H_bH_c)$ and a are not the same;
10. Using the point M_a and the point A, construct a point G (rule W01); ;
11. Using the point H and the point G, construct a point O (rule W01); ;
12. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;

13. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; lines $m(H_bH_c)$ and a are not parallel; points A and T_a are not the same; points E_a and A are not the same.

Determination conditions: lines $m(H_bH_c)$ and a are not the same; points A and T_a are not the same; points A and T_a are not the same; points H_a and T_a are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W16,W17,WOnline1,WOnline2]

Lemmas used: [D21,D23,D26,D28,D3,D5,D8,GD01,GD02,GL01,GL03,GL04,GL09,GL17,L104,L11,L12,L38,L3

Solving time: 54.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{a} 80 40
point T_{a} 70.86 40
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_r H_{a}
cmark_rb T_{a}
cmark_r E_{a}
color 0 0 0
fontsize 8

% DET: points H_{a} and T_{a} are not the same
% Constructing a line a which passes through point H_{a} and point T_{a}
line a H_{a} T_{a}

color 200 200 200
drawline a
color 0 0 0




% Constructing a line h_{a} which is perpendicular to line a and which passes through point H_{a}
perp h_{a} H_{a} a

color 200 200 200
drawline h_{a}
color 0 0 0




% Generating random value V[_G78381]
random V[_G78381]
```

```
% Calculating value V[_G78402] using formula V[_G78381]*20
expression V[_G78402] { V[_G78381]*20 }


% Constructing a point E_{a} which is a point for which holds H_{a}E_{a} = V[_G78402] and angle T_{
    a}H_{a}E_{a} = 90
turtle E_{a} T_{a} H_{a} 90 V[_G78402]
cmark_r E_{a}



% Choosing randomly a point A on the line E_{a}H_{a}
online A E_{a} H_{a}
cmark_t A
color 200 200 200
drawline E_{a} H_{a}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and T_{a} are not the same
% Constructing a line s_{a} which passes through point A and point T_{a}
line s_{a} A T_{a}

color 200 200 200
drawline s_{a}
color 0 0 0



% NDG: points A and T_{a} are not the same; points E_{a} and A are not the same% DET: points A and
    T_{a} are not the same
% Constructing an angle V[_G78764] which is equal to the angle E_{a}AT_{a}
angle_o V[_G78764] E_{a} A T_{a}


% Calculating value angle[_G78843] using formula 1/pow(2,0)*V[_G78764]+0/pow(2,0)*180
expression angle[_G78843] { 1/pow(2,0)*V[_G78764]+0/pow(2,0)*180 }


% Constructing a point P_{\_G78840} which is an image of the point T_{a} in a rotation around the
    point A for the angle 1/pow(2,0)*V[_G78764]+0/pow(2,0)*180
rotate P_{\_G78840} A angle[_G78843] T_{a}
cmark_r P_{\_G78840}
color 200 200 200
drawarc_p A T_{a} angle[_G78843]
color 0 0 0
```

```
% Constructing a line AO which passes through point A and point P_{\_G78840}
line AO A P_{\_G78840}

color 200 200 200
drawline AO
color 0 0 0



% Constructing a line m(H_{b}H_{c}) which contains the point E_{a} and is parallel to the line AO
parallel m(H_{b}H_{c}) E_{a} AO

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: lines m(H_{b}H_{c}) and a are not parallel% DET: lines m(H_{b}H_{c}) and a are not the same
% Constructing a point M_{a} which belongs to line m(H_{b}H_{c}) and line a
intersec M_{a} m(H_{b}H_{c}) a
cmark_r M_{a}



% Constructing a line L_{\_G79359} which passes through point M_{a} and point A
line L_{\_G79359} M_{a} A

color 200 200 200
drawline L_{\_G79359}
color 0 0 0


% Constructing a point P_{\_G79460} with coordinates (0,0)
point P_{\_G79460} 0 0
cmark_r P_{\_G79460}

% Constructing a point P_{\_G79384} such that M_{a}P_{\_G79384}/M_{a}P_{\_G79460}=1
towards P_{\_G79384} M_{a} P_{\_G79460} 1
cmark_r P_{\_G79384}
color 200 200 200
drawsegment M_{a} P_{\_G79384}
color 0 0 0

% Constructing a point P_{\_G79429} such that M_{a}P_{\_G79429}/M_{a}P_{\_G79460}=3
towards P_{\_G79429} M_{a} P_{\_G79460} 3
cmark_r P_{\_G79429}
color 200 200 200
drawsegment M_{a} P_{\_G79429}
color 0 0 0

% Constructing a line L_{\_G79390} which passes through point A and point P_{\_G79429}
line L_{\_G79390} A P_{\_G79429}
```

```
color 200 200 200
drawline L_{\_G79390}
color 0 0 0


% Constructing a line L_{\_G79353} which contains the point P_{\_G79384} and is parallel to the
    line L_{\_G79390}
parallel L_{\_G79353} P_{\_G79384} L_{\_G79390}

color 200 200 200
drawline L_{\_G79353}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G79353} and line L_{\_G79359}
intersec G L_{\_G79353} L_{\_G79359}
cmark_t G



% Constructing a point O such that HO/HG=1.5
towards O H G 1.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    lines m(H_{b}H_{c}) and a are not parallel; points A and T_{a} are not the same; points E_{a}
    and A are not the same
% Determination conditions: lines m(H_{b}H_{c}) and a are not the same; points A and T_{a} are not
    the same; points A and T_{a} are not the same; points H_{a} and T_{a} are not the same
```

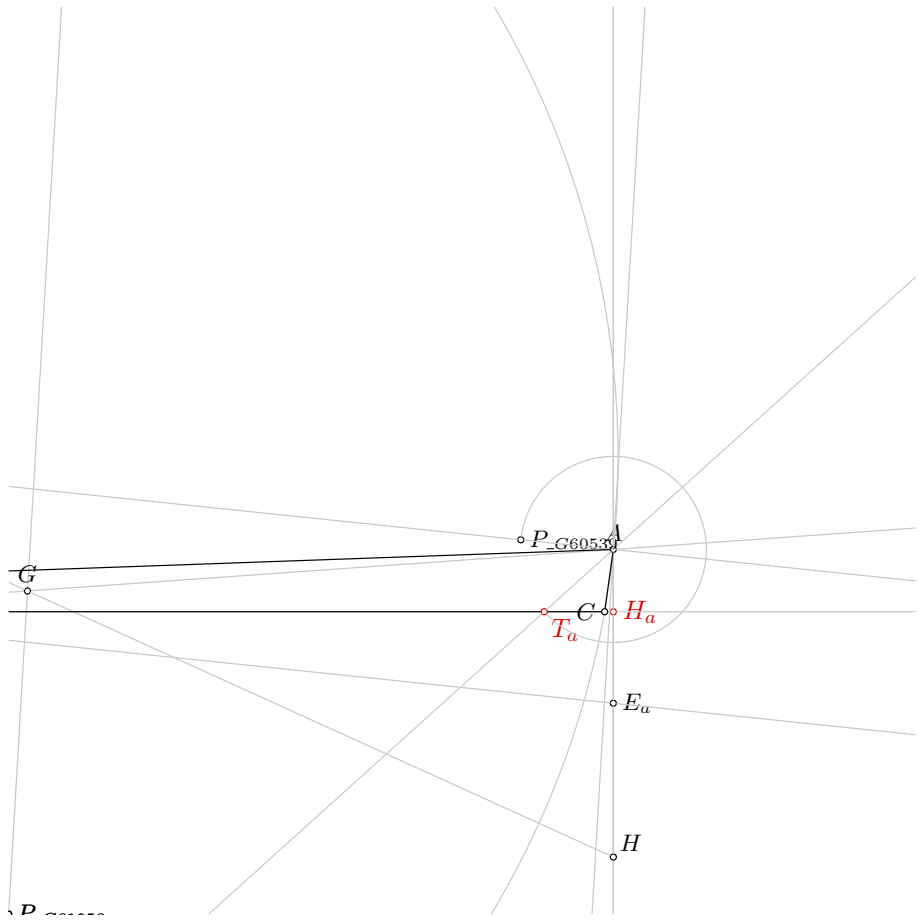

Figure 1: Illustration of the problem 0809

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_a=$\_H_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.214 seconds.

NDG conditions Points T_a and A are not identical

Points A and H are not identical

Points A, M_a and P_G73321 are not collinear

Line through points H_a and A is not perpendicular to line through points A and P_G73321

Line through points A and H_a is not parallel with line through points B and C

4.1.2 Proving T_a=_T_a

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_a=_H_a

Proving failed

4.2.2 Proving T_a=_T_a

Proving failed

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_a=_H_a

Proving failed

4.3.2 Proving T_a=_T_a

Proving failed

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_a=_H_a

Proving failed

4.4.2 Proving T_a=_T_a

Proving failed

4.4.3 Proving E_a=_E_a

Proving failed

Problem 810

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 810: Given a point E_a, a point H_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 811

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 811: Given a point E_a, a point H_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 812

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 812: Given a point E_a, a point H_c and a point H_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
2. Choose freely a point H_b on the circle $k(E_a, A)$ (rule WOncircle);
3. Using the point H_b and the point E_a, construct a line $m(H_bE_a)$ (rule W14); % DET: points H_b and E_a are not the same;
4. Using the point H_b and the point H_c, construct a line $m(H_bH_c)$ (rule W14); % DET: points H_b and H_c are not the same;
5. Using the line $m(H_bH_c)$ and the line $m(H_bE_a)$, construct a point N (rule W03); % NDG: lines $m(H_bH_c)$ and $m(H_bE_a)$ are not parallel % DET: lines $m(H_bH_c)$ and $m(H_bE_a)$ are not the same;
6. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point E_a, construct a point M_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_a and M_a must be different;
8. Choose freely a point A on the circle $k(E_a, A)$ (rule WOncircle);
9. Using the point A and the point E_a, construct a point H (rule W01); ;
10. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;

11. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;

12. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same;

13. Using the point M_a and the point C, construct a point B (rule W01); .

Non-degenerate conditions: lines b and h_c are not parallel; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points H_b and N are not the same; lines $m(H_bH_c)$ and $m(H_bE_a)$ are not parallel; points H_c and E_a are not the same.

Determination conditions: lines b and h_c are not the same; points H_c and H are not the same; points A and H_b are not the same; points E_a and M_a must be different; lines $m(H_bH_c)$ and $m(H_bE_a)$ are not the same; points H_b and H_c are not the same; points H_b and E_a are not the same.

Rules used: [W01,W02,W03,W05a,W06,W14,WOncircle1]

Lemmas used: [D10,D21,D28,D32,D6,D7,GD01,GD02,GL01,GL03,GL04,L20,L21,L22,L3,L38,L39,L47,L48]

Solving time: 65.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{c} 68.91 84.83
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H_{c}
cmark_l H_{b}
color 0 0 0
fontsize 8

% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0




% Choosing randomly a point H_{b} on the circle with center E_{a} through point H_{c}
oncircle H_{b} E_{a} H_{c}
cmark_l H_{b}
color 200 200 200
drawcircle E_{a} H_{c}
color 0 0 0
```

```
% DET: points H_{b} and E_{a} are not the same
% Constructing bisector m(H_{b}E_{a}) of the segment H_{b}E_{a}
med m(H_{b}E_{a}) H_{b} E_{a}

color 200 200 200
drawline m(H_{b}E_{a})
color 0 0 0

color 200 200 200
drawsegment H_{b} E_{a}
color 0 0 0


% DET: points H_{b} and H_{c} are not the same
% Constructing bisector m(H_{b}H_{c}) of the segment H_{b}H_{c}
med m(H_{b}H_{c}) H_{b} H_{c}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0

color 200 200 200
drawsegment H_{b} H_{c}
color 0 0 0


% NDG: lines m(H_{b}H_{c}) and m(H_{b}E_{a}) are not parallel% DET: lines m(H_{b}H_{c}) and m(H_{b}
    E_{a}) are not the same
% Constructing a point N which belongs to line m(H_{b}H_{c}) and line m(H_{b}E_{a})
intersec N m(H_{b}H_{c}) m(H_{b}E_{a})
cmark_r N


% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{a} and M_{a} must be
    different
% Constructing a point M_{a} which is an image of the point E_{a} in the symmetry to point/line N
sim M_{a} N E_{a}
cmark_r M_{a}



% Choosing randomly a point A on the circle with center E_{a} through point H_{b}
oncircle A E_{a} H_{b}
cmark_t A
```

```
color 200 200 200
drawcircle E_{a} H_{b}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line m(H_{b}H_{c}) and circle k(N,
    M_{a}) intersect; points H_{b} and N are not the same; lines m(H_{b}H_{c}) and m(H_{b}E_{a})
```

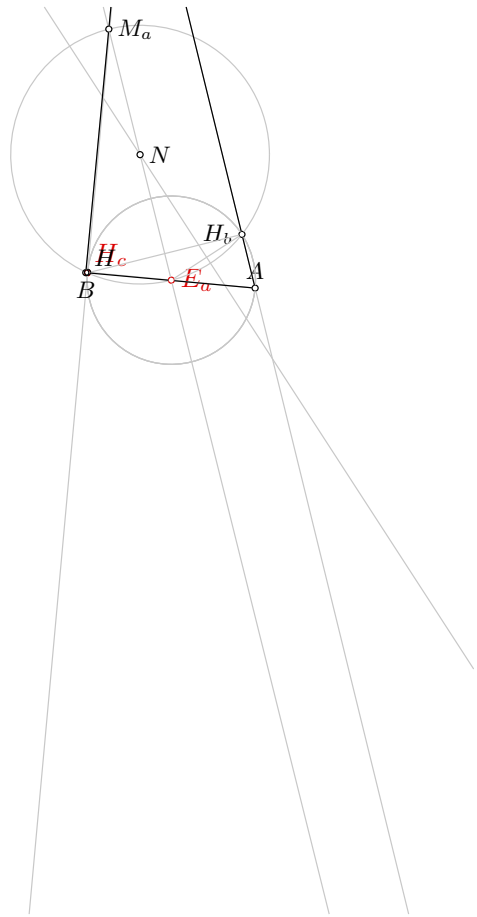

Figure 1: Illustration of the problem 0812

```
    are not parallel; points H_{c} and E_{a} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H_{c} and H are not the same
    ; points A and H_{b} are not the same; points E_{a} and M_{a} must be different; lines m(H_{b}H
    _{c}) and m(H_{b}E_{a}) are not the same; points H_{b} and H_{c} are not the same; points H_{b}
     and E_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 813

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 813: Given a point E_a, a point H_b and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 814

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 814: Given a point E_a, a point M_a and a point H_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
2. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;
3. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;
4. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
5. Choose freely a point H_b on the circle $k(N, M_a)$ (rule WOncircle);
6. Using the point H_b and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_b and E_a are not the same;
7. Using the circle $k(N, M_a)$, the circle $k(E_a, A)$, the point H_b, the point N and the point E_a, construct a point H_c (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_a, A)$ intersect % DET: circles $k(N, M_a)$ and $k(E_a, A)$ are not the same; points H_b and H_c must be different;
8. Choose freely a point A on the circle $k(E_a, A)$ (rule WOncircle);
9. Using the point A and the point E_a, construct a point H (rule W01); ;
10. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;

11. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;

12. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same;

13. Using the point M_a and the point C, construct a point B (rule W01); .

Non-degenerate conditions: lines b and h_c are not parallel; circles $k(N, M_a)$ and $k(E_a, A)$ intersect; points H_b and E_a are not the same; points E_a and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel.

Determination conditions: lines b and h_c are not the same; points H_c and H are not the same; points A and H_b are not the same; circles $k(N, M_a)$ and $k(E_a, A)$ are not the same; points H_b and H_c must be different; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points E_a and M_a are not the same.

Rules used: [W01,W02,W03,W06,W08,W14,WOncircle1]

Lemmas used: [D10,D21,D28,D32,D6,D7,GD01,GD02,GL01,GL03,GL04,L20,L21,L22,L3,L38,L39,L47,L48]

Solving time: 66.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point M_{a} 65 40
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r M_{a}
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
```

```
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0


% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{b} on the circle with center N through point E_{a}
oncircle H_{b} N E_{a}
cmark_l H_{b}
color 200 200 200
drawcircle N E_{a}
color 0 0 0


% NDG: points H_{b} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{b}
circle k(E_{a},A) E_{a} H_{b}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(E_{a},A) intersect% DET: circles k(N,M_{a}) and k(E_{a},A) are not
    the same; points H_{b} and H_{c} must be different
% Constructing a line L_{\_G149808} which passes through point N and point E_{a}
line L_{\_G149808} N E_{a}

color 200 200 200
drawline L_{\_G149808}
color 0 0 0


% Constructing a point H_{c} which is an image of the point H_{b} in the symmetry to point/line L
    _{\_G149808}
```

```
sim H_{c} L_{\_G149808} H_{b}
cmark_rt H_{c}


% Choosing randomly a point A on the circle with center E_{a} through point H_{b}
oncircle A E_{a} H_{b}
cmark_t A
color 200 200 200
drawcircle E_{a} H_{b}
color 0 0 0


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0


% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C


% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0
```

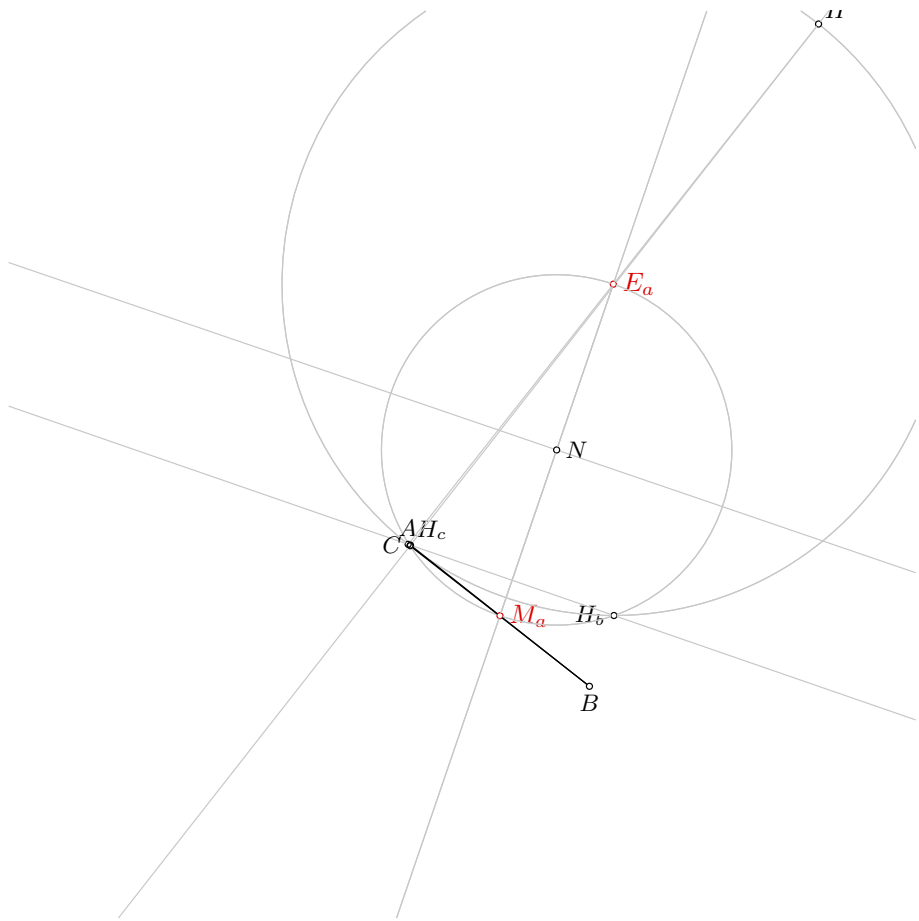

Figure 1: Illustration of the problem 0814

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; circles k(N,M_{a}) and k(E_{a},A)
    intersect; points H_{b} and E_{a} are not the same; points E_{a} and N are not the same; lines
    m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel
% Determination conditions: lines b and h_{c} are not the same; points H_{c} and H are not the same
    ; points A and H_{b} are not the same; circles k(N,M_{a}) and k(E_{a},A) are not the same;
    points H_{b} and H_{c} must be different; lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the
    same; points E_{a} and M_{a} are not the same; points E_{a} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 12 terms.

Time Complexity: Time spent by the prover is 0.247 seconds.

NDG conditions Points N and E_a are not identical

Line through points H_b and A is not parallel with line through points H_c and H

Points H_b and A are not identical

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving M_a=_M_a

NDG conditions are:

$S_{M^0_{m(E_aM_a)}E_aM_a} \neq S_{T^1_{m(E_aM_a)}E_aM_a}$ i.e., lines $M^0_{m(E_aM_a)}T^1_{m(E_aM_a)}$ and E_aM_a are not parallel (construction based assumption)

$S_{AH_cH} \neq S_{H_bH_cH}$ i.e., lines AH_b and H_cH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{CBF^3_{\_h_b}}$ i.e., lines AC and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 815

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 815: Given a point E_a, a point H_b and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
2. Using the point H_b and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_b and E_a are not the same;
3. Using the circle $k(E_a, A)$, the line b, the point E_a and the point H_b, construct a point A (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points H_b and A must be different;
4. Using the point A and the point E_a, construct a point H (rule W01); ;
5. Using the point M_b and the point A, construct a point C (rule W01); ;
6. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
7. Using the point H and the point C, construct a line h_c (rule W02); % DET: points H and C are not the same;
8. Using the circle $k(E_a, A)$, the line h_c, the point E_a and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_a, A)$ intersect % DET: points H and H_c must be different;
9. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;
10. Using the line h_b and the line c, construct a point B (rule W03); % NDG: lines h_b and c are not parallel % DET: lines h_b and c are not the same.

Non-degenerate conditions: lines h_b and c are not parallel; line h_c and circle $k(E_a, A)$ intersect; line b and circle $k(E_a, A)$ intersect; points H_b and E_a are not the same.

Determination conditions: lines h_b and c are not the same; points A and H_c are not the same; points H and H_c must be different; points H and C are not the same; points H_b and H are not the same; points H_b and A must be different; points H_b and M_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D22,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 9.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{b} 89.36 77.83
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_l H_{b}
cmark_lt M_{b}
color 0 0 0
fontsize 8

% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points H_{b} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{b}
circle k(E_{a},A) E_{a} H_{b}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points H_{b} and A must be different
% Constructing a point P_{\_G174150} which is a foot of the point E_{a} on the line b
foot P_{\_G174150} E_{a} b
cmark_r P_{\_G174150}
color 200 200 200
drawline E_{a} P_{\_G174150}
color 0 0 0
```

```
% Constructing a point A which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    174150}
sim A P_{\_G174150} H_{b}
cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that M_{b}C/M_{b}A=-1
towards C M_{b} A -1
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% DET: points H and C are not the same
% Constructing a line h_{c} which passes through point H and point C
line h_{c} H C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{c} and circle k(E_{a},A) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G174587} which is a foot of the point E_{a} on the line h_{c}
foot P_{\_G174587} E_{a} h_{c}
cmark_r P_{\_G174587}
color 200 200 200
drawline E_{a} P_{\_G174587}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    174587}
sim H_{c} P_{\_G174587} H
```

```
cmark_rt H_{c}


% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{b} and c are not parallel% DET: lines h_{b} and c are not the same
% Constructing a point B which belongs to line h_{b} and line c
intersec B h_{b} c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and c are not parallel; line h_{c} and circle k(E_{a},A)
    intersect; line b and circle k(E_{a},A) intersect; points H_{b} and E_{a} are not the same
% Determination conditions: lines h_{b} and c are not the same; points A and H_{c} are not the same
    ; points H and H_{c} must be different; points H and C are not the same; points H_{b} and H are
     not the same; points H_{b} and A must be different; points H_{b} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.193 seconds.

NDG conditions Points M_b and H_b are not identical

Points M_b and H_b are not identical

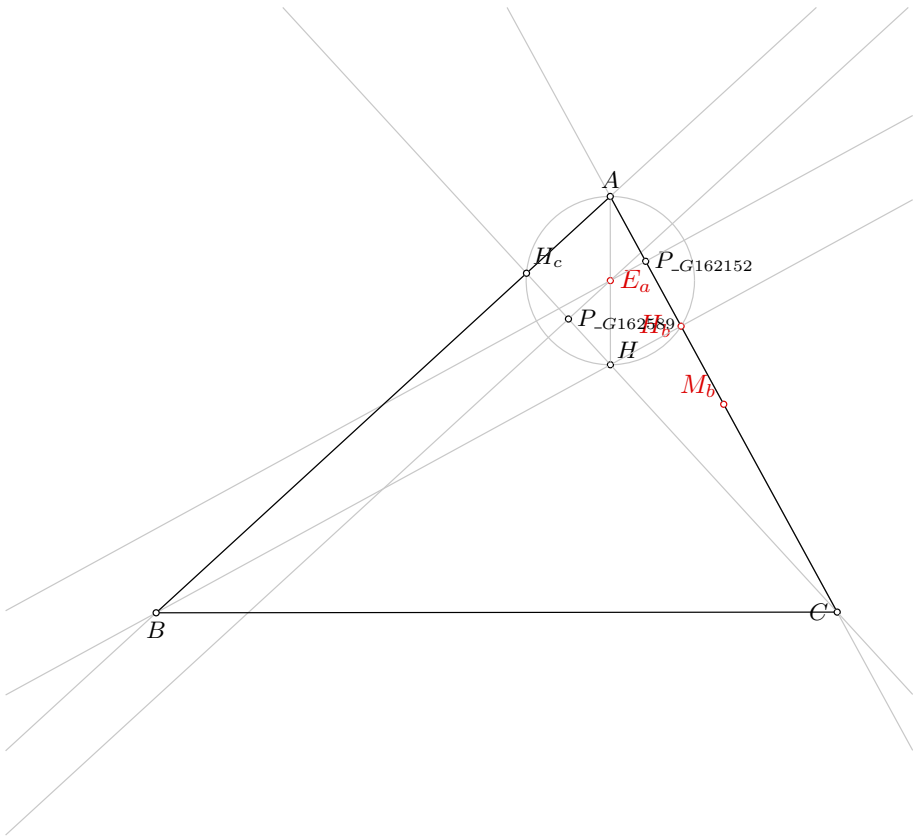

Figure 1: Illustration of the problem 0815

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving M_b=_M_b

NDG conditions are:

$S_{H_bAH_c} \neq S_{HAH_c}$ i.e., lines H_bH and AH_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving M_b=_M_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 816

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 816: Given a point E_a, a point H_b and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_b and E_a are not the same;
2. Using the point H_b and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points H_b and M_c are not the same;
3. Using the circle $k(E_a, A)$, the circle $k(M_c, A)$, the point H_b, the point E_a and the point M_c, construct a point A (rule W08); % NDG: circles $k(E_a, A)$ and $k(M_c, A)$ intersect % DET: circles $k(E_a, A)$ and $k(M_c, A)$ are not the same; points H_b and A must be different;
4. Using the point A and the point E_a, construct a point H (rule W01); ;
5. Using the point M_c and the point A, construct a point B (rule W01); ;
6. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
7. Using the point M_c and the point A, construct a line c (rule W02); % DET: points M_c and A are not the same;
8. Using the circle $k(E_a, A)$, the line c, the point E_a and the point A, construct a point H_c (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points A and H_c must be different;
9. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
10. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same.

Non-degenerate conditions: lines b and h_c are not parallel; line c and circle $k(E_a, A)$ intersect; circles $k(E_a, A)$ and $k(M_c, A)$ intersect; points H_b and M_c are not the same; points H_b and E_a are not the same.

Determination conditions: lines b and h_c are not the same; points H and H_c are not the same; points A and H_c must be different; points M_c and A are not the same; points H_b and A are not the same; circles $k(E_a, A)$ and $k(M_c, A)$ are not the same; points H_b and A must be different.

Rules used: [W01,W02,W03,W05,W06,W08]

Lemmas used: [D10,D20,D28,D6,D7,GD01,GD02,GL03,GL04,GL09,L3,L41,L47,L48]

Solving time: 9.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{b} 89.36 77.83
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_l H_{b}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% NDG: points H_{b} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{b}
circle k(E_{a},A) E_{a} H_{b}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: points H_{b} and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point H
    _{b}
circle k(M_{c},A) M_{c} H_{b}

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: circles k(E_{a},A) and k(M_{c},A) intersect% DET: circles k(E_{a},A) and k(M_{c},A) are not
    the same; points H_{b} and A must be different
% Constructing a line L_{\_G200432} which passes through point E_{a} and point M_{c}
line L_{\_G200432} E_{a} M_{c}
```

```
color 200 200 200
drawline L_{\_G200432}
color 0 0 0


% Constructing a point A which is an image of the point H_{b} in the symmetry to point/line L_{\_G
    200432}
sim A L_{\_G200432} H_{b}
cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that M_{c}B/M_{c}A=-1
towards B M_{c} A -1
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% DET: points M_{c} and A are not the same
% Constructing a line c which passes through point M_{c} and point A
line c M_{c} A

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points A and H_{c} must be different
% Constructing a point P_{\_G200849} which is a foot of the point E_{a} on the line c
foot P_{\_G200849} E_{a} c
cmark_r P_{\_G200849}
color 200 200 200
drawline E_{a} P_{\_G200849}
```

```
color 0 0 0

% Constructing a point H_{c} which is an image of the point A in the symmetry to point/line P_{\_G
    200849}
sim H_{c} P_{\_G200849} A
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line c and circle k(E_{a},A)
    intersect; circles k(E_{a},A) and k(M_{c},A) intersect; points H_{b} and M_{c} are not the same
    ; points H_{b} and E_{a} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H and H_{c} are not the same
    ; points A and H_{c} must be different; points M_{c} and A are not the same; points H_{b} and A
     are not the same; circles k(E_{a},A) and k(M_{c},A) are not the same; points H_{b} and A must
    be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

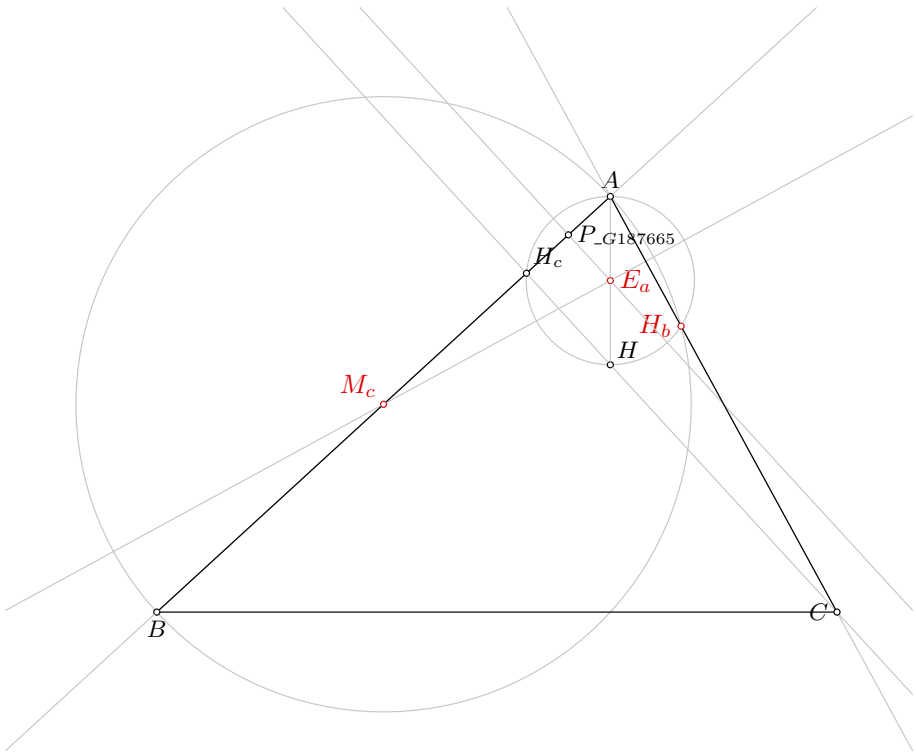

Figure 1: Illustration of the problem 0816

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.175 seconds.

NDG conditions Points M_c and E_a are not identical

Points M_c and E_a are not identical

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving M_c=_M_c

NDG conditions are:

$S_{H_bHH_c} \neq S_{AHH_c}$ i.e., lines H_bA and HH_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 817

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 817: Given a point H_b, a point N and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;
2. Choose freely a point E_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and N are not the same;
4. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point E_a, construct a point M_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_a and M_a must be different;
5. Using the point H_b and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_b and E_a are not the same;
6. Using the circle $k(N, M_a)$, the circle $k(E_a, A)$, the point H_b, the point N and the point E_a, construct a point H_c (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_a, A)$ intersect % DET: circles $k(N, M_a)$ and $k(E_a, A)$ are not the same; points H_b and H_c must be different;
7. Choose freely a point A on the circle $k(E_a, A)$ (rule WOncircle);
8. Using the point A and the point E_a, construct a point H (rule W01); ;
9. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
10. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;

11. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same;

12. Using the point M_a and the point C, construct a point B (rule W01); .

Non-degenerate conditions: lines b and h_c are not parallel; circles $k(N, M_a)$ and $k(E_a, A)$ intersect; points H_b and E_a are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points H_b and N are not the same.

Determination conditions: lines b and h_c are not the same; points H_c and H are not the same; points A and H_b are not the same; circles $k(N, M_a)$ and $k(E_a, A)$ are not the same; points H_b and H_c must be different; points E_a and M_a must be different; points E_a and N are not the same.

Rules used: [W01,W02,W03,W05a,W06,W08,WOncircle1]

Lemmas used: [D10,D21,D28,D32,D6,D7,GD01,GD02,GL01,GL03,GL04,L20,L21,L22,L3,L38,L39,L47,L48]

Solving time: 60.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{b} 89.36 77.83
point N 72.5 61.93
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_l H_{b}
cmark_r N
cmark_r E_{a}
color 0 0 0
fontsize 8

% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{a} on the circle with center N through point H_{b}
oncircle E_{a} N H_{b}
cmark_r E_{a}
color 200 200 200
drawcircle N H_{b}
color 0 0 0


% DET: points E_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point N
```

```
line m(H_{b}H_{c}) E_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{a} and M_{a} must be
    different
% Constructing a point M_{a} which is an image of the point E_{a} in the symmetry to point/line N
sim M_{a} N E_{a}
cmark_r M_{a}


% NDG: points H_{b} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{b}
circle k(E_{a},A) E_{a} H_{b}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(E_{a},A) intersect% DET: circles k(N,M_{a}) and k(E_{a},A) are not
    the same; points H_{b} and H_{c} must be different
% Constructing a line L_{\_G238080} which passes through point N and point E_{a}
line L_{\_G238080} N E_{a}

color 200 200 200
drawline L_{\_G238080}
color 0 0 0


% Constructing a point H_{c} which is an image of the point H_{b} in the symmetry to point/line L
    _{\_G238080}
sim H_{c} L_{\_G238080} H_{b}
cmark_rt H_{c}



% Choosing randomly a point A on the circle with center E_{a} through point H_{b}
oncircle A E_{a} H_{b}
cmark_t A
color 200 200 200
drawcircle E_{a} H_{b}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
```

```
drawsegment A H
color 0 0 0


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; circles k(N,M_{a}) and k(E_{a},A)
    intersect; points H_{b} and E_{a} are not the same; line m(H_{b}H_{c}) and circle k(N,M_{a})
    intersect; points H_{b} and N are not the same
% Determination conditions: lines b and h_{c} are not the same; points H_{c} and H are not the same
    ; points A and H_{b} are not the same; circles k(N,M_{a}) and k(E_{a},A) are not the same;
    points H_{b} and H_{c} must be different; points E_{a} and M_{a} must be different; points E_{a
    } and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

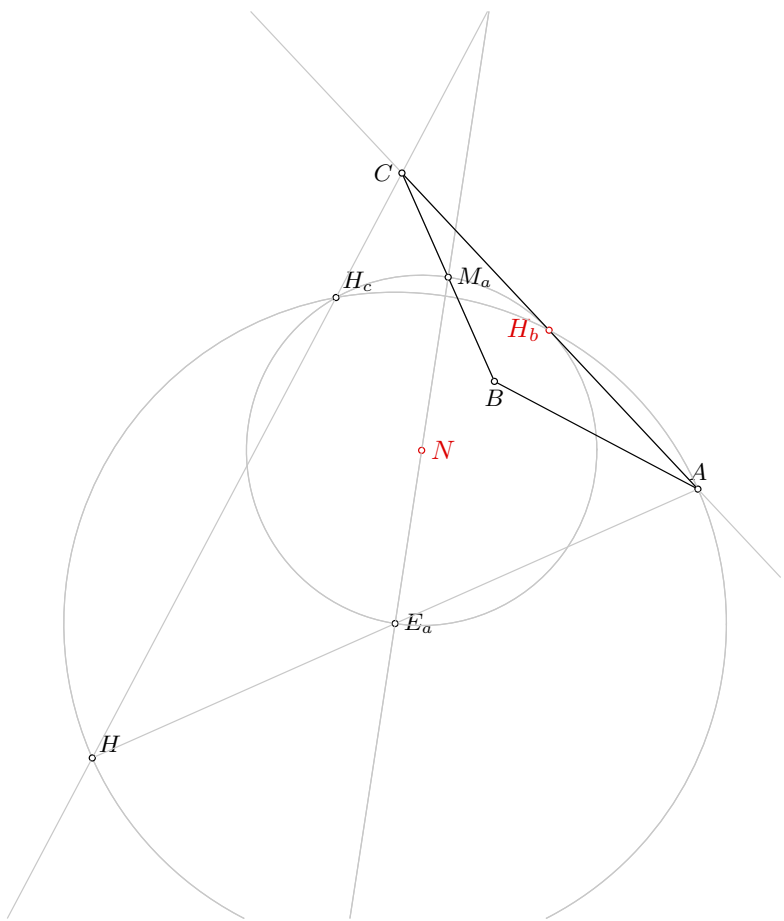

Figure 1: Illustration of the problem 0817

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_b=_H_b

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_b=_H_b

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_b=_H_b

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_b=_H_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving $E_a = \_E_a$

Proving failed

Problem 818

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 818: Given a point E_a, a point H_b and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 819

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 819: Given a point E_a, a point H_b and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 820

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 820: Given a point E_a, a point H_b and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 821

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 821: Given a point E_a, a point H_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 822

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 822: Given a point E_a, a point H_c and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 823

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 823: Given a point E_a, a point M_a and a point H_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
2. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;
3. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;
4. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
5. Choose freely a point H_c on the circle $k(N, M_a)$ (rule WOncircle);
6. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
7. Using the circle $k(N, M_a)$, the circle $k(E_a, A)$, the point H_c, the point N and the point E_a, construct a point H_b (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_a, A)$ intersect % DET: circles $k(N, M_a)$ and $k(E_a, A)$ are not the same; points H_c and H_b must be different;
8. Choose freely a point A on the circle $k(E_a, A)$ (rule WOncircle);
9. Using the point A and the point E_a, construct a point H (rule W01); ;
10. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;

11. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;

12. Using the line c and the line h_b, construct a point B (rule W03); % NDG: lines c and h_b are not parallel % DET: lines c and h_b are not the same;

13. Using the point M_a and the point B, construct a point C (rule W01); .

Non-degenerate conditions: lines c and h_b are not parallel; circles $k(N, M_a)$ and $k(E_a, A)$ intersect; points H_c and E_a are not the same; points E_a and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel.

Determination conditions: lines c and h_b are not the same; points H_b and H are not the same; points A and H_c are not the same; circles $k(N, M_a)$ and $k(E_a, A)$ are not the same; points H_c and H_b must be different; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points E_a and M_a are not the same.

Rules used: [W01,W02,W03,W06,W08,W14,WOncircle1]

Lemmas used: [D21,D28,D3,D32,D6,D7,D9,GD01,GD02,GL01,GL03,GL04,L20,L21,L22,L38,L39,L47,L48]

Solving time: 66.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point M_{a} 65 40
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r M_{a}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
```

```
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0


% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{c} on the circle with center N through point E_{a}
oncircle H_{c} N E_{a}
cmark_rt H_{c}
color 200 200 200
drawcircle N E_{a}
color 0 0 0


% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(E_{a},A) intersect% DET: circles k(N,M_{a}) and k(E_{a},A) are not
    the same; points H_{c} and H_{b} must be different
% Constructing a line L_{\_G46021} which passes through point N and point E_{a}
line L_{\_G46021} N E_{a}

color 200 200 200
drawline L_{\_G46021}
color 0 0 0


% Constructing a point H_{b} which is an image of the point H_{c} in the symmetry to point/line L
    _{\_G46021}
```

```
sim H_{b} L_{\_G46021} H_{c}
cmark_l H_{b}


% Choosing randomly a point A on the circle with center E_{a} through point H_{c}
oncircle A E_{a} H_{c}
cmark_t A
color 200 200 200
drawcircle E_{a} H_{c}
color 0 0 0


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0


% NDG: lines c and h_{b} are not parallel% DET: lines c and h_{b} are not the same
% Constructing a point B which belongs to line c and line h_{b}
intersec B c h_{b}
cmark_b B


% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0
```

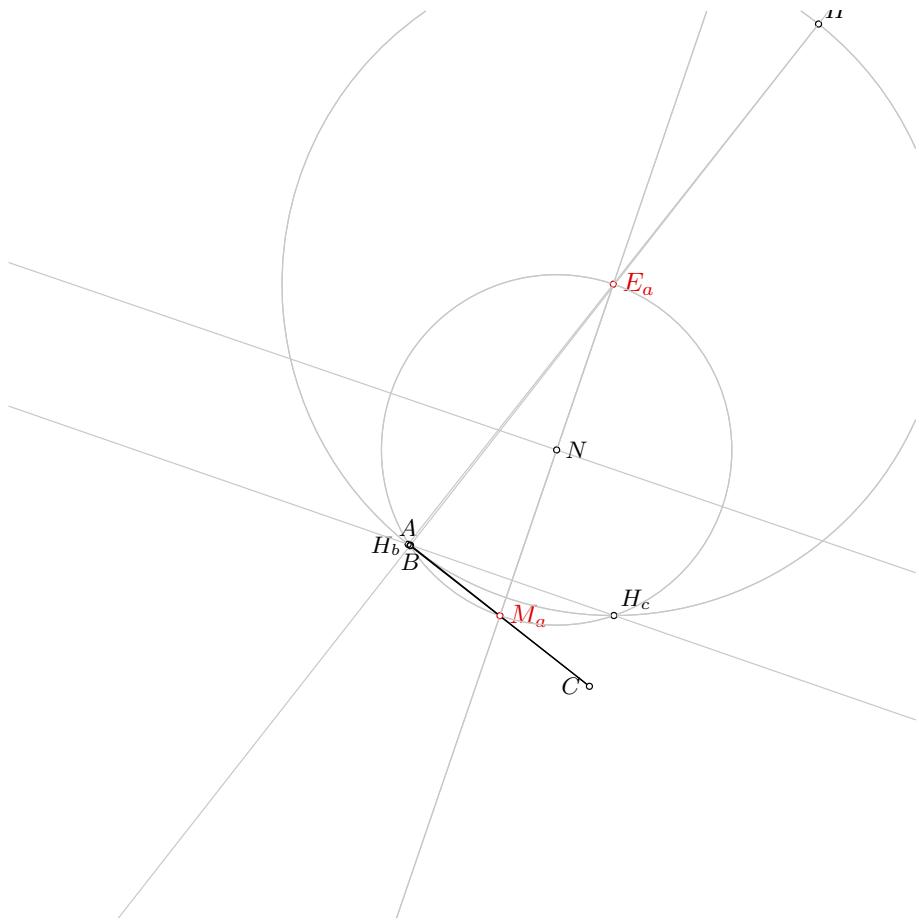

Figure 1: Illustration of the problem 0823

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{b} are not parallel; circles k(N,M_{a}) and k(E_{a},A)
    intersect; points H_{c} and E_{a} are not the same; points E_{a} and N are not the same; lines
    m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel
% Determination conditions: lines c and h_{b} are not the same; points H_{b} and H are not the same
    ; points A and H_{c} are not the same; circles k(N,M_{a}) and k(E_{a},A) are not the same;
    points H_{c} and H_{b} must be different; lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the
    same; points E_{a} and M_{a} are not the same; points E_{a} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 12 terms.

Time Complexity: Time spent by the prover is 0.246 seconds.

NDG conditions Points N and E_a are not identical

Line through points H_b and H is not parallel with line through points A and H_c

Points A and H_c are not identical

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving M_a=_M_a

NDG conditions are:

$S_{M^0_{m(E_aM_a)}E_aM_a} \neq S_{T^1_{m(E_aM_a)}E_aM_a}$ i.e., lines $M^0_{m(E_aM_a)}T^1_{m(E_aM_a)}$ and E_aM_a are not parallel (construction based assumption)

$S_{AH_bH} \neq S_{H_cH_bH}$ i.e., lines AH_c and H_bH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)

$S_{ACF^4_{\_h_c}} \neq S_{BCF^4_{\_h_c}}$ i.e., lines AB and $CF^4_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.3 Proving H_c=_H_c

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 4478 terms.

Time Complexity: Time spent by the prover is 4.370 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 824

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 824: Given a point E_a, a point H_c and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
2. Using the point H_c and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points H_c and M_b are not the same;
3. Using the circle $k(E_a, A)$, the circle $k(M_b, C)$, the point H_c, the point E_a and the point M_b, construct a point A (rule W08); % NDG: circles $k(E_a, A)$ and $k(M_b, C)$ intersect % DET: circles $k(E_a, A)$ and $k(M_b, C)$ are not the same; points H_c and A must be different;
4. Using the point A and the point E_a, construct a point H (rule W01); ;
5. Using the point M_b and the point A, construct a point C (rule W01); ;
6. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
7. Using the point M_b and the point A, construct a line b (rule W02); % DET: points M_b and A are not the same;
8. Using the circle $k(E_a, A)$, the line b, the point E_a and the point A, construct a point H_b (rule W05); % NDG: line b and circle $k(E_a, A)$ intersect % DET: points A and H_b must be different;
9. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
10. Using the line c and the line h_b, construct a point B (rule W03); % NDG: lines c and h_b are not parallel % DET: lines c and h_b are not the same.

Non-degenerate conditions: lines c and h_b are not parallel; line b and circle $k(E_a, A)$ intersect; circles $k(E_a, A)$ and $k(M_b, C)$ intersect; points H_c and M_b are not the same; points H_c and E_a are not the same.

Determination conditions: lines c and h_b are not the same; points H and H_b are not the same; points A and H_b must be different; points M_b and A are not the same; points H_c and A are not the same; circles $k(E_a, A)$ and $k(M_b, C)$ are not the same; points H_c and A must be different.

Rules used: [W01,W02,W03,W05,W06,W08]

Lemmas used: [D22,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L43,L45,L47,L48]

Solving time: 9.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{c} 68.91 84.83
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H_{c}
cmark_lt M_{b}
color 0 0 0
fontsize 8

% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: points H_{c} and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point H
    _{c}
circle k(M_{b},C) M_{b} H_{c}

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: circles k(E_{a},A) and k(M_{b},C) intersect% DET: circles k(E_{a},A) and k(M_{b},C) are not
    the same; points H_{c} and A must be different
% Constructing a line L_{\_G72953} which passes through point E_{a} and point M_{b}
line L_{\_G72953} E_{a} M_{b}
```

```
color 200 200 200
drawline L_{\_G72953}
color 0 0 0


% Constructing a point A which is an image of the point H_{c} in the symmetry to point/line L_{\_G
    72953}
sim A L_{\_G72953} H_{c}
cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that M_{b}C/M_{b}A=-1
towards C M_{b} A -1
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% DET: points M_{b} and A are not the same
% Constructing a line b which passes through point M_{b} and point A
line b M_{b} A

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(E_{a},A) intersect% DET: points A and H_{b} must be different
% Constructing a point P_{\_G73370} which is a foot of the point E_{a} on the line b
foot P_{\_G73370} E_{a} b
cmark_r P_{\_G73370}
color 200 200 200
drawline E_{a} P_{\_G73370}
```

```
color 0 0 0

% Constructing a point H_{b} which is an image of the point A in the symmetry to point/line P_{\_G
    73370}
sim H_{b} P_{\_G73370} A
cmark_l H_{b}


% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines c and h_{b} are not parallel% DET: lines c and h_{b} are not the same
% Constructing a point B which belongs to line c and line h_{b}
intersec B c h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{b} are not parallel; line b and circle k(E_{a},A)
    intersect; circles k(E_{a},A) and k(M_{b},C) intersect; points H_{c} and M_{b} are not the same
    ; points H_{c} and E_{a} are not the same
% Determination conditions: lines c and h_{b} are not the same; points H and H_{b} are not the same
    ; points A and H_{b} must be different; points M_{b} and A are not the same; points H_{c} and A
     are not the same; circles k(E_{a},A) and k(M_{b},C) are not the same; points H_{c} and A must
    be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

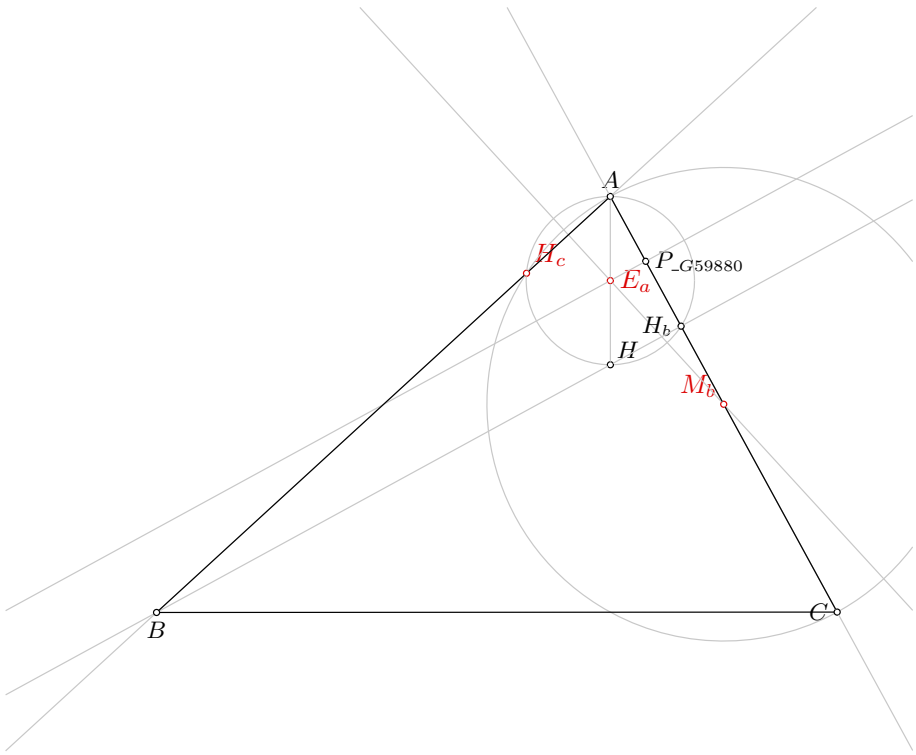

Figure 1: Illustration of the problem 0824

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.178 seconds.

NDG conditions Points M_b, H_c and E_a are not collinear

Points M_b, H_c and E_a are not collinear

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving M_b=_M_b

NDG conditions are:

$S_{H_cHH_b} \neq S_{AHH_b}$ i.e., lines H_cA and HH_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)

$S_{ACF^2_{\_h_c}} \neq S_{BCF^2_{\_h_c}}$ i.e., lines AB and $CF^2_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving M_b=_M_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 825

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 825: Given a point E_a, a point H_c and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
2. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
3. Using the circle $k(E_a, A)$, the line c, the point E_a and the point H_c, construct a point A (rule W05); % NDG: line c and circle $k(E_a, A)$ intersect % DET: points H_c and A must be different;
4. Using the point A and the point E_a, construct a point H (rule W01); ;
5. Using the point M_c and the point A, construct a point B (rule W01); ;
6. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
7. Using the point H and the point B, construct a line h_b (rule W02); % DET: points H and B are not the same;
8. Using the circle $k(E_a, A)$, the line h_b, the point E_a and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_a, A)$ intersect % DET: points H and H_b must be different;
9. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
10. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; line h_b and circle $k(E_a, A)$ intersect; line c and circle $k(E_a, A)$ intersect; points H_c and E_a are not the same.

Determination conditions: lines h_c and b are not the same; points A and H_b are not the same; points H and H_b must be different; points H and B are not the same; points H_c and H are not the same; points H_c and A must be different; points H_c and M_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D20,D28,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L46,L47,L48]

Solving time: 9.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point H_{c} 68.91 84.83
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_rt H_{c}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: line c and circle k(E_{a},A) intersect% DET: points H_{c} and A must be different
% Constructing a point P_{\_G98048} which is a foot of the point E_{a} on the line c
foot P_{\_G98048} E_{a} c
cmark_r P_{\_G98048}
color 200 200 200
drawline E_{a} P_{\_G98048}
color 0 0 0
```

```
% Constructing a point A which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    98048}
sim A P_{\_G98048} H_{c}
cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that M_{c}B/M_{c}A=-1
towards B M_{c} A -1
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% DET: points H and B are not the same
% Constructing a line h_{b} which passes through point H and point B
line h_{b} H B

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{b} and circle k(E_{a},A) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G98485} which is a foot of the point E_{a} on the line h_{b}
foot P_{\_G98485} E_{a} h_{b}
cmark_r P_{\_G98485}
color 200 200 200
drawline E_{a} P_{\_G98485}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    98485}
sim H_{b} P_{\_G98485} H
```

```
cmark_l H_{b}


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; line h_{b} and circle k(E_{a},A)
    intersect; line c and circle k(E_{a},A) intersect; points H_{c} and E_{a} are not the same
% Determination conditions: lines h_{c} and b are not the same; points A and H_{b} are not the same
    ; points H and H_{b} must be different; points H and B are not the same; points H_{c} and H are
     not the same; points H_{c} and A must be different; points H_{c} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.176 seconds.

NDG conditions Points H_c, M_c and E_a are not collinear

Points H_c, M_c and E_a are not collinear

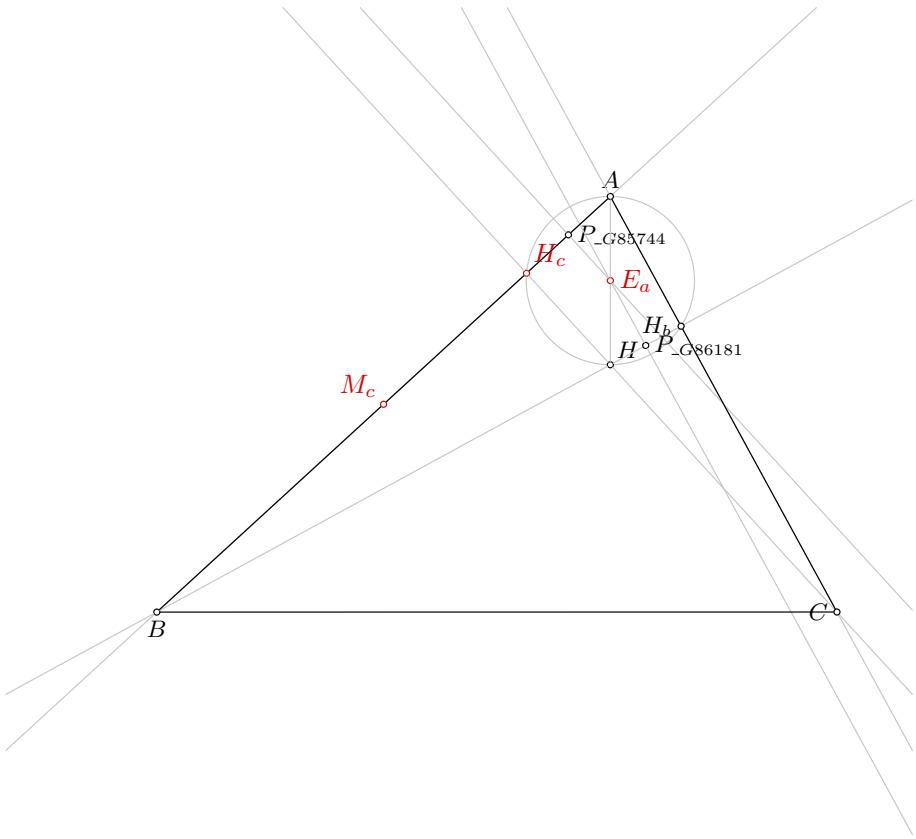

Figure 1: Illustration of the problem 0825

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving M_c=_M_c

NDG conditions are:

$S_{H_cAH_b} \neq S_{HAH_b}$ i.e., lines H_cH and AH_b are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^2_{\_h_c}} \neq S_{BCF^2_{\_h_c}}$ i.e., lines AB and $CF^2_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 826

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 826: Given a point H_c, a point N and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;
2. Choose freely a point E_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and N are not the same;
4. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point E_a, construct a point M_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_a and M_a must be different;
5. Using the point H_c and the point E_a, construct a circle $k(E_a, A)$ (rule W06); % NDG: points H_c and E_a are not the same;
6. Using the circle $k(N, M_a)$, the circle $k(E_a, A)$, the point H_c, the point N and the point E_a, construct a point H_b (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_a, A)$ intersect % DET: circles $k(N, M_a)$ and $k(E_a, A)$ are not the same; points H_c and H_b must be different;
7. Choose freely a point A on the circle $k(E_a, A)$ (rule WOncircle);
8. Using the point A and the point E_a, construct a point H (rule W01); ;
9. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;
10. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;

11. Using the line c and the line h_b, construct a point B (rule W03); % NDG: lines c and h_b are not parallel % DET: lines c and h_b are not the same;

12. Using the point M_a and the point B, construct a point C (rule W01); .

Non-degenerate conditions: lines c and h_b are not parallel; circles $k(N, M_a)$ and $k(E_a, A)$ intersect; points H_c and E_a are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: lines c and h_b are not the same; points H_b and H are not the same; points A and H_c are not the same; circles $k(N, M_a)$ and $k(E_a, A)$ are not the same; points H_c and H_b must be different; points E_a and M_a must be different; points E_a and N are not the same.

Rules used: [W01,W02,W03,W05a,W06,W08,WOncircle1]

Lemmas used: [D21,D28,D3,D32,D6,D7,D9,GD01,GD02,GL01,GL03,GL04,L20,L21,L22,L38,L39,L47,L48]

Solving time: 60.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{c} 68.91 84.83
point N 72.5 61.93
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_rt H_{c}
cmark_r N
cmark_r E_{a}
color 0 0 0
fontsize 8

% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{a} on the circle with center N through point H_{c}
oncircle E_{a} N H_{c}
cmark_r E_{a}
color 200 200 200
drawcircle N H_{c}
color 0 0 0


% DET: points E_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point N
```

```
line m(H_{b}H_{c}) E_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{a} and M_{a} must be
    different
% Constructing a point M_{a} which is an image of the point E_{a} in the symmetry to point/line N
sim M_{a} N E_{a}
cmark_r M_{a}


% NDG: points H_{c} and E_{a} are not the same
% Constructing a circle k(E_{a},A) whose center is at point E_{a} and which passes through point H
    _{c}
circle k(E_{a},A) E_{a} H_{c}

color 200 200 200
drawcircle k(E_{a},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(E_{a},A) intersect% DET: circles k(N,M_{a}) and k(E_{a},A) are not
    the same; points H_{c} and H_{b} must be different
% Constructing a line L_{\_G136441} which passes through point N and point E_{a}
line L_{\_G136441} N E_{a}

color 200 200 200
drawline L_{\_G136441}
color 0 0 0


% Constructing a point H_{b} which is an image of the point H_{c} in the symmetry to point/line L
    _{\_G136441}
sim H_{b} L_{\_G136441} H_{c}
cmark_l H_{b}



% Choosing randomly a point A on the circle with center E_{a} through point H_{c}
oncircle A E_{a} H_{c}
cmark_t A
color 200 200 200
drawcircle E_{a} H_{c}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
```

```
drawsegment A H
color 0 0 0


% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines c and h_{b} are not parallel% DET: lines c and h_{b} are not the same
% Constructing a point B which belongs to line c and line h_{b}
intersec B c h_{b}
cmark_b B



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{b} are not parallel; circles k(N,M_{a}) and k(E_{a},A)
    intersect; points H_{c} and E_{a} are not the same; line m(H_{b}H_{c}) and circle k(N,M_{a})
    intersect; points H_{c} and N are not the same
% Determination conditions: lines c and h_{b} are not the same; points H_{b} and H are not the same
    ; points A and H_{c} are not the same; circles k(N,M_{a}) and k(E_{a},A) are not the same;
    points H_{c} and H_{b} must be different; points E_{a} and M_{a} must be different; points E_{a
    } and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

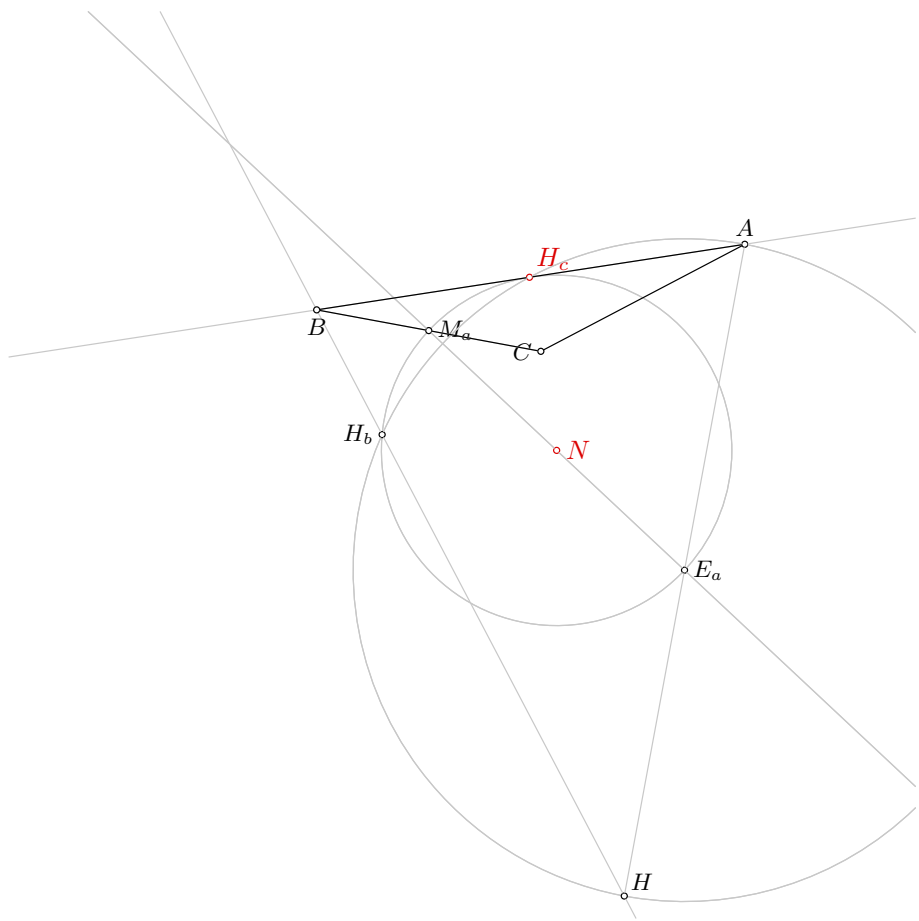

Figure 1: Illustration of the problem 0826

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_c=_H_c

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_c=_H_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_a=_E_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_c=_H_c

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_c=_H_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving $E_a = \_E_a$

Proving failed

Problem 827

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 827: Given a point E_a, a point H_c and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 828

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 828: Given a point E_a, a point H_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 829

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 829: Given a point E_a, a point H_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 830

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 830: Given a point E_a, a point H_c and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 831

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 831: Given a point E_a, a point I and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;

2. Using the point I and the point M_a, construct a line IM_a (rule W02); % DET: points I and M_a are not the same;

3. Using the point I and the point M_a, construct a circle $k_over(I, M_a)$ (rule W09); % NDG: points I and M_a are not the same;

4. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;

5. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;

6. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;

7. Using the point I, the circle $k(N, M_a)$, the point N and the point E_a, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

8. Using the circle $k(I, P_a)$ and the circle $k_over(I, M_a)$, construct a point P_a and a point A_{fi} (rule W07); % NDG: circles $k(I, P_a)$ and $k_over(I, M_a)$ intersect % DET: circles $k(I, P_a)$ and $k_over(I, M_a)$ are not the same;

9. Using the point P_a and the point M_a, construct a point $P‘_a$ (rule W01); ;

10. Using the circle $k(I, P_a)$, the point M_a and the point I, construct a line $x1$ and a line a (rule W12); % NDG: point M_a is outside the circle $k(I, P_a)$;

11. Using the circle $k(N, M_a)$, the line a, the point N and the point M_a, construct a point H_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points M_a and H_a must be different;

12. Using the point H_a and the point E_a, construct a line h_a (rule W02); % DET: points H_a and E_a are not the same;

13. Using the point M_a and the line a, construct a line m_a (rule W10b); ;

14. Using the point $P`_a$ and the line $IM_a$, construct a line $AP`_a$ (rule W16); ;

15. Using the line $AP`_a$ and the line $h_a$, construct a point $A$ (rule W03); % NDG: lines $AP`_a$ and h_a are not parallel % DET: lines $AP`_a$ and h_a are not the same;

16. Using the point I and the point A, construct a line s_a (rule W02); % DET: points I and A are not the same;

17. Using the line m_a and the line s_a, construct a point N_a (rule W03); % NDG: lines m_a and s_a are not parallel % DET: lines m_a and s_a are not the same;

18. Using the point I and the point N_a, construct a circle $k(N_a, C)$ (rule W06); % NDG: points I and N_a are not the same;

19. Using the circle $k(N_a, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(N_a, C)$ intersect.

Non-degenerate conditions: line a and circle $k(N_a, C)$ intersect; points I and N_a are not the same; lines m_a and s_a are not parallel; lines $AP`_a$ and h_a are not parallel; line a and circle $k(N, M_a)$ intersect; point M_a is outside the circle $k(I, P_a)$; circles $k(I, P_a)$ and $k_over(I, M_a)$ intersect; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points E_a and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel; points I and M_a are not the same.

Determination conditions: lines m_a and s_a are not the same; points I and A are not the same; lines $AP`_a$ and h_a are not the same; points H_a and E_a are not the same; points M_a and H_a must be different; circles $k(I, P_a)$ and $k_over(I, M_a)$ are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points I and M_a are not the same; points E_a and M_a are not the same.

Rules used: [W01,W02,W03,W04,W05,W06,W07,W09,W10b,W12,W14,W16,W22]

Lemmas used: [D11,D2,D21,D27,D28,D3,D32,D47,D5,D65,D8,D85,GD01,GD02,GL01,GL03,GL09,L119,L19,L

Solving time: 51.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point I 74.37 61.15
point M_{a} 65 40
```

```
color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_b I
cmark_r M_{a}
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% DET: points I and M_{a} are not the same
% Constructing a line IM_{a} which passes through point I and point M_{a}
line IM_{a} I M_{a}

color 200 200 200
drawline IM_{a}
color 0 0 0



% NDG: points I and M_{a} are not the same
% Constructing midpoint P_{\_G201308} of the segment IM_{a}
midpoint P_{\_G201308} I M_{a}
cmark_r P_{\_G201308}

% Constructing a circle k_over(I,M_{a}) whose center is at point P_{\_G201308} and which passes
    through point I
circle k_over(I,M_{a}) P_{\_G201308} I

color 200 200 200
drawcircle k_over(I,M_{a})
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0
```

```
% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G201863] from point N to point E_{a}
distance V[_G201863] N E_{a}


% Calculating distance V[_G201887] from point N to point I
distance V[_G201887] N I


% Calculating value V[_G201908] using formula V[_G201863]/V[_G201887]
expression V[_G201908] { V[_G201863]/V[_G201887] }


% Constructing a point P_{\_G201939} such that NP_{\_G201939}/NI=V[_G201863]/V[_G201887]
towards P_{\_G201939} N I V[_G201908]
cmark_r P_{\_G201939}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    201939}
circle k(I,P_{a}) I P_{\_G201939}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: circles k(I,P_{a}) and k_over(I,M_{a}) intersect% DET: circles k(I,P_{a}) and k_over(I,M_{a
    }) are not the same
% Constructing points P_{a} and A_{fi} which are in intersection of k(I,P_{a}) and k_over(I,M_{a})
intersec2 P_{a} A_{fi} k(I,P_{a}) k_over(I,M_{a})
cmark_r P_{a}
cmark_r A_{fi}



% Constructing a point P'_{a} such that P_{a}P'_{a}/P_{a}M_{a}=2
```

```
towards P‘_{a} P_{a} M_{a} 2
cmark_r P‘_{a}
color 200 200 200
drawsegment P_{a} P‘_{a}
color 0 0 0


% NDG: point M_{a} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G202545} of the segment M_{a}I
midpoint P_{\_G202545} M_{a} I
cmark_r P_{\_G202545}

% Constructing a circle C_{\_G202548} whose center is at point P_{\_G202545} and which passes
    through point M_{a}
circle C_{\_G202548} P_{\_G202545} M_{a}

color 200 200 200
drawcircle C_{\_G202548}
color 0 0 0


% Constructing points P_{\_G202551} and P_{\_G202554} which are in intersection of C_{\_G202548}
    and k(I,P_{a})
intersec2 P_{\_G202551} P_{\_G202554} C_{\_G202548} k(I,P_{a})
cmark_r P_{\_G202551}
cmark_r P_{\_G202554}

% Constructing a line x1 which passes through point M_{a} and point P_{\_G202551}
line x1 M_{a} P_{\_G202551}

color 200 200 200
drawline x1
color 0 0 0


% Constructing a line a which passes through point M_{a} and point P_{\_G202554}
line a M_{a} P_{\_G202554}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(N,M_{a}) intersect% DET: points M_{a} and H_{a} must be different
% Constructing a point P_{\_G202888} which is a foot of the point N on the line a
foot P_{\_G202888} N a
cmark_r P_{\_G202888}
color 200 200 200
drawline N P_{\_G202888}
color 0 0 0

% Constructing a point H_{a} which is an image of the point M_{a} in the symmetry to point/line P
    _{\_G202888}
sim H_{a} P_{\_G202888} M_{a}
cmark_r H_{a}
```

```
% DET: points H_{a} and E_{a} are not the same
% Constructing a line h_{a} which passes through point H_{a} and point E_{a}
line h_{a} H_{a} E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% Constructing a line m_{a} which is perpendicular to line a and which passes through point M_{a}
perp m_{a} M_{a} a

color 200 200 200
drawline m_{a}
color 0 0 0



% Constructing a line AP‘_{a} which contains the point P‘_{a} and is parallel to the line IM_{a}
parallel AP‘_{a} P‘_{a} IM_{a}

color 200 200 200
drawline AP‘_{a}
color 0 0 0



% NDG: lines AP‘_{a} and h_{a} are not parallel% DET: lines AP‘_{a} and h_{a} are not the same
% Constructing a point A which belongs to line AP‘_{a} and line h_{a}
intersec A AP‘_{a} h_{a}
cmark_t A


% DET: points I and A are not the same
% Constructing a line s_{a} which passes through point I and point A
line s_{a} I A

color 200 200 200
drawline s_{a}
color 0 0 0



% NDG: lines m_{a} and s_{a} are not parallel% DET: lines m_{a} and s_{a} are not the same
% Constructing a point N_{a} which belongs to line m_{a} and line s_{a}
intersec N_{a} m_{a} s_{a}
cmark_b N_{a}


% NDG: points I and N_{a} are not the same
% Constructing a circle k(N_{a},C) whose center is at point N_{a} and which passes through point I
```

Figure 1: Illustration of the problem 0831

```
circle k(N_{a},C) N_{a} I

color 200 200 200
drawcircle k(N_{a},C)
color 0 0 0



% NDG: line a and circle k(N_{a},C) intersect
% Constructing points C and B which are in intersection of k(N_{a},C) and a
intersec2 C B k(N_{a},C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(N_{a},C) intersect; points I and N_{a} are not the
     same; lines m_{a} and s_{a} are not parallel; lines AP'_{a} and h_{a} are not parallel; line a
     and circle k(N,M_{a}) intersect; point M_{a} is outside the circle k(I,P_{a}); circles k(I,P_{
    a}) and k_over(I,M_{a}) intersect; point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points E_{a} and N are not the same; lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are
    not parallel; points I and M_{a} are not the same
% Determination conditions: lines m_{a} and s_{a} are not the same; points I and A are not the same
    ; lines AP'_{a} and h_{a} are not the same; points H_{a} and E_{a} are not the same; points M_{
    a} and H_{a} must be different; circles k(I,P_{a}) and k_over(I,M_{a}) are not the same; lines
    m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the same; points E_{a} and M_{a} are not the same;
    points I and M_{a} are not the same; points E_{a} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving I=_I

Proving failed

4.1.3 Proving M_a=_M_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving I=_I

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving I=_I

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving I=_I

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 832

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 832: Given a point E_a, a point I and a point M_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 833

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 833: Given a point E_a, a point I and a point M_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 834

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 834: Given a point E_a, a point I and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and N are not the same;

2. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;

3. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point E_a, construct a point M_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_a and M_a must be different;

4. Using the point M_a and the point I, construct a line IM_a (rule W02); % DET: points M_a and I are not the same;

5. Using the point I and the point M_a, construct a circle $k_over(I, M_a)$ (rule W09); % NDG: points I and M_a are not the same;

6. Using the point I, the circle $k(N, M_a)$, the point N and the point E_a, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

7. Using the circle $k(I, P_a)$ and the circle $k_over(I, M_a)$, construct a point P_a and a point A_{fi} (rule W07); % NDG: circles $k(I, P_a)$ and $k_over(I, M_a)$ intersect % DET: circles $k(I, P_a)$ and $k_over(I, M_a)$ are not the same;

8. Using the point P_a and the point M_a, construct a point $P‘_a$ (rule W01); ;

9. Using the circle $k(I, P_a)$, the point M_a and the point I, construct a line $x1$ and a line a (rule W12); % NDG: point M_a is outside the circle $k(I, P_a)$;

10. Using the circle $k(N, M_a)$, the line a, the point N and the point M_a, construct a point H_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points M_a and H_a must be different;

11. Using the point H_a and the point E_a, construct a line h_a (rule W02); % DET: points H_a and E_a are not the same;

12. Using the point M_a and the line a, construct a line m_a (rule W10b); ;

13. Using the point $P`_a$ and the line $IM_a$, construct a line $AP`_a$ (rule W16); ;

14. Using the line $AP`_a$ and the line $h_a$, construct a point $A$ (rule W03); % NDG: lines $AP`_a$ and h_a are not parallel % DET: lines $AP`_a$ and h_a are not the same;

15. Using the point I and the point A, construct a line s_a (rule W02); % DET: points I and A are not the same;

16. Using the line m_a and the line s_a, construct a point N_a (rule W03); % NDG: lines m_a and s_a are not parallel % DET: lines m_a and s_a are not the same;

17. Using the point I and the point N_a, construct a circle $k(N_a, C)$ (rule W06); % NDG: points I and N_a are not the same;

18. Using the circle $k(N_a, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(N_a, C)$ intersect.

Non-degenerate conditions: line a and circle $k(N_a, C)$ intersect; points I and N_a are not the same; lines m_a and s_a are not parallel; lines $AP`_a$ and h_a are not parallel; line a and circle $k(N, M_a)$ intersect; point M_a is outside the circle $k(I, P_a)$; circles $k(I, P_a)$ and $k_over(I, M_a)$ intersect; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points I and M_a are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: lines m_a and s_a are not the same; points I and A are not the same; lines $AP`_a$ and h_a are not the same; points H_a and E_a are not the same; points M_a and H_a must be different; circles $k(I, P_a)$ and $k_over(I, M_a)$ are not the same; points M_a and I are not the same; points E_a and M_a must be different; points E_a and N are not the same.

Rules used: [W01,W02,W03,W04,W05,W05a,W06,W07,W09,W10b,W12,W16,W22]

Lemmas used: [D11,D2,D21,D27,D28,D3,D32,D47,D5,D65,D8,D85,GD01,GD02,GL01,GL03,GL09,L119,L19,L

Solving time: 52.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point I 74.37 61.15
point N 72.5 61.93

color 220 0 0
fontsize 9
```

```
cmark_r E_{a}
cmark_b I
cmark_r N
color 0 0 0
fontsize 8

% DET: points E_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point N
line m(H_{b}H_{c}) E_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{a} and M_{a} must be
    different
% Constructing a point M_{a} which is an image of the point E_{a} in the symmetry to point/line N
sim M_{a} N E_{a}
cmark_r M_{a}


% DET: points M_{a} and I are not the same
% Constructing a line IM_{a} which passes through point M_{a} and point I
line IM_{a} M_{a} I

color 200 200 200
drawline IM_{a}
color 0 0 0



% NDG: points I and M_{a} are not the same
% Constructing midpoint P_{\_G36633} of the segment IM_{a}
midpoint P_{\_G36633} I M_{a}
cmark_r P_{\_G36633}

% Constructing a circle k_over(I,M_{a}) whose center is at point P_{\_G36633} and which passes
    through point I
circle k_over(I,M_{a}) P_{\_G36633} I

color 200 200 200
drawcircle k_over(I,M_{a})
color 0 0 0
```

```
% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G36819] from point N to point E_{a}
distance V[_G36819] N E_{a}


% Calculating distance V[_G36843] from point N to point I
distance V[_G36843] N I


% Calculating value V[_G36864] using formula V[_G36819]/V[_G36843]
expression V[_G36864] { V[_G36819]/V[_G36843] }


% Constructing a point P_{\_G36895} such that NP_{\_G36895}/NI=V[_G36819]/V[_G36843]
towards P_{\_G36895} N I V[_G36864]
cmark_r P_{\_G36895}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    36895}
circle k(I,P_{a}) I P_{\_G36895}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: circles k(I,P_{a}) and k_over(I,M_{a}) intersect% DET: circles k(I,P_{a}) and k_over(I,M_{a
    }) are not the same
% Constructing points P_{a} and A_{fi} which are in intersection of k(I,P_{a}) and k_over(I,M_{a})
intersec2 P_{a} A_{fi} k(I,P_{a}) k_over(I,M_{a})
cmark_r P_{a}
cmark_r A_{fi}



% Constructing a point P‘_{a} such that P_{a}P‘_{a}/P_{a}M_{a}=2
towards P‘_{a} P_{a} M_{a} 2
cmark_r P‘_{a}
color 200 200 200
drawsegment P_{a} P‘_{a}
color 0 0 0


% NDG: point M_{a} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G37500} of the segment M_{a}I
midpoint P_{\_G37500} M_{a} I
cmark_r P_{\_G37500}

% Constructing a circle C_{\_G37503} whose center is at point P_{\_G37500} and which passes through
     point M_{a}
circle C_{\_G37503} P_{\_G37500} M_{a}

color 200 200 200
```

```
drawcircle C_{\_G37503}
color 0 0 0


% Constructing points P_{\_G37506} and P_{\_G37509} which are in intersection of C_{\_G37503} and k
    (I,P_{a})
intersec2 P_{\_G37506} P_{\_G37509} C_{\_G37503} k(I,P_{a})
cmark_r P_{\_G37506}
cmark_r P_{\_G37509}

% Constructing a line x1 which passes through point M_{a} and point P_{\_G37506}
line x1 M_{a} P_{\_G37506}

color 200 200 200
drawline x1
color 0 0 0


% Constructing a line a which passes through point M_{a} and point P_{\_G37509}
line a M_{a} P_{\_G37509}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(N,M_{a}) intersect% DET: points M_{a} and H_{a} must be different
% Constructing a point P_{\_G37843} which is a foot of the point N on the line a
foot P_{\_G37843} N a
cmark_r P_{\_G37843}
color 200 200 200
drawline N P_{\_G37843}
color 0 0 0

% Constructing a point H_{a} which is an image of the point M_{a} in the symmetry to point/line P
    _{\_G37843}
sim H_{a} P_{\_G37843} M_{a}
cmark_r H_{a}


% DET: points H_{a} and E_{a} are not the same
% Constructing a line h_{a} which passes through point H_{a} and point E_{a}
line h_{a} H_{a} E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Constructing a line m_{a} which is perpendicular to line a and which passes through point M_{a}
perp m_{a} M_{a} a

color 200 200 200
```

```
drawline m_{a}
color 0 0 0



% Constructing a line AP‘_{a} which contains the point P‘_{a} and is parallel to the line IM_{a}
parallel AP‘_{a} P‘_{a} IM_{a}

color 200 200 200
drawline AP‘_{a}
color 0 0 0



% NDG: lines AP‘_{a} and h_{a} are not parallel% DET: lines AP‘_{a} and h_{a} are not the same
% Constructing a point A which belongs to line AP‘_{a} and line h_{a}
intersec A AP‘_{a} h_{a}
cmark_t A


% DET: points I and A are not the same
% Constructing a line s_{a} which passes through point I and point A
line s_{a} I A

color 200 200 200
drawline s_{a}
color 0 0 0



% NDG: lines m_{a} and s_{a} are not parallel% DET: lines m_{a} and s_{a} are not the same
% Constructing a point N_{a} which belongs to line m_{a} and line s_{a}
intersec N_{a} m_{a} s_{a}
cmark_b N_{a}


% NDG: points I and N_{a} are not the same
% Constructing a circle k(N_{a},C) whose center is at point N_{a} and which passes through point I
circle k(N_{a},C) N_{a} I

color 200 200 200
drawcircle k(N_{a},C)
color 0 0 0



% NDG: line a and circle k(N_{a},C) intersect
% Constructing points C and B which are in intersection of k(N_{a},C) and a
intersec2 C B k(N_{a},C) a
cmark_l C
cmark_b B



drawsegment A B
```

Figure 1: Illustration of the problem 0834

```
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(N_{a},C) intersect; points I and N_{a} are not the
     same; lines m_{a} and s_{a} are not parallel; lines AP'_{a} and h_{a} are not parallel; line a
     and circle k(N,M_{a}) intersect; point M_{a} is outside the circle k(I,P_{a}); circles k(I,P_{
    a}) and k_over(I,M_{a}) intersect; point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points I and M_{a} are not the same; line m(H_{b}H_{c}) and circle k(N,M_{a})
    intersect; points E_{a} and N are not the same
% Determination conditions: lines m_{a} and s_{a} are not the same; points I and A are not the same
    ; lines AP'_{a} and h_{a} are not the same; points H_{a} and E_{a} are not the same; points M_{
    a} and H_{a} must be different; circles k(I,P_{a}) and k_over(I,M_{a}) are not the same; points
     M_{a} and I are not the same; points E_{a} and M_{a} must be different; points E_{a} and N are
     not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving I=_I

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving I=_I

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving I=_I

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving I=_I

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 835

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 835: Given a point E_a, a point I and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 836

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 836: Given a point E_a, a point I and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 837

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 837: Given a point E_a, a point I and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 838

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 838: Given a point E_a, a point I and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 839

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 839: Given a point E_a, a point M_a and a point M_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
2. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;
3. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;
4. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
5. Choose freely a point M_b on the circle $k(N, M_a)$ (rule WOncircle);
6. Choose freely a point A (rule free);
7. Using the point A and the point M_b, construct a point C (rule W01); ;
8. Using the point A and the point M_a, construct a point G (rule W01); ;
9. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: points E_a and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel.

Determination conditions: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points E_a and M_a are not the same.

Rules used: [W01,W02,W03,W06,W14,WOncircle1,free]

Lemmas used: [D22,D32,GD02,GL01,GL03,GL04,L20,L21,L22,L38,L39,L47,L48,L55,L56]

Solving time: 199.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point M_{a} 65 40
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r M_{a}
cmark_lt M_{b}
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0


% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% Choosing randomly a point M_{b} on the circle with center N through point E_{a}
oncircle M_{b} N E_{a}
cmark_lt M_{b}
color 200 200 200
drawcircle N E_{a}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a line L_{\_G79842} which passes through point A and point M_{a}
line L_{\_G79842} A M_{a}

color 200 200 200
drawline L_{\_G79842}
color 0 0 0


% Constructing a point P_{\_G79943} with coordinates (0,0)
point P_{\_G79943} 0 0
cmark_r P_{\_G79943}

% Constructing a point P_{\_G79867} such that AP_{\_G79867}/AP_{\_G79943}=2
towards P_{\_G79867} A P_{\_G79943} 2
cmark_r P_{\_G79867}
color 200 200 200
drawsegment A P_{\_G79867}
color 0 0 0

% Constructing a point P_{\_G79912} such that AP_{\_G79912}/AP_{\_G79943}=3
towards P_{\_G79912} A P_{\_G79943} 3
cmark_r P_{\_G79912}
color 200 200 200
drawsegment A P_{\_G79912}
color 0 0 0

% Constructing a line L_{\_G79873} which passes through point M_{a} and point P_{\_G79912}
line L_{\_G79873} M_{a} P_{\_G79912}
```

```
color 200 200 200
drawline L_{\_G79873}
color 0 0 0


% Constructing a line L_{\_G79836} which contains the point P_{\_G79867} and is parallel to the
    line L_{\_G79873}
parallel L_{\_G79836} P_{\_G79867} L_{\_G79873}

color 200 200 200
drawline L_{\_G79836}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G79836} and line L_{\_G79842}
intersec G L_{\_G79836} L_{\_G79842}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points E_{a} and N are not the same; lines m(E_{a}M_{a}) and m(H_{b}H
    _{c}) are not parallel
% Determination conditions: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the same; points E_{a}
    and M_{a} are not the same; points E_{a} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 97 terms.

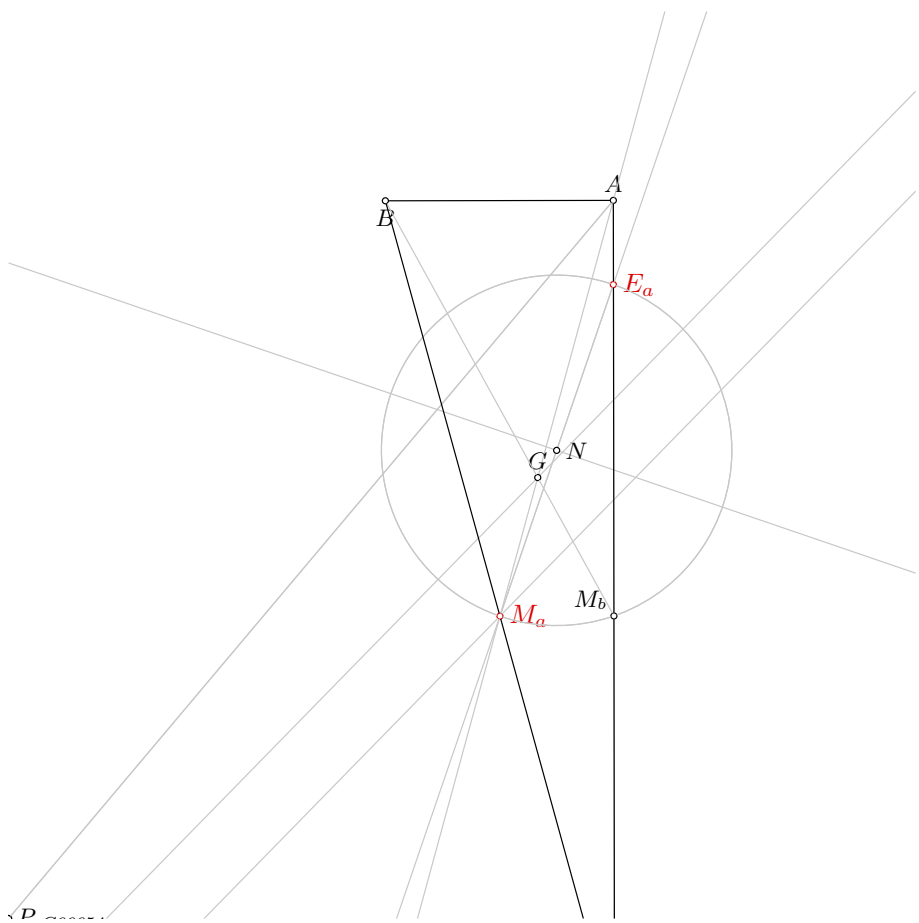

Figure 1: Illustration of the problem 0839

Time Complexity: Time spent by the prover is 1.075 seconds.

NDG conditions Points A, M_a and P_G76115 are not collinear

Points E_a and P_G76115 are not identical

4.1.3 Proving M_b=$\_M_b$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=$\_E_a$

Proving failed

4.2.2 Proving M_a=$\_M_a$

Proving failed

4.2.3 Proving M_b=$\_M_b$

NDG conditions are:

$S_{M^0_{m(E_aM_a)}E_aM_a} \neq S_{T^1_{m(E_aM_a)}E_aM_a}$ i.e., lines $M^0_{m(E_aM_a)}T^1_{m(E_aM_a)}$ and E_aM_a are not parallel (construction based assumption)

$S_{P\_G72738AM_a} \neq S_{P^2_{L\_G72707}AM_a}$ i.e., lines $P\_G72738P^2_{L\_G72707}$ and AM_a are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 42

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=$\_E_a$

Proving failed

4.3.2 Proving M_a=$\_M_a$

Proving failed

4.3.3 Proving M_b=$\_M_b$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 28 terms.

Time Complexity: Time spent by the prover is 0.070 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=$\_E_a$

Proving failed

4.4.2 Proving M_a=$\_M_a$

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 840

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 840: Given a point E_a, a point M_a and a point M_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
2. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;
3. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;
4. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
5. Choose freely a point M_c on the circle $k(N, M_a)$ (rule WOncircle);
6. Choose freely a point A (rule free);
7. Using the point A and the point M_c, construct a point B (rule W01); ;
8. Using the point A and the point M_a, construct a point G (rule W01); ;
9. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: points E_a and N are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel.

Determination conditions: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points E_a and M_a are not the same.

Rules used: [W01,W02,W03,W06,W14,WOncircle1,free]

Lemmas used: [D20,D32,GD02,GL01,GL03,GL04,L20,L21,L22,L38,L39,L47,L48,L55,L57]

Solving time: 198.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point M_{a} 65 40
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r M_{a}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0


% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N


% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% Choosing randomly a point M_{c} on the circle with center N through point E_{a}
oncircle M_{c} N E_{a}
cmark_lt M_{c}
color 200 200 200
drawcircle N E_{a}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a line L_{\_G104210} which passes through point A and point M_{a}
line L_{\_G104210} A M_{a}

color 200 200 200
drawline L_{\_G104210}
color 0 0 0


% Constructing a point P_{\_G104311} with coordinates (0,0)
point P_{\_G104311} 0 0
cmark_r P_{\_G104311}

% Constructing a point P_{\_G104235} such that AP_{\_G104235}/AP_{\_G104311}=2
towards P_{\_G104235} A P_{\_G104311} 2
cmark_r P_{\_G104235}
color 200 200 200
drawsegment A P_{\_G104235}
color 0 0 0

% Constructing a point P_{\_G104280} such that AP_{\_G104280}/AP_{\_G104311}=3
towards P_{\_G104280} A P_{\_G104311} 3
cmark_r P_{\_G104280}
color 200 200 200
drawsegment A P_{\_G104280}
color 0 0 0

% Constructing a line L_{\_G104241} which passes through point M_{a} and point P_{\_G104280}
line L_{\_G104241} M_{a} P_{\_G104280}
```

```
color 200 200 200
drawline L_{\_G104241}
color 0 0 0


% Constructing a line L_{\_G104204} which contains the point P_{\_G104235} and is parallel to the
    line L_{\_G104241}
parallel L_{\_G104204} P_{\_G104235} L_{\_G104241}

color 200 200 200
drawline L_{\_G104204}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G104204} and line L_{\_G104210}
intersec G L_{\_G104204} L_{\_G104210}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points E_{a} and N are not the same; lines m(E_{a}M_{a}) and m(H_{b}H
    _{c}) are not parallel
% Determination conditions: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the same; points E_{a}
    and M_{a} are not the same; points E_{a} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 97 terms.

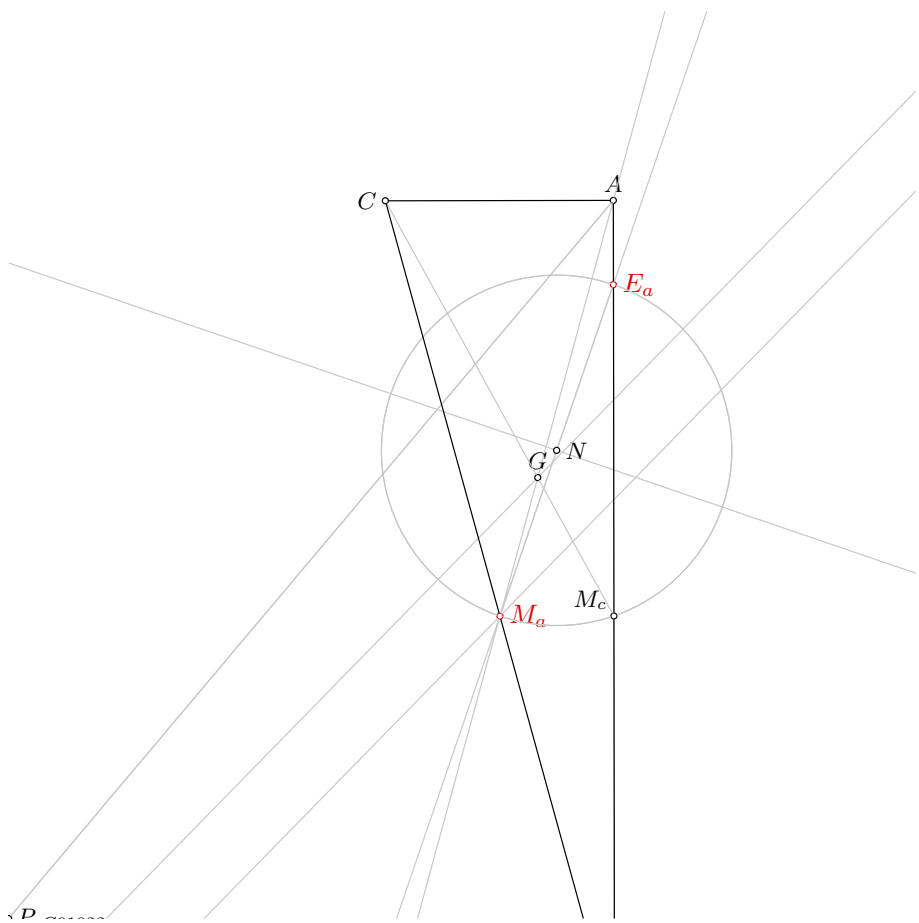

Figure 1: Illustration of the problem 0840

Time Complexity: Time spent by the prover is 1.021 seconds.

NDG conditions Points $P\_G100483$, A and M_a are not collinear

Points $P\_G100483$, N and E_a are not collinear

4.1.3 Proving M_c=$\_M_c$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=$\_E_a$

Proving failed

4.2.2 Proving M_a=$\_M_a$

Proving failed

4.2.3 Proving M_c=$\_M_c$

NDG conditions are:

$S_{M^0_{m(E_aM_a)}E_aM_a} \neq S_{T^1_{m(E_aM_a)}E_aM_a}$ i.e., lines $M^0_{m(E_aM_a)}T^1_{m(E_aM_a)}$ and E_aM_a are not parallel (construction based assumption)

$S_{P\_G97106AM_a} \neq S_{P^2_{L\_G97075}AM_a}$ i.e., lines $P\_G97106P^2_{L\_G97075}$ and AM_a are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=$\_E_a$

Proving failed

4.3.2 Proving M_a=$\_M_a$

Proving failed

4.3.3 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 28 terms.

Time Complexity: Time spent by the prover is 0.070 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=$\_E_a$

Proving failed

4.4.2 Proving M_a=$\_M_a$

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 841

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 841: Given a point M_a, a point N and a point E_a, construct the triangle ABC.

2 Status

Problem is redundant.

3 Solution

3.1 Construction in natural language form

1. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;
2. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
3. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;
4. Choose freely a point A (rule free);
5. Using the point A and the point M_a, construct a point G (rule W01); ;
6. Using the point N and the point G, construct a point O (rule W01); ;
7. Using the point A and the point E_a, construct a line h_a (rule W02); % DET: points A and E_a are not the same;
8. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
9. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
10. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;

11. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points M_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and E_a are not the same; points M_a and E_a must be different; points M_a and N are not the same.

Rules used: [W01,W02,W04,W05,W05a,W06,free]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GD02,GL01,GL03,GL09,L11,L12,L15,L19,L20,L21,L22,L38

Solving time: 6.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{a} 65 40
point N 72.5 61.93
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_r M_{a}
cmark_r N
cmark_r E_{a}
color 0 0 0
fontsize 8

% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
```

```
sim E_{a} N M_{a}
cmark_r E_{a}



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a line L_{\_G140096} which passes through point A and point M_{a}
line L_{\_G140096} A M_{a}

color 200 200 200
drawline L_{\_G140096}
color 0 0 0


% Constructing a point P_{\_G140197} with coordinates (0,0)
point P_{\_G140197} 0 0
cmark_r P_{\_G140197}

% Constructing a point P_{\_G140121} such that AP_{\_G140121}/AP_{\_G140197}=2
towards P_{\_G140121} A P_{\_G140197} 2
cmark_r P_{\_G140121}
color 200 200 200
drawsegment A P_{\_G140121}
color 0 0 0

% Constructing a point P_{\_G140166} such that AP_{\_G140166}/AP_{\_G140197}=3
towards P_{\_G140166} A P_{\_G140197} 3
cmark_r P_{\_G140166}
color 200 200 200
drawsegment A P_{\_G140166}
color 0 0 0

% Constructing a line L_{\_G140127} which passes through point M_{a} and point P_{\_G140166}
line L_{\_G140127} M_{a} P_{\_G140166}

color 200 200 200
drawline L_{\_G140127}
color 0 0 0


% Constructing a line L_{\_G140090} which contains the point P_{\_G140121} and is parallel to the
    line L_{\_G140127}
parallel L_{\_G140090} P_{\_G140121} L_{\_G140127}

color 200 200 200
drawline L_{\_G140090}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G140090} and line L_{\_G140096}
```

```
intersec G L_{\_G140090} L_{\_G140096}
cmark_t G



% Constructing a point O such that NO/NG=3
towards O N G 3
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0


% DET: points A and E_{a} are not the same
% Constructing a line h_{a} which passes through point A and point E_{a}
line h_{a} A E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G140973} which is a foot of the point N on the line h_{a}
foot P_{\_G140973} N h_{a}
cmark_r P_{\_G140973}
color 200 200 200
drawline N P_{\_G140973}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G140973}
sim H_{a} P_{\_G140973} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0
```

```
% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect;
     points M_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and E_{a} are not the same; points M_{a} and E_{a} must be different;
    points M_{a} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_a=_M_a

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_a=_M_a

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_a=_E_a

Proving failed

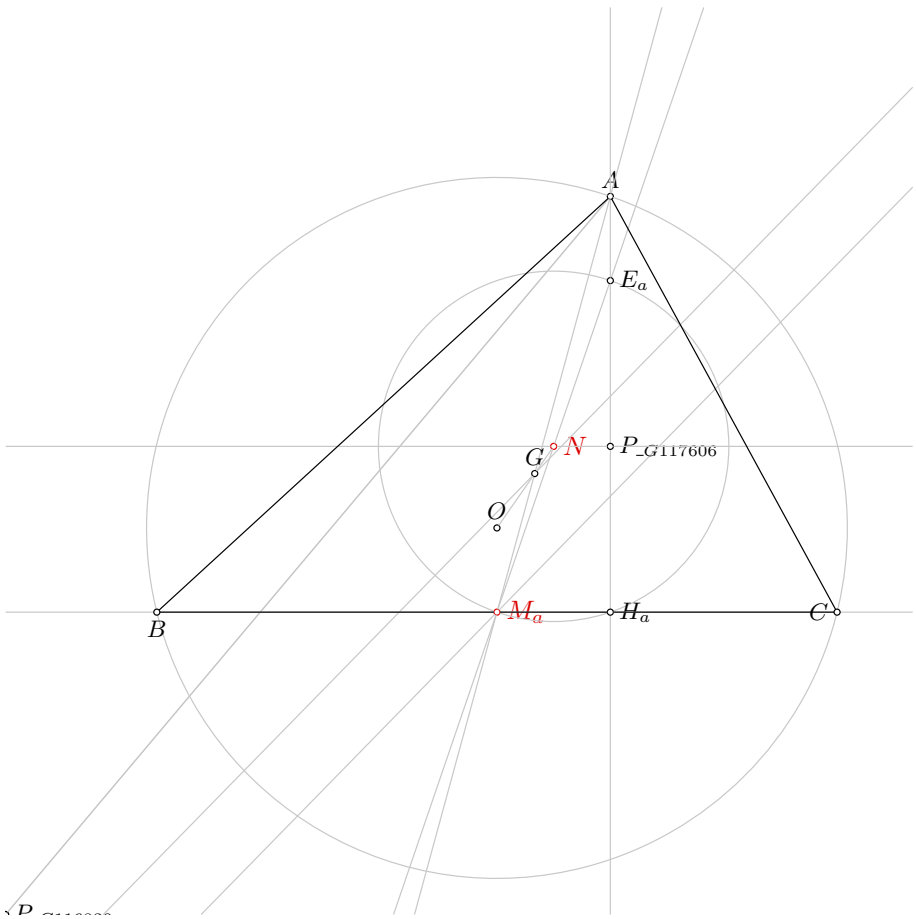

Figure 1: Illustration of the problem 0841

4.3 GCLC - Wu method

4.3.1 Proving M_a=_M_a

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_a=_E_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_a=_M_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_a=_E_a

Proving failed

Problem 842

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 842: Given a point E_a, a point M_a and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and M_a are not the same;
2. Using the point M_a and the point O, construct a line m_a (rule W02); % DET: points M_a and O are not the same;
3. Using the point M_a and the line m_a, construct a line a (rule W10a); ;
4. Using the point E_a and the point M_a, construct a line $m(E_aM_a)$ (rule W14); % DET: points E_a and M_a are not the same;
5. Using the line $m(E_aM_a)$ and the line $m(H_bH_c)$, construct a point N (rule W03); % NDG: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel % DET: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same;
6. Using the point N and the point O, construct a point G (rule W01); ;
7. Using the point M_a and the point G, construct a point A (rule W01); ;
8. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
9. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; lines $m(E_aM_a)$ and $m(H_bH_c)$ are not parallel.

Determination conditions: lines $m(E_aM_a)$ and $m(H_bH_c)$ are not the same; points E_a and M_a are not the same; points M_a and O are not the same; points E_a and M_a are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W14]

Lemmas used: [D1,D11,D21,D26,D32,GD01,GD02,GL01,GL03,GL04,GL09,L11,L12,L15,L20,L21,L22,L38,L39,

Solving time: 6.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point M_{a} 65 40
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r M_{a}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point M_{a}
line m(H_{b}H_{c}) E_{a} M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% DET: points M_{a} and O are not the same
% Constructing a line m_{a} which passes through point M_{a} and point O
line m_{a} M_{a} O

color 200 200 200
drawline m_{a}
color 0 0 0




% Constructing a line a which is perpendicular to line m_{a} and which passes through point M_{a}
perp a M_{a} m_{a}

color 200 200 200
drawline a
color 0 0 0



% DET: points E_{a} and M_{a} are not the same
```

```
% Constructing bisector m(E_{a}M_{a}) of the segment E_{a}M_{a}
med m(E_{a}M_{a}) E_{a} M_{a}

color 200 200 200
drawline m(E_{a}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{a}
color 0 0 0


% NDG: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel% DET: lines m(E_{a}M_{a}) and m(H_{b}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{a}) and line m(H_{b}H_{c})
intersec N m(E_{a}M_{a}) m(H_{b}H_{c})
cmark_r N



% Constructing a line L_{\_G170833} which passes through point N and point O
line L_{\_G170833} N O

color 200 200 200
drawline L_{\_G170833}
color 0 0 0


% Constructing a point P_{\_G170934} with coordinates (0,0)
point P_{\_G170934} 0 0
cmark_r P_{\_G170934}

% Constructing a point P_{\_G170858} such that NP_{\_G170858}/NP_{\_G170934}=1
towards P_{\_G170858} N P_{\_G170934} 1
cmark_r P_{\_G170858}
color 200 200 200
drawsegment N P_{\_G170858}
color 0 0 0

% Constructing a point P_{\_G170903} such that NP_{\_G170903}/NP_{\_G170934}=3
towards P_{\_G170903} N P_{\_G170934} 3
cmark_r P_{\_G170903}
color 200 200 200
drawsegment N P_{\_G170903}
color 0 0 0

% Constructing a line L_{\_G170864} which passes through point O and point P_{\_G170903}
line L_{\_G170864} O P_{\_G170903}

color 200 200 200
drawline L_{\_G170864}
color 0 0 0


% Constructing a line L_{\_G170827} which contains the point P_{\_G170858} and is parallel to the
    line L_{\_G170864}
```

```
parallel L_{\_G170827} P_{\_G170858} L_{\_G170864}

color 200 200 200
drawline L_{\_G170827}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G170827} and line L_{\_G170833}
intersec G L_{\_G170827} L_{\_G170833}
cmark_t G



% Constructing a point A such that M_{a}A/M_{a}G=3
towards A M_{a} G 3
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0


% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not parallel
% Determination conditions: lines m(E_{a}M_{a}) and m(H_{b}H_{c}) are not the same; points E_{a}
    and M_{a} are not the same; points M_{a} and O are not the same; points E_{a} and M_{a} are not
     the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

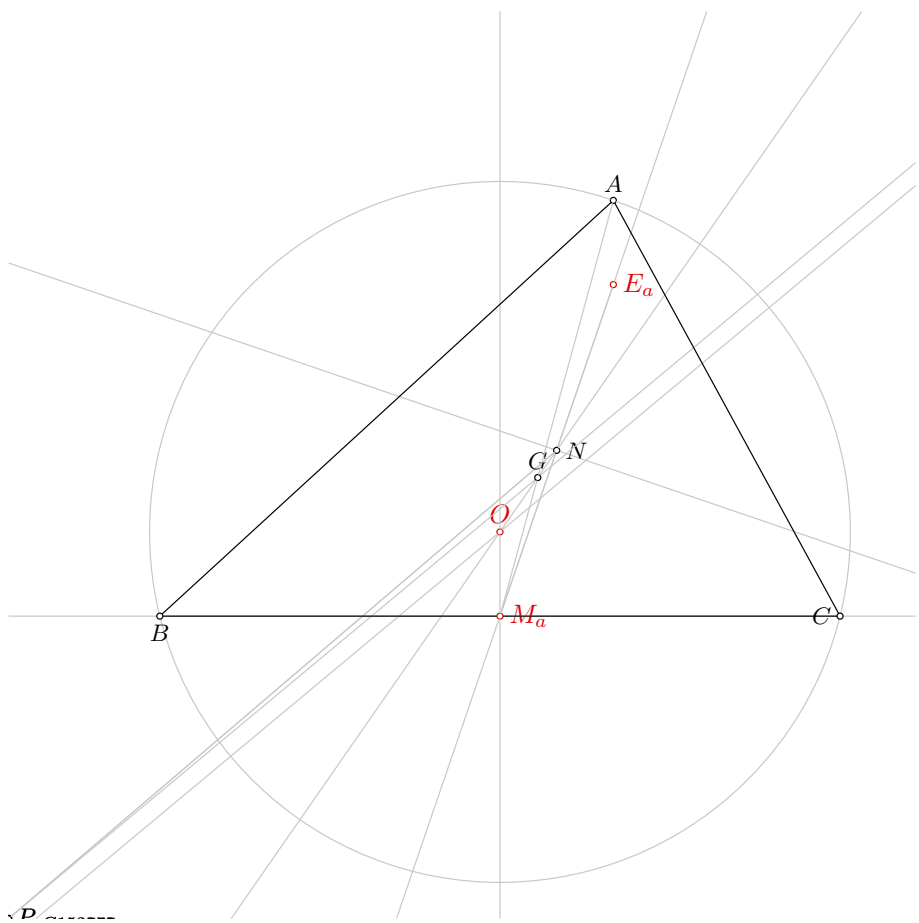

Figure 1: Illustration of the problem 0842

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving M_a=_M_a

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving M_a=_M_a

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 923 terms.

Time Complexity: Time spent by the prover is 1.990 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving $O{=}\_O$

Proving failed

Problem 843

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 843: Given a point E_a, a point M_a and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 844

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 844: Given a point E_a, a point M_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 845

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 845: Given a point E_a, a point M_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 846

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 846: Given a point E_a, a point M_b and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_b, construct a line $m(E_aM_b)$ (rule W14); % DET: points E_a and M_b are not the same;

2. Using the point E_a and the point M_c, construct a line $m(E_aM_c)$ (rule W14); % DET: points E_a and M_c are not the same;

3. Using the line $m(E_aM_c)$ and the line $m(E_aM_b)$, construct a point N (rule W03); % NDG: lines $m(E_aM_c)$ and $m(E_aM_b)$ are not parallel % DET: lines $m(E_aM_c)$ and $m(E_aM_b)$ are not the same;

4. Using the point M_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points M_b and N are not the same;

5. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;

6. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point M_b, construct a point E_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_b and E_b must be different;

7. Using the point M_c and the point E_b, construct a line $m(BH_a)$ (rule W02); % DET: points M_c and E_b are not the same;

8. Using the point E_a and the line $m(BH_a)$, construct a line h_a (rule W16); ;

9. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;

10. Using the point H_a and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points H_a and M_b are not the same;

11. Using the circle $k(M_b, C)$, the line h_a, the point M_b and the point H_a, construct a point A (rule W05); % NDG: line h_a and circle $k(M_b, C)$ intersect % DET: points H_a and A must be different;

12. Using the point M_b and the point A, construct a point C (rule W01); ;

13. Using the point M_c and the point A, construct a point B (rule W01); .

Non-degenerate conditions: line h_a and circle $k(M_b, C)$ intersect; points H_a and M_b are not the same; line h_a and circle $k(N, M_a)$ intersect; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points E_a and N are not the same; lines $m(E_aM_c)$ and $m(E_aM_b)$ are not parallel.

Determination conditions: points H_a and A must be different; points E_a and H_a must be different; points M_c and E_b are not the same; points M_b and E_b must be different; points M_b and N are not the same; lines $m(E_aM_c)$ and $m(E_aM_b)$ are not the same; points E_a and M_c are not the same; points E_a and M_b are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W14,W16]

Lemmas used: [D20,D22,D28,D3,D32,D5,D8,GD02,GL01,GL03,GL04,GL09,L17,L18,L19,L21,L22,L23,L40,L42

Solving time: 25.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point M_{b} 95 67.5
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_lt M_{b}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{b} are not the same
% Constructing bisector m(E_{a}M_{b}) of the segment E_{a}M_{b}
med m(E_{a}M_{b}) E_{a} M_{b}

color 200 200 200
drawline m(E_{a}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{b}
color 0 0 0
```

```
% DET: points E_{a} and M_{c} are not the same
% Constructing bisector m(E_{a}M_{c}) of the segment E_{a}M_{c}
med m(E_{a}M_{c}) E_{a} M_{c}

color 200 200 200
drawline m(E_{a}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{a} M_{c}
color 0 0 0


% NDG: lines m(E_{a}M_{c}) and m(E_{a}M_{b}) are not parallel% DET: lines m(E_{a}M_{c}) and m(E_{a}
    M_{b}) are not the same
% Constructing a point N which belongs to line m(E_{a}M_{c}) and line m(E_{a}M_{b})
intersec N m(E_{a}M_{c}) m(E_{a}M_{b})
cmark_r N


% DET: points M_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point M_{b} and point N
line m(H_{a}H_{c}) M_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{b} and E_{b} must be
    different
% Constructing a point E_{b} which is an image of the point M_{b} in the symmetry to point/line N
sim E_{b} N M_{b}
cmark_r E_{b}


% DET: points M_{c} and E_{b} are not the same
% Constructing a line m(BH_{a}) which passes through point M_{c} and point E_{b}
line m(BH_{a}) M_{c} E_{b}

color 200 200 200
drawline m(BH_{a})
color 0 0 0
```

```
% Constructing a line h_{a} which contains the point E_{a} and is parallel to the line m(BH_{a})
parallel h_{a} E_{a} m(BH_{a})

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G217692} which is a foot of the point N on the line h_{a}
foot P_{\_G217692} N h_{a}
cmark_r P_{\_G217692}
color 200 200 200
drawline N P_{\_G217692}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G217692}
sim H_{a} P_{\_G217692} E_{a}
cmark_r H_{a}


% NDG: points H_{a} and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point H
    _{a}
circle k(M_{b},C) M_{b} H_{a}

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: line h_{a} and circle k(M_{b},C) intersect% DET: points H_{a} and A must be different
% Constructing a point P_{\_G217996} which is a foot of the point M_{b} on the line h_{a}
foot P_{\_G217996} M_{b} h_{a}
cmark_r P_{\_G217996}
color 200 200 200
drawline M_{b} P_{\_G217996}
color 0 0 0

% Constructing a point A which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    217996}
sim A P_{\_G217996} H_{a}
cmark_t A



% Constructing a point C such that M_{b}C/M_{b}A=-1
towards C M_{b} A -1
cmark_l C
color 200 200 200
drawsegment A C
```

```
color 0 0 0



% Constructing a point B such that M_{c}B/M_{c}A=-1
towards B M_{c} A -1
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line h_{a} and circle k(M_{b},C) intersect; points H_{a} and M_{b} are
     not the same; line h_{a} and circle k(N,M_{a}) intersect; line m(H_{a}H_{c}) and circle k(N,M
    _{a}) intersect; points E_{a} and N are not the same; lines m(E_{a}M_{c}) and m(E_{a}M_{b}) are
     not parallel
% Determination conditions: points H_{a} and A must be different; points E_{a} and H_{a} must be
    different; points M_{c} and E_{b} are not the same; points M_{b} and E_{b} must be different;
    points M_{b} and N are not the same; lines m(E_{a}M_{c}) and m(E_{a}M_{b}) are not the same;
    points E_{a} and M_{c} are not the same; points E_{a} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 9 terms.

Time Complexity: Time spent by the prover is 0.308 seconds.

NDG conditions Points M_b and M_c are not identical

Points M_b and M_c are not identical

Line through points M_b and E_a is not parallel with line through points M_c and E_b

Points tempPoint-256h_a and E_a are not identical

Points M_b and tempPoint-256h_a are not identical

Points $P_{\_G212710}$ and E_a are not identical

Points $P_{\_G212710}$ and E_a are not identical

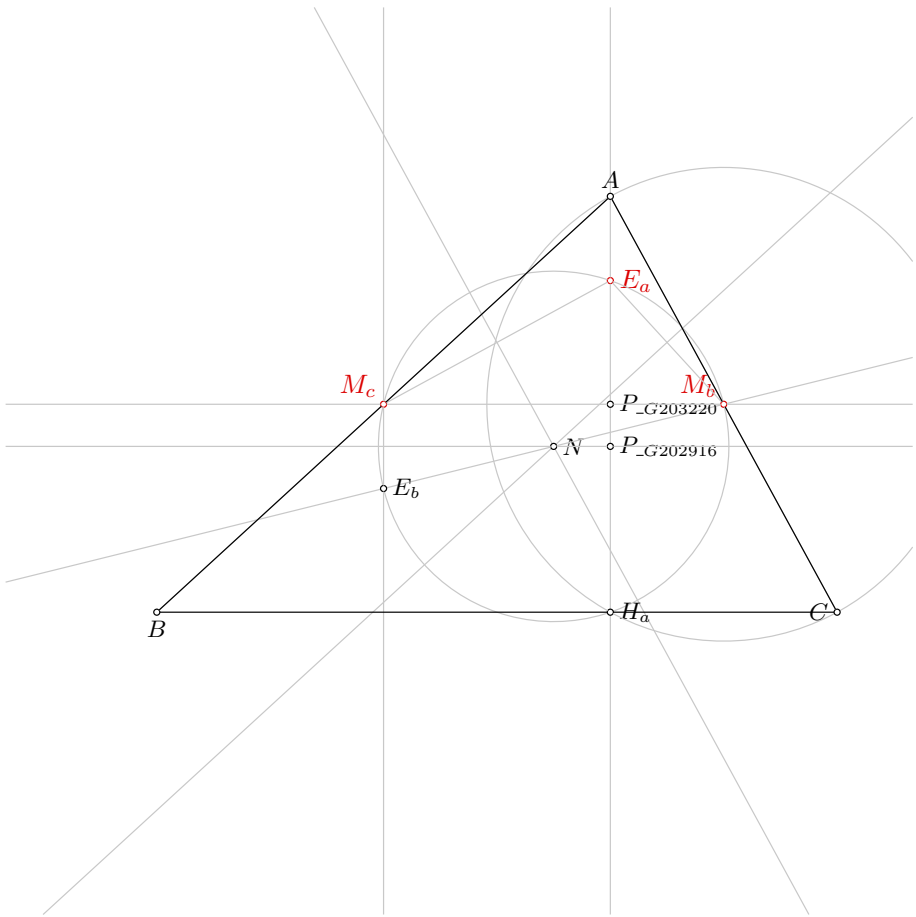

Figure 1: Illustration of the problem 0846

4.1.3 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.28 seconds.

NDG conditions Points M_b and M_c are not identical

Points M_b and M_c are not identical

Line through points M_b and E_a is not parallel with line through points M_c and E_b

Points tempPoint-76h_a and E_a are not identical

Points M_b and tempPoint-76h_a are not identical

Points E_a and $P_{\_G214046}$ are not identical

Points M_b, E_a and $P_{\_G214046}$ are not collinear

4.2 GCLC - Area method

4.2.1 Proving E_a=$\_E_a$

Proving failed

4.2.2 Proving M_b=$\_M_b$

NDG conditions are:

$S_{M^2_{m(E_a M_c)} M^0_{m(E_a M_b)} T^1_{m(E_a M_b)}} \neq S_{T^3_{m(E_a M_c)} M^0_{m(E_a M_b)} T^1_{m(E_a M_b)}}$ i.e., lines $M^2_{m(E_a M_c)} T^3_{m(E_a M_c)}$ and $M^0_{m(E_a M_b)} T^1_{m(E_a M_b)}$ are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a} BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.2.3 Proving M_c=$\_M_c$

NDG conditions are:

$S_{M^2_{m(E_a M_c)} M^0_{m(E_a M_b)} T^1_{m(E_a M_b)}} \neq S_{T^3_{m(E_a M_c)} M^0_{m(E_a M_b)} T^1_{m(E_a M_b)}}$ i.e., lines $M^2_{m(E_a M_c)} T^3_{m(E_a M_c)}$ and $M^0_{m(E_a M_b)} T^1_{m(E_a M_b)}$ are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a} BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_a=$\_E_a$

Proving failed

4.3.2 Proving M_b=$\_M_b$

Proving failed

4.3.3 Proving M_c=$\_M_c$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 847

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 847: Given a point M_b, a point N and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
2. Choose freely a point E_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and N are not the same;
4. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point E_a, construct a point M_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_a and M_a must be different;
5. Choose freely a point A (rule free);
6. Using the point A and the point M_b, construct a point C (rule W01); ;
7. Using the point A and the point M_a, construct a point G (rule W01); ;
8. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points M_b and N are not the same.

Determination conditions: points E_a and M_a must be different; points E_a and N are not the same.

Rules used: [W01,W02,W05a,W06,WOncircle1,free]

Lemmas used: [D22,D32,GD02,GL01,GL03,GL04,L17,L20,L21,L22,L38,L39,L47,L48,L55,L56]

Solving time: 149.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{b} 95 67.5
point N 72.5 61.93
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_lt M_{b}
cmark_r N
cmark_r E_{a}
color 0 0 0
fontsize 8

% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{a} on the circle with center N through point M_{b}
oncircle E_{a} N M_{b}
cmark_r E_{a}
color 200 200 200
drawcircle N M_{b}
color 0 0 0


% DET: points E_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point N
line m(H_{b}H_{c}) E_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{a} and M_{a} must be
    different
% Constructing a point M_{a} which is an image of the point E_{a} in the symmetry to point/line N
sim M_{a} N E_{a}
cmark_r M_{a}



% Constructing a free point A
point A 80 95
```

```
cmark_t A


% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a line L_{\_G249580} which passes through point A and point M_{a}
line L_{\_G249580} A M_{a}

color 200 200 200
drawline L_{\_G249580}
color 0 0 0


% Constructing a point P_{\_G249681} with coordinates (0,0)
point P_{\_G249681} 0 0
cmark_r P_{\_G249681}

% Constructing a point P_{\_G249605} such that AP_{\_G249605}/AP_{\_G249681}=2
towards P_{\_G249605} A P_{\_G249681} 2
cmark_r P_{\_G249605}
color 200 200 200
drawsegment A P_{\_G249605}
color 0 0 0

% Constructing a point P_{\_G249650} such that AP_{\_G249650}/AP_{\_G249681}=3
towards P_{\_G249650} A P_{\_G249681} 3
cmark_r P_{\_G249650}
color 200 200 200
drawsegment A P_{\_G249650}
color 0 0 0

% Constructing a line L_{\_G249611} which passes through point M_{a} and point P_{\_G249650}
line L_{\_G249611} M_{a} P_{\_G249650}

color 200 200 200
drawline L_{\_G249611}
color 0 0 0


% Constructing a line L_{\_G249574} which contains the point P_{\_G249605} and is parallel to the
    line L_{\_G249611}
parallel L_{\_G249574} P_{\_G249605} L_{\_G249611}

color 200 200 200
drawline L_{\_G249574}
color 0 0 0
```

```
% Constructing a point G which belongs to line L_{\_G249574} and line L_{\_G249580}
intersec G L_{\_G249574} L_{\_G249580}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect; points M_{b} and N
     are not the same
% Determination conditions: points E_{a} and M_{a} must be different; points E_{a} and N are not
    the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_b=_M_b

NDG conditions are:

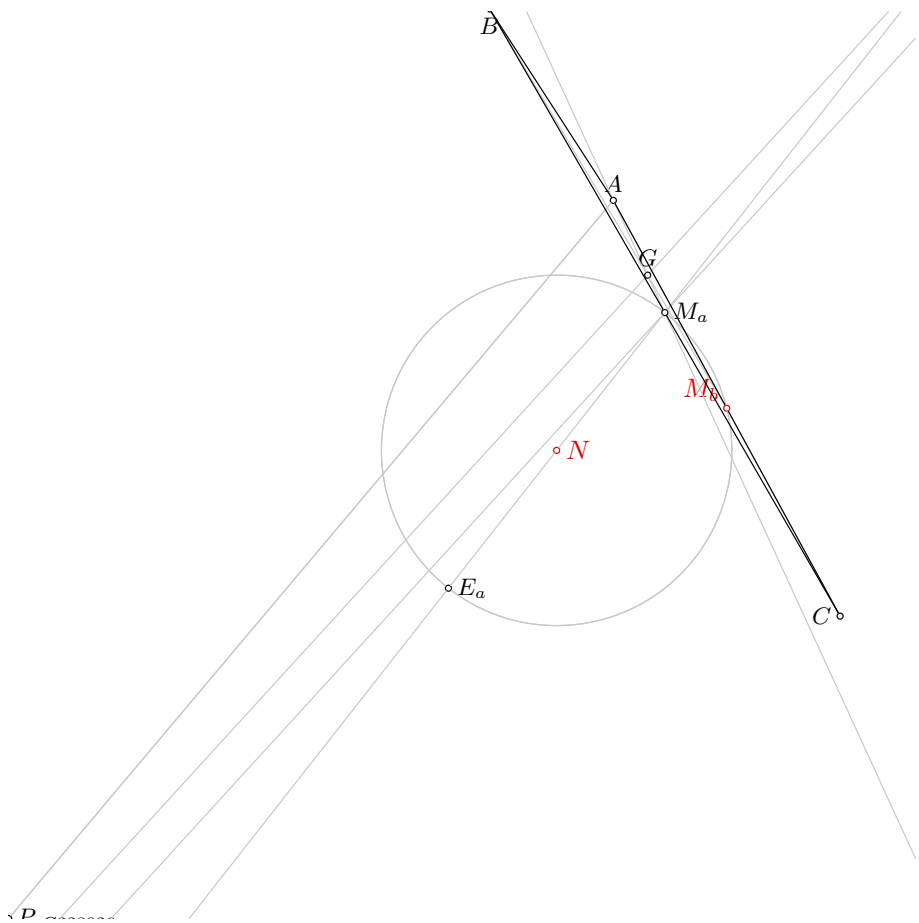

Figure 1: Illustration of the problem 0847

$S_{P_{\_G229195}AM_a} \neq S_{P^0_{L_{\_G229164}}AM_a}$ i.e., lines $P_{\_G229195}P^0_{L_{\_G229164}}$ and AM_a are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 42

Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving E_a=$\_E_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_b=$\_M_b$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving E_a=$\_E_a$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_b=$\_M_b$

Proving failed

4.4.2 Proving N=$\_N$

Proving failed

4.4.3 Proving E_a=$\_E_a$

Proving failed

Problem 848

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 848: Given a point E_a, a point M_b and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_b, construct a line $m(AH_c)$ (rule W02); % DET: points E_a and M_b are not the same;
2. Using the point M_b and the point O, construct a line m_b (rule W02); % DET: points M_b and O are not the same;
3. Using the point M_b and the line m_b, construct a line b (rule W10a); ;
4. Using the point E_a and the line m_b, construct a line $m(AH_b)$ (rule W16); ;
5. Using the point O and the line $m(AH_c)$, construct a line m_c (rule W16); ;
6. Using the line m_c and the line $m(AH_b)$, construct a point M_c (rule W03); % NDG: lines m_c and $m(AH_b)$ are not parallel % DET: lines m_c and $m(AH_b)$ are not the same;
7. Using the point M_c and the line m_c, construct a line c (rule W10a); ;
8. Using the line c and the line b, construct a point A (rule W03); % NDG: lines c and b are not parallel % DET: lines c and b are not the same;
9. Using the point A and the point E_a, construct a point H (rule W01); ;
10. Using the point M_b and the point A, construct a point C (rule W01); ;
11. Using the point O and the point H, construct a point G (rule W01); ;
12. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: lines c and b are not parallel; lines m_c and $m(AH_b)$ are not parallel.

Determination conditions: lines c and b are not the same; lines m_c and $m(AH_b)$ are not the same; points M_b and O are not the same; points E_a and M_b are not the same.

Rules used: [W01,W02,W03,W10a,W16]

Lemmas used: [D1,D12,D13,D20,D22,D28,GD01,GD02,GL01,GL03,GL04,GL09,L1,L41,L43,L45,L47,L48,L56,L

Solving time: 3.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point M_{b} 95 67.5
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_lt M_{b}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{b} are not the same
% Constructing a line m(AH_{c}) which passes through point E_{a} and point M_{b}
line m(AH_{c}) E_{a} M_{b}

color 200 200 200
drawline m(AH_{c})
color 0 0 0



% DET: points M_{b} and O are not the same
% Constructing a line m_{b} which passes through point M_{b} and point O
line m_{b} M_{b} O

color 200 200 200
drawline m_{b}
color 0 0 0



% Constructing a line b which is perpendicular to line m_{b} and which passes through point M_{b}
perp b M_{b} m_{b}

color 200 200 200
drawline b
color 0 0 0
```

```
% Constructing a line m(AH_{b}) which contains the point E_{a} and is parallel to the line m_{b}
parallel m(AH_{b}) E_{a} m_{b}

color 200 200 200
drawline m(AH_{b})
color 0 0 0



% Constructing a line m_{c} which contains the point O and is parallel to the line m(AH_{c})
parallel m_{c} O m(AH_{c})

color 200 200 200
drawline m_{c}
color 0 0 0



% NDG: lines m_{c} and m(AH_{b}) are not parallel% DET: lines m_{c} and m(AH_{b}) are not the same
% Constructing a point M_{c} which belongs to line m_{c} and line m(AH_{b})
intersec M_{c} m_{c} m(AH_{b})
cmark_lt M_{c}



% Constructing a line c which is perpendicular to line m_{c} and which passes through point M_{c}
perp c M_{c} m_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines c and b are not parallel% DET: lines c and b are not the same
% Constructing a point A which belongs to line c and line b
intersec A c b
cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that M_{b}C/M_{b}A=-1
towards C M_{b} A -1
cmark_l C
color 200 200 200
```

```
drawsegment A C
color 0 0 0


% Constructing a line L_{\_G44746} which passes through point O and point H
line L_{\_G44746} O H

color 200 200 200
drawline L_{\_G44746}
color 0 0 0


% Constructing a point P_{\_G44847} with coordinates (0,0)
point P_{\_G44847} 0 0
cmark_r P_{\_G44847}

% Constructing a point P_{\_G44771} such that OP_{\_G44771}/OP_{\_G44847}=1
towards P_{\_G44771} O P_{\_G44847} 1
cmark_r P_{\_G44771}
color 200 200 200
drawsegment O P_{\_G44771}
color 0 0 0

% Constructing a point P_{\_G44816} such that OP_{\_G44816}/OP_{\_G44847}=3
towards P_{\_G44816} O P_{\_G44847} 3
cmark_r P_{\_G44816}
color 200 200 200
drawsegment O P_{\_G44816}
color 0 0 0

% Constructing a line L_{\_G44777} which passes through point H and point P_{\_G44816}
line L_{\_G44777} H P_{\_G44816}

color 200 200 200
drawline L_{\_G44777}
color 0 0 0


% Constructing a line L_{\_G44740} which contains the point P_{\_G44771} and is parallel to the
    line L_{\_G44777}
parallel L_{\_G44740} P_{\_G44771} L_{\_G44777}

color 200 200 200
drawline L_{\_G44740}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G44740} and line L_{\_G44746}
intersec G L_{\_G44740} L_{\_G44746}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
```

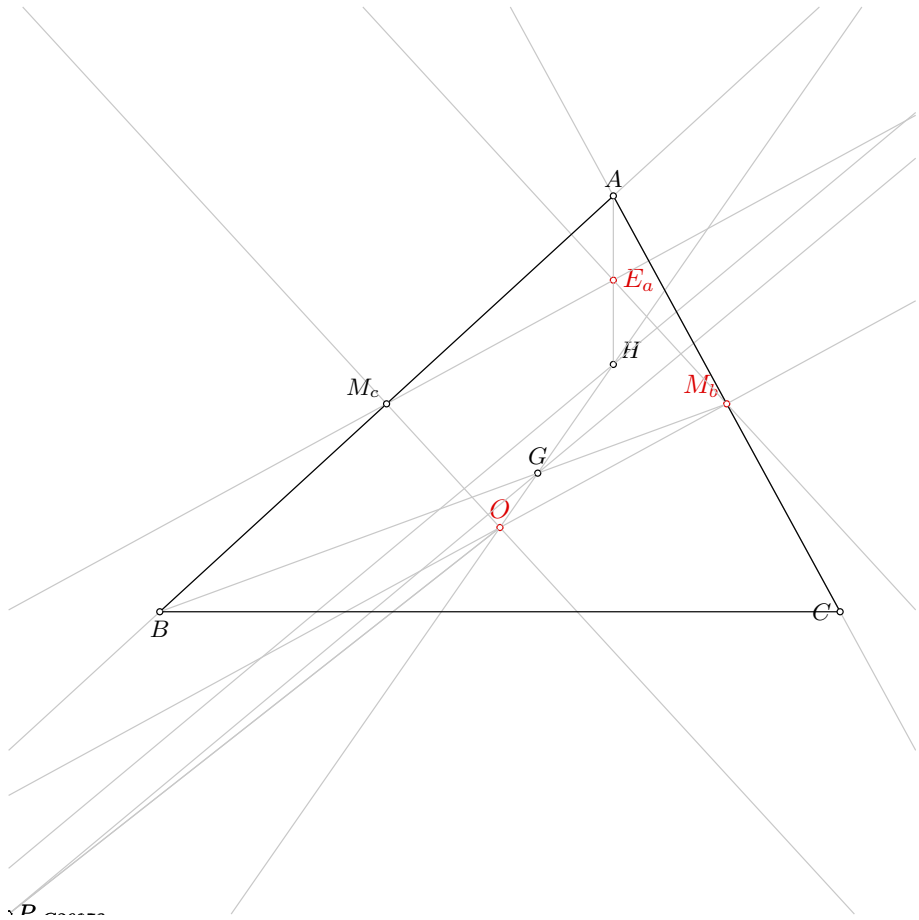

Figure 1: Illustration of the problem 0848

```
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and b are not parallel; lines m_{c} and m(AH_{b}) are not
    parallel
% Determination conditions: lines c and b are not the same; lines m_{c} and m(AH_{b}) are not the
    same; points M_{b} and O are not the same; points E_{a} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=$\_E_a$

Proving failed

4.1.2 Proving M_b=$\_M_b$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 9 terms.

Time Complexity: Time spent by the prover is 0.18 seconds.

NDG conditions Points E_a and O are not identical

Line through points M_b and M_c is not perpendicular to line through points M_c and E_a

4.1.3 Proving O=$\_O$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=$\_E_a$

Proving failed

4.2.2 Proving M_b=$\_M_b$

NDG conditions are:

$S_{OE_aP^1_{m(AH_b)}} \neq S_{P^2_{m_c}E_aP^1_{m(AH_b)}}$ i.e., lines $OP^2_{m_c}$ and $E_aP^1_{m(AH_b)}$ are not parallel (construction based assumption)

$S_{M_cOP^2_{m_c}} \neq 0$ i.e., points M_c, O and $P^2_{m_c}$ are not collinear (foot is not the point itself; construction based assumption)

$S_{M_cM_bT^0_b} \neq S_{F^3_cM_bT^0_b}$ i.e., lines $M_cF^3_c$ and $M_bT^0_b$ are not parallel (construction based assumption)

$S_{P\_G30876OH} \neq S_{P^4_{L\_G30845}OH}$ i.e., lines $P\_G30876P^4_{L\_G30845}$ and OH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^8_{\_m_b}} \neq S_{F^7_{\_m_a}\_M_bF^8_{\_m_b}}$ i.e., lines $\_M_aF^7_{\_m_a}$ and $\_M_bF^8_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.090 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 849

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 849: Given a point E_a, a point M_b and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 850

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 850: Given a point E_a, a point M_b and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 851

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 851: Given a point E_a, a point M_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 852

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 852: Given a point M_c, a point N and a point E_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
2. Choose freely a point E_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points E_a and N are not the same;
4. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point E_a, construct a point M_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_a and M_a must be different;
5. Choose freely a point A (rule free);
6. Using the point A and the point M_c, construct a point B (rule W01); ;
7. Using the point A and the point M_a, construct a point G (rule W01); ;
8. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points M_c and N are not the same.

Determination conditions: points E_a and M_a must be different; points E_a and N are not the same.

Rules used: [W01,W02,W05a,W06,WOncircle1,free]

Lemmas used: [D20,D32,GD02,GL01,GL03,GL04,L18,L20,L21,L22,L38,L39,L47,L48,L55,L57]

Solving time: 150.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{c} 50 67.5
point N 72.5 61.93
point E_{a} 80 83.86

color 220 0 0
fontsize 9

cmark_lt M_{c}
cmark_r N
cmark_r E_{a}
color 0 0 0
fontsize 8

% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{a} on the circle with center N through point M_{c}
oncircle E_{a} N M_{c}
cmark_r E_{a}
color 200 200 200
drawcircle N M_{c}
color 0 0 0


% DET: points E_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point E_{a} and point N
line m(H_{b}H_{c}) E_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{a} and M_{a} must be
    different
% Constructing a point M_{a} which is an image of the point E_{a} in the symmetry to point/line N
sim M_{a} N E_{a}
cmark_r M_{a}



% Constructing a free point A
point A 80 95
```

```
cmark_t A


% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% Constructing a line L_{\_G90526} which passes through point A and point M_{a}
line L_{\_G90526} A M_{a}

color 200 200 200
drawline L_{\_G90526}
color 0 0 0


% Constructing a point P_{\_G90627} with coordinates (0,0)
point P_{\_G90627} 0 0
cmark_r P_{\_G90627}

% Constructing a point P_{\_G90551} such that AP_{\_G90551}/AP_{\_G90627}=2
towards P_{\_G90551} A P_{\_G90627} 2
cmark_r P_{\_G90551}
color 200 200 200
drawsegment A P_{\_G90551}
color 0 0 0

% Constructing a point P_{\_G90596} such that AP_{\_G90596}/AP_{\_G90627}=3
towards P_{\_G90596} A P_{\_G90627} 3
cmark_r P_{\_G90596}
color 200 200 200
drawsegment A P_{\_G90596}
color 0 0 0

% Constructing a line L_{\_G90557} which passes through point M_{a} and point P_{\_G90596}
line L_{\_G90557} M_{a} P_{\_G90596}

color 200 200 200
drawline L_{\_G90557}
color 0 0 0


% Constructing a line L_{\_G90520} which contains the point P_{\_G90551} and is parallel to the
    line L_{\_G90557}
parallel L_{\_G90520} P_{\_G90551} L_{\_G90557}

color 200 200 200
drawline L_{\_G90520}
color 0 0 0
```

```
% Constructing a point G which belongs to line L_{\_G90520} and line L_{\_G90526}
intersec G L_{\_G90520} L_{\_G90526}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect; points M_{c} and N
     are not the same
% Determination conditions: points E_{a} and M_{a} must be different; points E_{a} and N are not
    the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.032 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_a=_E_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_c=_M_c

NDG conditions are:

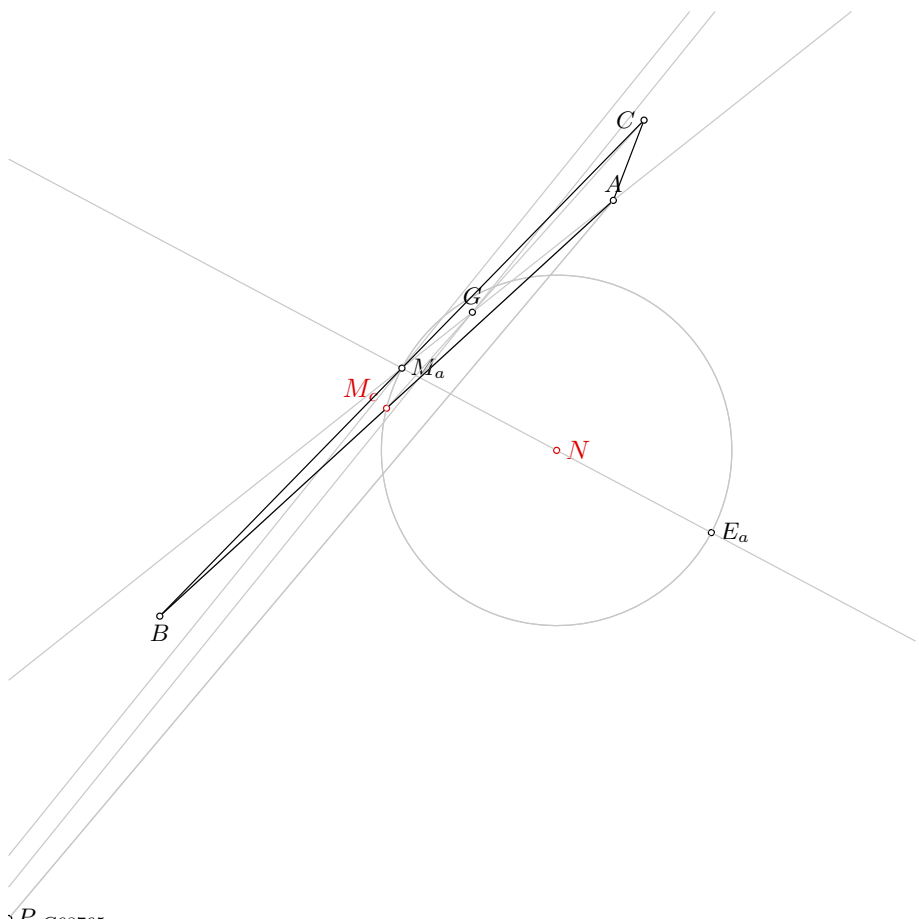

Figure 1: Illustration of the problem 0852

$S_{P\_G69934AM_a} \neq S_{P^0_{L\_G69903}AM_a}$ i.e., lines $P\_G69934P^0_{L\_G69903}$ and AM_a are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving E_a=$\_E_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.070 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving E_a=$\_E_a$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_c=$\_M_c$

Proving failed

4.4.2 Proving N=$\_N$

Proving failed

4.4.3 Proving E_a=$\_E_a$

Proving failed

Problem 853

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 853: Given a point E_a, a point M_c and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_a and the point M_c, construct a line $m(AH_b)$ (rule W02); % DET: points E_a and M_c are not the same;
2. Using the point M_c and the point O, construct a line m_c (rule W02); % DET: points M_c and O are not the same;
3. Using the point M_c and the line m_c, construct a line c (rule W10a); ;
4. Using the point E_a and the line m_c, construct a line $m(AH_c)$ (rule W16); ;
5. Using the point O and the line $m(AH_b)$, construct a line m_b (rule W16); ;
6. Using the line m_b and the line $m(AH_c)$, construct a point M_b (rule W03); % NDG: lines m_b and $m(AH_c)$ are not parallel % DET: lines m_b and $m(AH_c)$ are not the same;
7. Using the point M_b and the line m_b, construct a line b (rule W10a); ;
8. Using the line b and the line c, construct a point A (rule W03); % NDG: lines b and c are not parallel % DET: lines b and c are not the same;
9. Using the point A and the point E_a, construct a point H (rule W01); ;
10. Using the point M_c and the point A, construct a point B (rule W01); ;
11. Using the point O and the point H, construct a point G (rule W01); ;
12. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: lines b and c are not parallel; lines m_b and $m(AH_c)$ are not parallel.

Determination conditions: lines b and c are not the same; lines m_b and $m(AH_c)$ are not the same; points M_c and O are not the same; points E_a and M_c are not the same.

Rules used: [W01,W02,W03,W10a,W16]

Lemmas used: [D1,D12,D13,D20,D22,D28,GD01,GD02,GL01,GL03,GL04,GL09,L1,L41,L43,L45,L47,L48,L57,L

Solving time: 3.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point M_{c} 50 67.5
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_lt M_{c}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{a} and M_{c} are not the same
% Constructing a line m(AH_{b}) which passes through point E_{a} and point M_{c}
line m(AH_{b}) E_{a} M_{c}

color 200 200 200
drawline m(AH_{b})
color 0 0 0



% DET: points M_{c} and O are not the same
% Constructing a line m_{c} which passes through point M_{c} and point O
line m_{c} M_{c} O

color 200 200 200
drawline m_{c}
color 0 0 0



% Constructing a line c which is perpendicular to line m_{c} and which passes through point M_{c}
perp c M_{c} m_{c}

color 200 200 200
drawline c
color 0 0 0
```

```
% Constructing a line m(AH_{c}) which contains the point E_{a} and is parallel to the line m_{c}
parallel m(AH_{c}) E_{a} m_{c}

color 200 200 200
drawline m(AH_{c})
color 0 0 0



% Constructing a line m_{b} which contains the point O and is parallel to the line m(AH_{b})
parallel m_{b} O m(AH_{b})

color 200 200 200
drawline m_{b}
color 0 0 0



% NDG: lines m_{b} and m(AH_{c}) are not parallel% DET: lines m_{b} and m(AH_{c}) are not the same
% Constructing a point M_{b} which belongs to line m_{b} and line m(AH_{c})
intersec M_{b} m_{b} m(AH_{c})
cmark_lt M_{b}



% Constructing a line b which is perpendicular to line m_{b} and which passes through point M_{b}
perp b M_{b} m_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines b and c are not parallel% DET: lines b and c are not the same
% Constructing a point A which belongs to line b and line c
intersec A b c
cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that M_{c}B/M_{c}A=-1
towards B M_{c} A -1
cmark_b B
color 200 200 200
```

```
drawsegment A B
color 0 0 0



% Constructing a line L_{\_G125055} which passes through point O and point H
line L_{\_G125055} O H

color 200 200 200
drawline L_{\_G125055}
color 0 0 0


% Constructing a point P_{\_G125156} with coordinates (0,0)
point P_{\_G125156} 0 0
cmark_r P_{\_G125156}

% Constructing a point P_{\_G125080} such that OP_{\_G125080}/OP_{\_G125156}=1
towards P_{\_G125080} O P_{\_G125156} 1
cmark_r P_{\_G125080}
color 200 200 200
drawsegment O P_{\_G125080}
color 0 0 0

% Constructing a point P_{\_G125125} such that OP_{\_G125125}/OP_{\_G125156}=3
towards P_{\_G125125} O P_{\_G125156} 3
cmark_r P_{\_G125125}
color 200 200 200
drawsegment O P_{\_G125125}
color 0 0 0

% Constructing a line L_{\_G125086} which passes through point H and point P_{\_G125125}
line L_{\_G125086} H P_{\_G125125}

color 200 200 200
drawline L_{\_G125086}
color 0 0 0


% Constructing a line L_{\_G125049} which contains the point P_{\_G125080} and is parallel to the
    line L_{\_G125086}
parallel L_{\_G125049} P_{\_G125080} L_{\_G125086}

color 200 200 200
drawline L_{\_G125049}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G125049} and line L_{\_G125055}
intersec G L_{\_G125049} L_{\_G125055}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
```

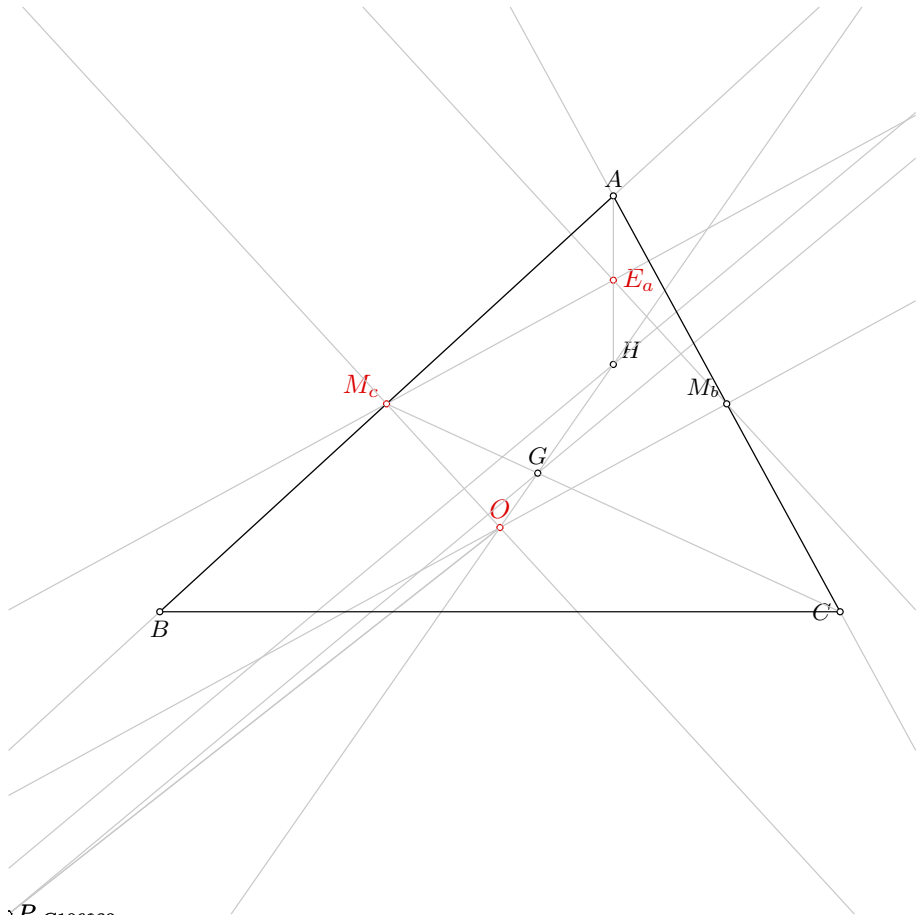

Figure 1: Illustration of the problem 0853

```
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and c are not parallel; lines m_{b} and m(AH_{c}) are not
    parallel
% Determination conditions: lines b and c are not the same; lines m_{b} and m(AH_{c}) are not the
    same; points M_{c} and O are not the same; points E_{a} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=$\_E_a$

Proving failed

4.1.2 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 9 terms.

Time Complexity: Time spent by the prover is 0.191 seconds.

NDG conditions Points M_c and O are not identical

Line through points M_b and M_c is not perpendicular to line through points M_c and O

4.1.3 Proving O=$\_O$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=$\_E_a$

Proving failed

4.2.2 Proving M_c=$\_M_c$

NDG conditions are:

$S_{OE_aP^1_{m(AH_c)}} \neq S_{P^2_{m_b}E_aP^1_{m(AH_c)}}$ i.e., lines $OP^2_{m_b}$ and $E_aP^1_{m(AH_c)}$ are not parallel (construction based assumption)

$S_{M_bOP^2_{m_b}} \neq 0$ i.e., points M_b, O and $P^2_{m_b}$ are not collinear (foot is not the point itself; construction based assumption)

$S_{M_bM_cT^0_c} \neq S_{F^3_bM_cT^0_c}$ i.e., lines $M_bF^3_b$ and $M_cT^0_c$ are not parallel (construction based assumption)

$S_{P_{\_G110900}OH} \neq S_{P^4_{L_{\_G110869}}OH}$ i.e., lines $P_{\_G110900}P^4_{L_{\_G110869}}$ and OH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^8_{\_m_b}} \neq S_{F^7_{\_m_a}\_M_bF^8_{\_m_b}}$ i.e., lines $\_M_aF^7_{\_m_a}$ and $\_M_bF^8_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.100 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 854

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 854: Given a point E_a, a point M_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 855

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 855: Given a point E_a, a point M_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 856

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 856: Given a point E_a, a point M_c and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 857

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 857: Given a point E_a, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point N and the point O, construct a point H (rule W01); ;
3. Using the point E_a and the point H, construct a point A (rule W01); ;
4. Using the point G and the point A, construct a point M_a (rule W01); ;
5. Using the point E_a and the point H, construct a line h_a (rule W02); % DET: points E_a and H are not the same;
6. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points E_a and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L19,L22,L55]

Solving time: 7.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{a} 80 83.86
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{a}
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G182669} which passes through point N and point O
line L_{\_G182669} N O

color 200 200 200
drawline L_{\_G182669}
color 0 0 0


% Constructing a point P_{\_G182770} with coordinates (0,0)
point P_{\_G182770} 0 0
cmark_r P_{\_G182770}

% Constructing a point P_{\_G182694} such that NP_{\_G182694}/NP_{\_G182770}=1
towards P_{\_G182694} N P_{\_G182770} 1
cmark_r P_{\_G182694}
color 200 200 200
drawsegment N P_{\_G182694}
color 0 0 0

% Constructing a point P_{\_G182739} such that NP_{\_G182739}/NP_{\_G182770}=3
towards P_{\_G182739} N P_{\_G182770} 3
cmark_r P_{\_G182739}
color 200 200 200
drawsegment N P_{\_G182739}
color 0 0 0

% Constructing a line L_{\_G182700} which passes through point O and point P_{\_G182739}
line L_{\_G182700} O P_{\_G182739}
```

```
color 200 200 200
drawline L_{\_G182700}
color 0 0 0


% Constructing a line L_{\_G182663} which contains the point P_{\_G182694} and is parallel to the
    line L_{\_G182700}
parallel L_{\_G182663} P_{\_G182694} L_{\_G182700}

color 200 200 200
drawline L_{\_G182663}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G182663} and line L_{\_G182669}
intersec G L_{\_G182663} L_{\_G182669}
cmark_t G



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point M_{a} such that GM_{a}/GA=-0.5
towards M_{a} G A -0.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points E_{a} and H are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H
line h_{a} E_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G183754} which is a foot of the point N on the line h_{a}
foot P_{\_G183754} N h_{a}
cmark_r P_{\_G183754}
color 200 200 200
drawline N P_{\_G183754}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G183754}
sim H_{a} P_{\_G183754} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

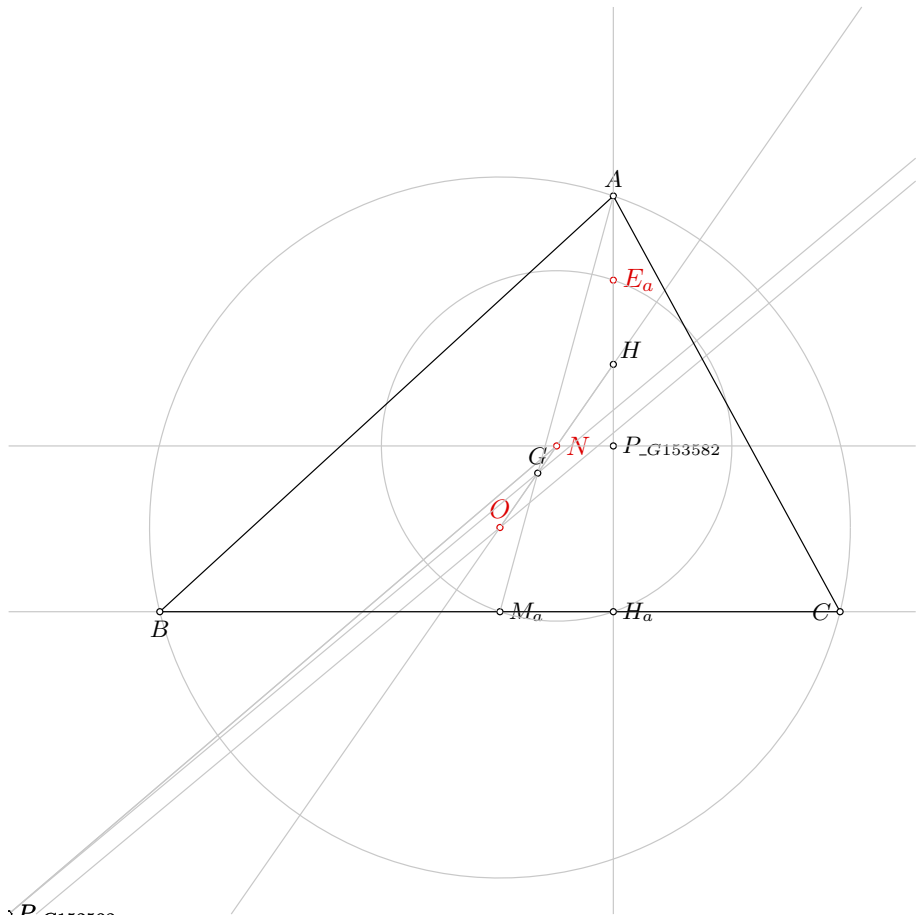

Figure 1: Illustration of the problem 0857

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points E_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points E_{a} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_a=_E_a

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_a=_E_a

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_a=_E_a

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_a=_E_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 858

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 858: Given a point E_a, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 859

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 859: Given a point E_a, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 860

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 860: Given a point E_a, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 861

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 861: Given a point E_a, a point O and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 862

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 862: Given a point E_a, a point O and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 863

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 863: Given a point E_a, a point O and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 864

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 864: Given a point E_a, a point T_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 865

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 865: Given a point E_a, a point T_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 866

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 866: Given a point E_a, a point T_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 867

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 867: Given a point E_b, a point E_c and a point G, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 868

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 868: Given a point E_b, a point E_c and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H, construct a point B (rule W01); ;
2. Using the point E_c and the point H, construct a point C (rule W01); ;
3. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
4. Using the point B and the point C, construct a line a (rule W02); % DET: points B and C are not the same;
5. Using the point H and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H and E_b are not the same;
6. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H and H_c must be different;
7. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
8. Using the circle $k(E_b, B)$, the line a, the point E_b and the point B, construct a point H_a (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points B and H_a must be different;
9. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
10. Using the line c and the line h_a, construct a point A (rule W03); % NDG: lines c and h_a are not parallel % DET: lines c and h_a are not the same.

Non-degenerate conditions: lines c and h_a are not parallel; line a and circle $k(E_b, B)$ intersect; line h_c and circle $k(E_b, B)$ intersect; points H and E_b are not the same.

Determination conditions: lines c and h_a are not the same; points H_a and H are not the same; points B and H_a must be different; points H_c and B are not the same; points H and H_c must be different; points B and C are not the same; points E_c and H are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D29,D3,D30,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 12.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point E_{c} 95 56.36
point H 80 72.73

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r E_{c}
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% DET: points B and C are not the same
% Constructing a line a which passes through point B and point C
line a B C

color 200 200 200
drawline a
color 0 0 0



% NDG: points H and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
circle k(E_{b},B) E_{b} H

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G29383} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G29383} E_{b} h_{c}
cmark_r P_{\_G29383}
color 200 200 200
drawline E_{b} P_{\_G29383}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    29383}
sim H_{c} P_{\_G29383} H
cmark_rt H_{c}


% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points B and H_{a} must be different
% Constructing a point P_{\_G29621} which is a foot of the point E_{b} on the line a
foot P_{\_G29621} E_{b} a
cmark_r P_{\_G29621}
color 200 200 200
drawline E_{b} P_{\_G29621}
color 0 0 0

% Constructing a point H_{a} which is an image of the point B in the symmetry to point/line P_{\_G
    29621}
sim H_{a} P_{\_G29621} B
cmark_r H_{a}
```

```
% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines c and h_{a} are not parallel% DET: lines c and h_{a} are not the same
% Constructing a point A which belongs to line c and line h_{a}
intersec A c h_{a}
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{a} are not parallel; line a and circle k(E_{b},B)
    intersect; line h_{c} and circle k(E_{b},B) intersect; points H and E_{b} are not the same
% Determination conditions: lines c and h_{a} are not the same; points H_{a} and H are not the same
    ; points B and H_{a} must be different; points H_{c} and B are not the same; points H and H_{c}
     must be different; points B and C are not the same; points E_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H=_H

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

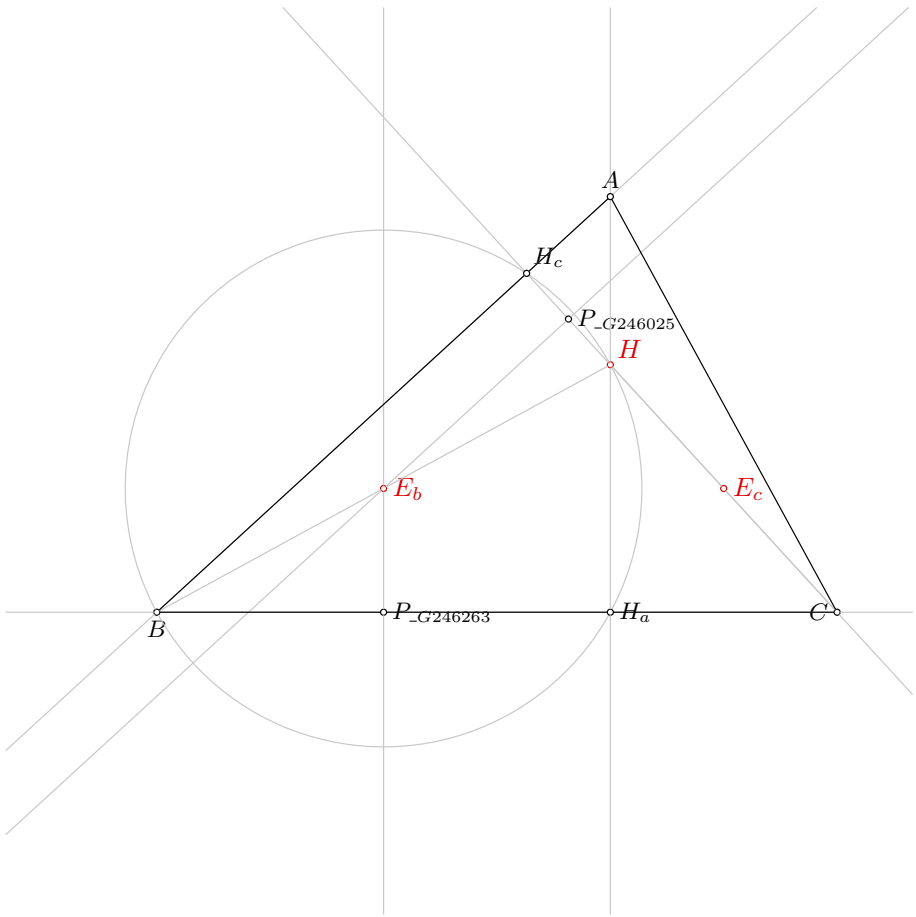

Figure 1: Illustration of the problem 0868

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving H=_H

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 2174 terms.

Time Complexity: Time spent by the prover is 1.880 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving H=_H

Proving failed

Problem 869

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 869: Given a point E_b, a point E_c and a point H_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;
2. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;
3. Using the circle $k(E_b, B)$, the circle $k(E_c, C)$, the point H_a, the point E_b and the point E_c, construct a point H (rule W08); % NDG: circles $k(E_b, B)$ and $k(E_c, C)$ intersect % DET: circles $k(E_b, B)$ and $k(E_c, C)$ are not the same; points H_a and H must be different;
4. Using the point H and the point E_b, construct a point B (rule W01); ;
5. Using the point E_c and the point H, construct a point C (rule W01); ;
6. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
7. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
8. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H and H_c must be different;
9. Using the point B and the point H_c, construct a line c (rule W02); % DET: points B and H_c are not the same;
10. Using the line h_a and the line c, construct a point A (rule W03); % NDG: lines h_a and c are not parallel % DET: lines h_a and c are not the same.

Non-degenerate conditions: lines h_a and c are not parallel; line h_c and circle $k(E_b, B)$ intersect; circles $k(E_b, B)$ and $k(E_c, C)$ intersect; points H_a and E_c are not the same; points H_a and E_b are not the same.

Determination conditions: lines h_a and c are not the same; points B and H_c are not the same; points H and H_c must be different; points H_a and H are not the same; points E_c and H are not the same; circles $k(E_b, B)$ and $k(E_c, C)$ are not the same; points H_a and H must be different.

Rules used: [W01,W02,W03,W05,W06,W08]

Lemmas used: [D10,D29,D3,D30,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51,L52,L54]

Solving time: 10.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point E_{c} 95 56.36
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r E_{c}
cmark_r H_{a}
color 0 0 0
fontsize 8

% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: circles k(E_{b},B) and k(E_{c},C) intersect% DET: circles k(E_{b},B) and k(E_{c},C) are not
    the same; points H_{a} and H must be different
% Constructing a line L_{\_G62152} which passes through point E_{b} and point E_{c}
line L_{\_G62152} E_{b} E_{c}
```

```
color 200 200 200
drawline L_{\_G62152}
color 0 0 0


% Constructing a point H which is an image of the point H_{a} in the symmetry to point/line L_{\_G
    62152}
sim H L_{\_G62152} H_{a}
cmark_rt H



% Constructing a point B such that HB/HE_{b}=2
towards B H E_{b} 2
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G62569} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G62569} E_{b} h_{c}
cmark_r P_{\_G62569}
color 200 200 200
drawline E_{b} P_{\_G62569}
```

```
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    62569}
sim H_{c} P_{\_G62569} H
cmark_rt H_{c}


% DET: points B and H_{c} are not the same
% Constructing a line c which passes through point B and point H_{c}
line c B H_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{a} and c are not parallel% DET: lines h_{a} and c are not the same
% Constructing a point A which belongs to line h_{a} and line c
intersec A h_{a} c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and c are not parallel; line h_{c} and circle k(E_{b},B)
    intersect; circles k(E_{b},B) and k(E_{c},C) intersect; points H_{a} and E_{c} are not the same
    ; points H_{a} and E_{b} are not the same
% Determination conditions: lines h_{a} and c are not the same; points B and H_{c} are not the same
    ; points H and H_{c} must be different; points H_{a} and H are not the same; points E_{c} and H
     are not the same; circles k(E_{b},B) and k(E_{c},C) are not the same; points H_{a} and H must
    be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving E_c=_E_c

Proving failed

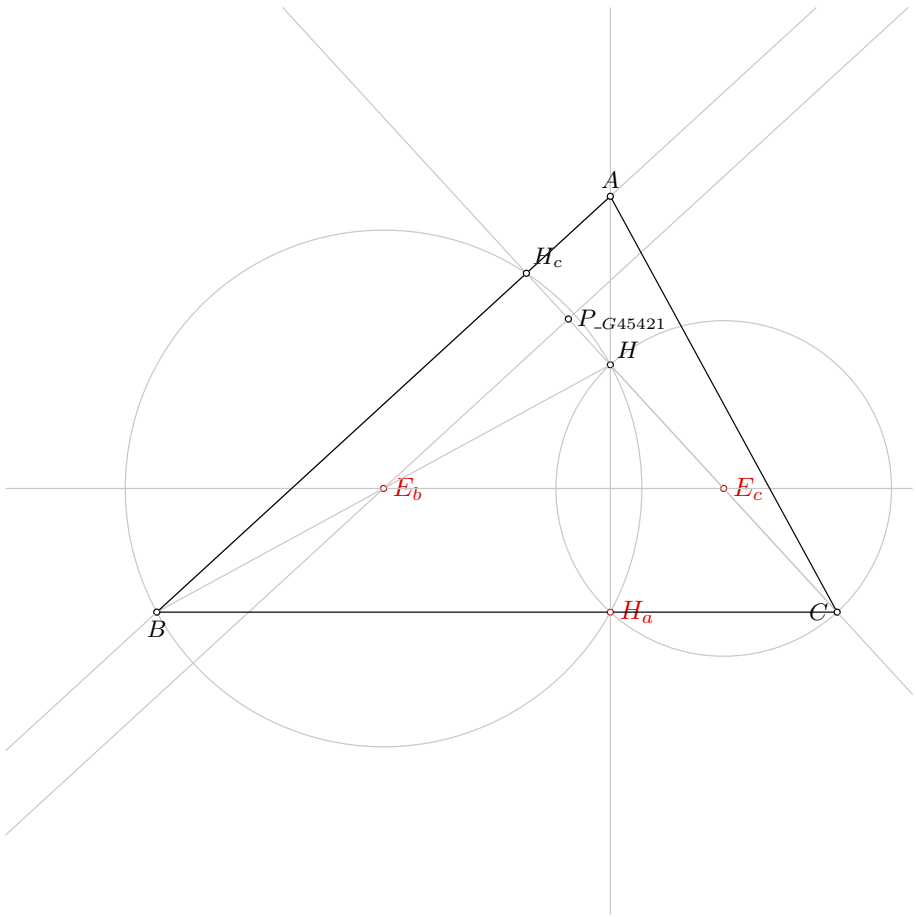

Figure 1: Illustration of the problem 0869

4.1.3 Proving H_a=_H_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 870

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 870: Given a point E_b, a point E_c and a point H_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
3. Using the circle $k(E_c, C)$, the line h_b, the point E_c and the point H_b, construct a point H (rule W05); % NDG: line h_b and circle $k(E_c, C)$ intersect % DET: points H_b and H must be different;
4. Using the point H and the point E_b, construct a point B (rule W01); ;
5. Using the point E_c and the point H, construct a point C (rule W01); ;
6. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
7. Using the point B and the point C, construct a line a (rule W02); % DET: points B and C are not the same;
8. Using the circle $k(E_c, C)$, the line a, the point E_c and the point C, construct a point H_a (rule W05); % NDG: line a and circle $k(E_c, C)$ intersect % DET: points C and H_a must be different;
9. Using the point H and the point H_a, construct a line h_a (rule W02); % DET: points H and H_a are not the same;
10. Using the line b and the line h_a, construct a point A (rule W03); % NDG: lines b and h_a are not parallel % DET: lines b and h_a are not the same.

Non-degenerate conditions: lines b and h_a are not parallel; line a and circle $k(E_c, C)$ intersect; line h_b and circle $k(E_c, C)$ intersect; points H_b and E_c are not the same.

Determination conditions: lines b and h_a are not the same; points H and H_a are not the same; points C and H_a must be different; points B and C are not the same; points H_b and C are not the same; points H_b and H must be different; points E_b and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D29,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 9.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point E_{c} 95 56.36
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r E_{c}
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line h_{b} and circle k(E_{c},C) intersect% DET: points H_{b} and H must be different
% Constructing a point P_{\_G91827} which is a foot of the point E_{c} on the line h_{b}
foot P_{\_G91827} E_{c} h_{b}
cmark_r P_{\_G91827}
color 200 200 200
drawline E_{c} P_{\_G91827}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    91827}
sim H P_{\_G91827} H_{b}
cmark_rt H



% Constructing a point B such that HB/HE_{b}=2
towards B H E_{b} 2
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% DET: points B and C are not the same
% Constructing a line a which passes through point B and point C
line a B C

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(E_{c},C) intersect% DET: points C and H_{a} must be different
% Constructing a point P_{\_G92264} which is a foot of the point E_{c} on the line a
foot P_{\_G92264} E_{c} a
cmark_r P_{\_G92264}
color 200 200 200
drawline E_{c} P_{\_G92264}
color 0 0 0

% Constructing a point H_{a} which is an image of the point C in the symmetry to point/line P_{\_G
    92264}
sim H_{a} P_{\_G92264} C
```

```
cmark_r H_{a}


% DET: points H and H_{a} are not the same
% Constructing a line h_{a} which passes through point H and point H_{a}
line h_{a} H H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines b and h_{a} are not parallel% DET: lines b and h_{a} are not the same
% Constructing a point A which belongs to line b and line h_{a}
intersec A b h_{a}
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{a} are not parallel; line a and circle k(E_{c},C)
    intersect; line h_{b} and circle k(E_{c},C) intersect; points H_{b} and E_{c} are not the same
% Determination conditions: lines b and h_{a} are not the same; points H and H_{a} are not the same
    ; points C and H_{a} must be different; points B and C are not the same; points H_{b} and C are
     not the same; points H_{b} and H must be different; points E_{b} and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

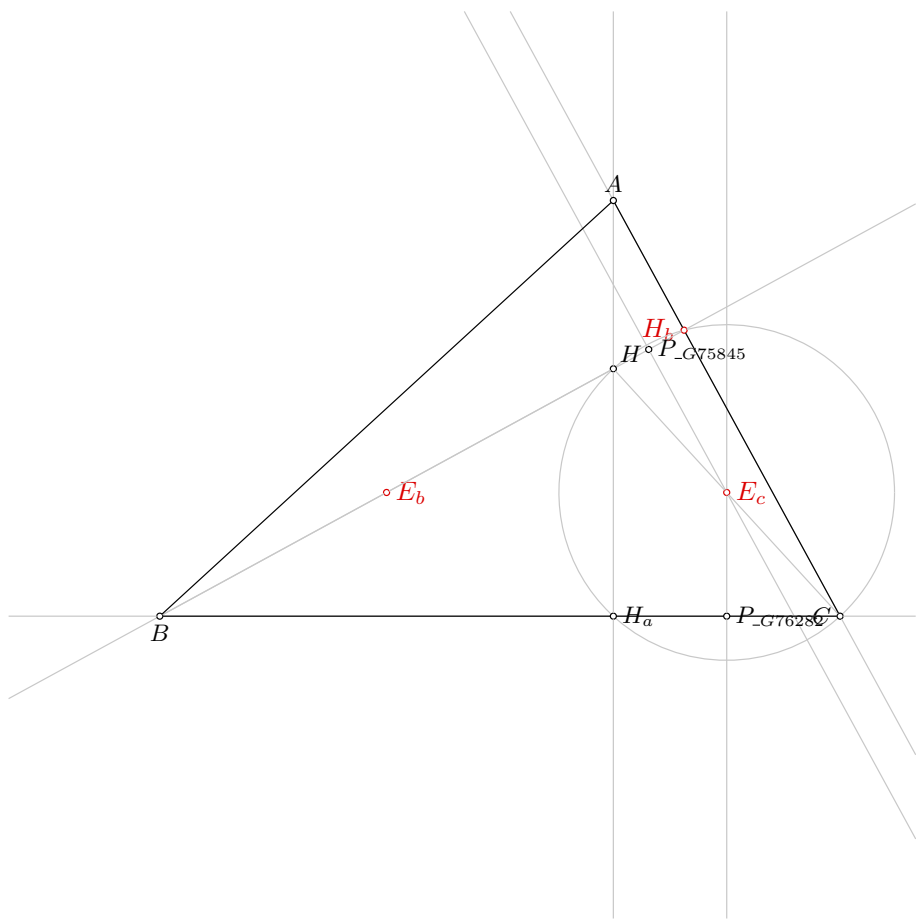

Figure 1: Illustration of the problem 0870

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 871

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 871: Given a point E_b, a point E_c and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
3. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H_c, construct a point H (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H_c and H must be different;
4. Using the point H and the point E_b, construct a point B (rule W01); ;
5. Using the point E_c and the point H, construct a point C (rule W01); ;
6. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
7. Using the point B and the point C, construct a line a (rule W02); % DET: points B and C are not the same;
8. Using the circle $k(E_b, B)$, the line a, the point E_b and the point B, construct a point H_a (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points B and H_a must be different;
9. Using the point H and the point H_a, construct a line h_a (rule W02); % DET: points H and H_a are not the same;
10. Using the line c and the line h_a, construct a point A (rule W03); % NDG: lines c and h_a are not parallel % DET: lines c and h_a are not the same.

Non-degenerate conditions: lines c and h_a are not parallel; line a and circle $k(E_b, B)$ intersect; line h_c and circle $k(E_b, B)$ intersect; points H_c and E_b are not the same.

Determination conditions: lines c and h_a are not the same; points H and H_a are not the same; points B and H_a must be different; points B and C are not the same; points H_c and B are not the same; points H_c and H must be different; points E_c and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D29,D3,D30,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 9.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point E_{c} 95 56.36
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r E_{c}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H_{c} and H must be different
% Constructing a point P_{\_G122182} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G122182} E_{b} h_{c}
cmark_r P_{\_G122182}
color 200 200 200
drawline E_{b} P_{\_G122182}
color 0 0 0
```

```
% Constructing a point H which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    122182}
sim H P_{\_G122182} H_{c}
cmark_rt H



% Constructing a point B such that HB/HE_{b}=2
towards B H E_{b} 2
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% DET: points B and C are not the same
% Constructing a line a which passes through point B and point C
line a B C

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points B and H_{a} must be different
% Constructing a point P_{\_G122619} which is a foot of the point E_{b} on the line a
foot P_{\_G122619} E_{b} a
cmark_r P_{\_G122619}
color 200 200 200
drawline E_{b} P_{\_G122619}
color 0 0 0

% Constructing a point H_{a} which is an image of the point B in the symmetry to point/line P_{\_G
    122619}
sim H_{a} P_{\_G122619} B
```

```
cmark_r H_{a}


% DET: points H and H_{a} are not the same
% Constructing a line h_{a} which passes through point H and point H_{a}
line h_{a} H H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines c and h_{a} are not parallel% DET: lines c and h_{a} are not the same
% Constructing a point A which belongs to line c and line h_{a}
intersec A c h_{a}
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{a} are not parallel; line a and circle k(E_{b},B)
    intersect; line h_{c} and circle k(E_{b},B) intersect; points H_{c} and E_{b} are not the same
% Determination conditions: lines c and h_{a} are not the same; points H and H_{a} are not the same
    ; points B and H_{a} must be different; points B and C are not the same; points H_{c} and B are
     not the same; points H_{c} and H must be different; points E_{c} and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving E_c=_E_c

Proving failed

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

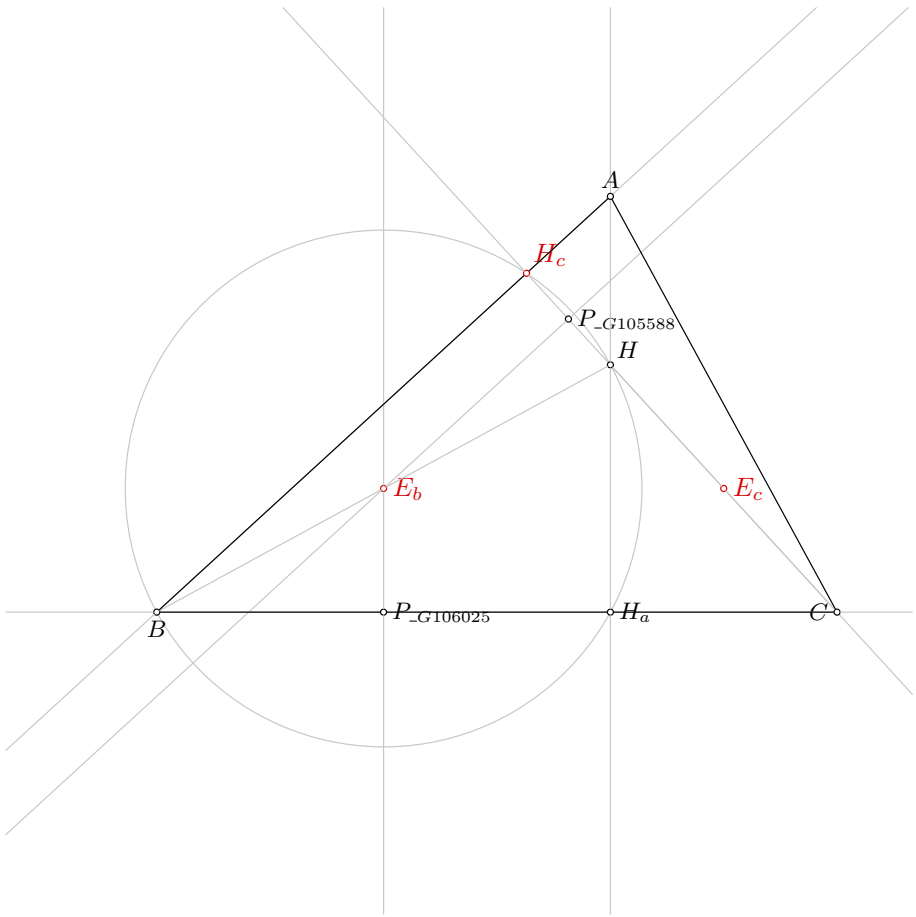

Figure 1: Illustration of the problem 0871

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving H_c=_H_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 872

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 872: Given a point E_b, a point E_c and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 873

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 873: Given a point E_b, a point E_c and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_a, construct a line $m(CH_b)$ (rule W02); % DET: points E_c and M_a are not the same;

2. Using the point E_b and the point E_c, construct a line $m(E_bE_c)$ (rule W14); % DET: points E_b and E_c are not the same;

3. Using the point E_b and the point M_a, construct a line $m(E_bM_a)$ (rule W14); % DET: points E_b and M_a are not the same;

4. Using the line $m(E_bM_a)$ and the line $m(E_bE_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_a)$ and $m(E_bE_c)$ are not parallel % DET: lines $m(E_bM_a)$ and $m(E_bE_c)$ are not the same;

5. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;

6. Using the point E_b and the line $m(CH_b)$, construct a line h_b (rule W16); ;

7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;

8. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;

9. Using the circle $k(E_c, C)$, the line h_b, the point E_c and the point H_b, construct a point H (rule W05); % NDG: line h_b and circle $k(E_c, C)$ intersect % DET: points H_b and H must be different;

10. Using the point H and the point E_b, construct a point B (rule W01); ;
11. Using the point E_c and the point H, construct a point C (rule W01); ;
12. Using the point N and the point H, construct a point G (rule W01); ;
13. Using the point M_a and the point G, construct a point A (rule W01); .

Non-degenerate conditions: line h_b and circle $k(E_c, C)$ intersect; points H_b and E_c are not the same; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same; lines $m(E_bM_a)$ and $m(E_bE_c)$ are not parallel.

Determination conditions: points H_b and H must be different; points E_b and H_b must be different; lines $m(E_bM_a)$ and $m(E_bE_c)$ are not the same; points E_b and M_a are not the same; points E_b and E_c are not the same; points E_c and M_a are not the same.

Rules used: [W01,W02,W03,W05,W06,W14,W16]

Lemmas used: [D29,D3,D30,D32,D6,D9,GD02,GL01,GL03,GL04,GL09,L16,L20,L23,L24,L37,L38,L52,L53,L55

Solving time: 25.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point E_{c} 95 56.36
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r E_{c}
cmark_r M_{a}
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{a} are not the same
% Constructing a line m(CH_{b}) which passes through point E_{c} and point M_{a}
line m(CH_{b}) E_{c} M_{a}

color 200 200 200
drawline m(CH_{b})
color 0 0 0



% DET: points E_{b} and E_{c} are not the same
% Constructing bisector m(E_{b}E_{c}) of the segment E_{b}E_{c}
med m(E_{b}E_{c}) E_{b} E_{c}

color 200 200 200
drawline m(E_{b}E_{c})
color 0 0 0
```

```
color 200 200 200
drawsegment E_{b} E_{c}
color 0 0 0


% DET: points E_{b} and M_{a} are not the same
% Constructing bisector m(E_{b}M_{a}) of the segment E_{b}M_{a}
med m(E_{b}M_{a}) E_{b} M_{a}

color 200 200 200
drawline m(E_{b}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{a}
color 0 0 0


% NDG: lines m(E_{b}M_{a}) and m(E_{b}E_{c}) are not parallel% DET: lines m(E_{b}M_{a}) and m(E_{b}
    E_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{a}) and line m(E_{b}E_{c})
intersec N m(E_{b}M_{a}) m(E_{b}E_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Constructing a line h_{b} which contains the point E_{b} and is parallel to the line m(CH_{b})
parallel h_{b} E_{b} m(CH_{b})

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G169415} which is a foot of the point N on the line h_{b}
foot P_{\_G169415} N h_{b}
cmark_r P_{\_G169415}
color 200 200 200
drawline N P_{\_G169415}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G169415}
sim H_{b} P_{\_G169415} E_{b}
```

```
cmark_l H_{b}


% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line h_{b} and circle k(E_{c},C) intersect% DET: points H_{b} and H must be different
% Constructing a point P_{\_G169719} which is a foot of the point E_{c} on the line h_{b}
foot P_{\_G169719} E_{c} h_{b}
cmark_r P_{\_G169719}
color 200 200 200
drawline E_{c} P_{\_G169719}
color 0 0 0

% Constructing a point H which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    169719}
sim H P_{\_G169719} H_{b}
cmark_rt H



% Constructing a point B such that HB/HE_{b}=2
towards B H E_{b} 2
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a line L_{\_G169981} which passes through point N and point H
line L_{\_G169981} N H

color 200 200 200
drawline L_{\_G169981}
color 0 0 0


% Constructing a point P_{\_G170082} with coordinates (0,0)
```

```
point P_{\_G170082} 0 0
cmark_r P_{\_G170082}

% Constructing a point P_{\_G170006} such that NP_{\_G170006}/NP_{\_G170082}=-1
towards P_{\_G170006} N P_{\_G170082} -1
cmark_r P_{\_G170006}
color 200 200 200
drawsegment P_{\_G170082} P_{\_G170006}
color 0 0 0

% Constructing a point P_{\_G170051} such that NP_{\_G170051}/NP_{\_G170082}=3
towards P_{\_G170051} N P_{\_G170082} 3
cmark_r P_{\_G170051}
color 200 200 200
drawsegment N P_{\_G170051}
color 0 0 0

% Constructing a line L_{\_G170012} which passes through point H and point P_{\_G170051}
line L_{\_G170012} H P_{\_G170051}

color 200 200 200
drawline L_{\_G170012}
color 0 0 0


% Constructing a line L_{\_G169975} which contains the point P_{\_G170006} and is parallel to the
    line L_{\_G170012}
parallel L_{\_G169975} P_{\_G170006} L_{\_G170012}

color 200 200 200
drawline L_{\_G169975}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G169975} and line L_{\_G169981}
intersec G L_{\_G169975} L_{\_G169981}
cmark_t G



% Constructing a point A such that M_{a}A/M_{a}G=3
towards A M_{a} G 3
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line h_{b} and circle k(E_{c},C) intersect; points H_{b} and E_{c} are
     not the same; line h_{b} and circle k(N,M_{a}) intersect; points E_{b} and N are not the same;
     lines m(E_{b}M_{a}) and m(E_{b}E_{c}) are not parallel
```

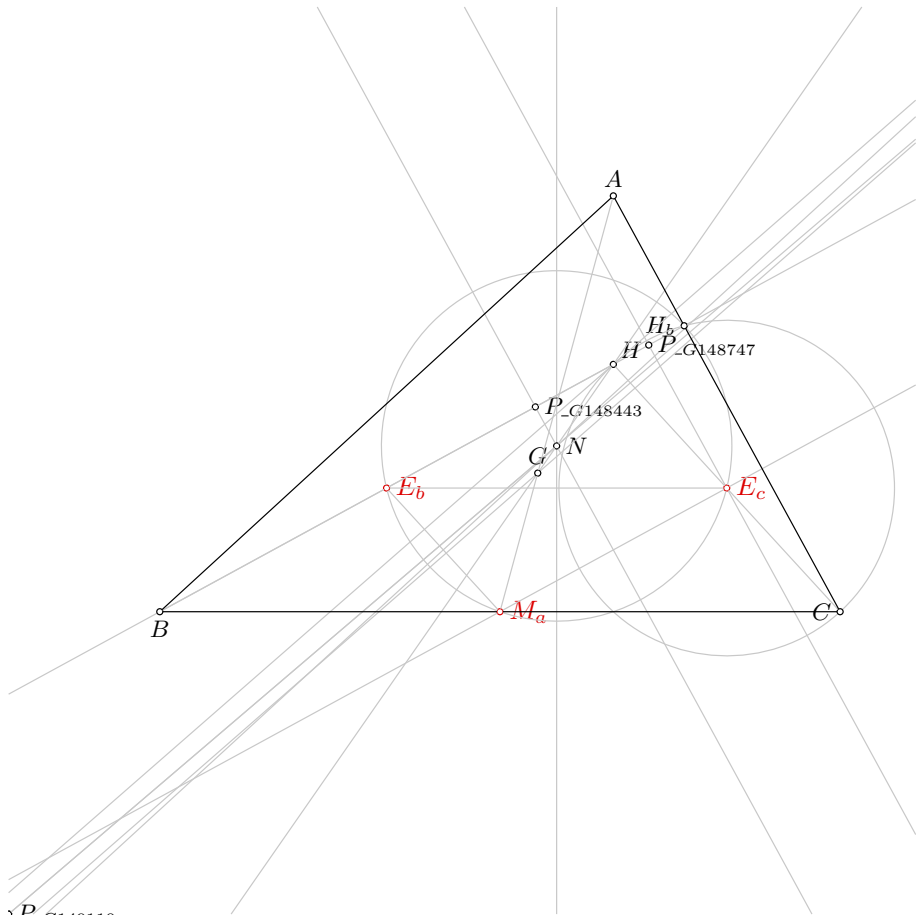

Figure 1: Illustration of the problem 0873

```
% Determination conditions: points H_{b} and H must be different; points E_{b} and H_{b} must be
    different; lines m(E_{b}M_{a}) and m(E_{b}E_{c}) are not the same; points E_{b} and M_{a} are
    not the same; points E_{b} and E_{c} are not the same; points E_{c} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2812 terms.

Time Complexity: Time spent by the prover is 9.422 seconds.

NDG conditions Points E_b and M_a are not identical

Points E_b and M_a are not identical

Points E_c, E_b and M_a are not collinear

Line through points E_c and E_b is not perpendicular to line through points E_b and M_a

Points E_b and $P\_G161284$ are not identical

Points A, B and C are not collinear

Line through points E_c and B is not perpendicular to line through points B and E_b

4.1.2 Proving E_c=_E_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2820 terms.

Time Complexity: Time spent by the prover is 9.817 seconds.

NDG conditions Points E_b and M_a are not identical

Points E_b and M_a are not identical

Points E_c, E_b and M_a are not collinear

Line through points E_c and $P\_G163334$ is not perpendicular to line through points $P\_G163334$ and M_a

Points E_c, $P\_G163334$ and E_b are not collinear

Points A, B and C are not collinear

Line through points E_c and B is not perpendicular to line through points B and E_b

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 17 terms.

Time Complexity: Time spent by the prover is 1.151 seconds.

NDG conditions Points E_b and M_a are not identical

Points E_b and M_a are not identical

Points E_c, E_b and M_a are not collinear

Line through points E_c and E_b is not perpendicular to line through points E_b and M_a

Points E_b and $P\_G165384$ are not identical

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving E_c=_E_c

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving E_c=_E_c

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving E_c=_E_c

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 874

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 874: Given a point E_b, a point M_b and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
2. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;
3. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;
4. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
5. Choose freely a point E_c on the circle $k(N, M_a)$ (rule WOncircle);
6. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
8. Choose freely a point A (rule free);
9. Using the point A and the point M_b, construct a point C (rule W01); ;
10. Using the point A and the point M_c, construct a point B (rule W01); .

Non-degenerate conditions: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel.

Determination conditions: points E_c and M_c must be different; points E_c and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points E_b and M_b are not the same.

Rules used: [W01,W02,W03,W05a,W06,W14,WOncircle1,free]

Lemmas used: [D20,D22,D32,GD02,GL01,GL03,GL04,L17,L18,L19,L20,L21,L23,L24,L41,L42,L44,L45,L50,L51

Solving time: 199.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point M_{b} 95 67.5
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_lt M_{b}
cmark_r E_{c}
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0


% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N
```

```
% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% Choosing randomly a point E_{c} on the circle with center N through point E_{b}
oncircle E_{c} N E_{b}
cmark_r E_{c}
color 200 200 200
drawcircle N E_{b}
color 0 0 0


% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
```

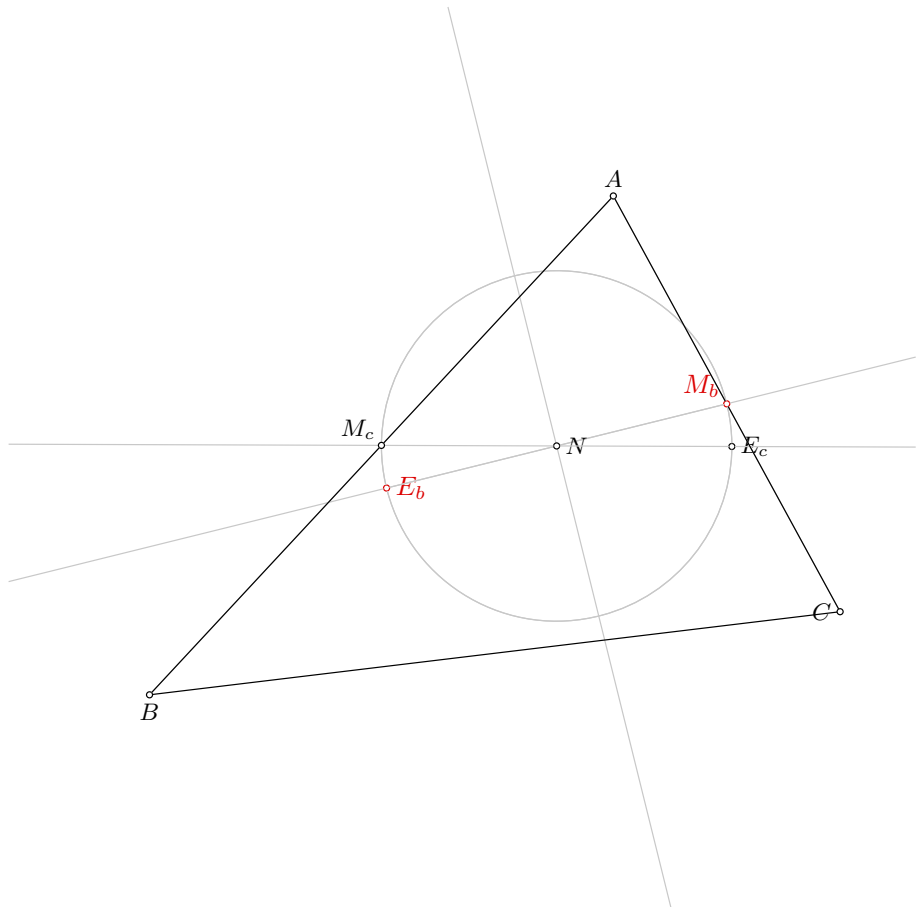

Figure 1: Illustration of the problem 0874

```
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect; points E_{b} and N
     are not the same; lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel
% Determination conditions: points E_{c} and M_{c} must be different; points E_{c} and N are not
    the same; lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the same; points E_{b} and M_{b} are
    not the same; points E_{b} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.054 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving M_b=_M_b

NDG conditions are:

$S_{M^0_{m(E_bM_b)}E_bM_b} \neq S_{T^1_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^0_{m(E_bM_b)}T^1_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 42

Time spent by the prover: 0.000 seconds

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving M_b=_M_b

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 875

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 875: Given a point E_c, a point M_c and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
2. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;
3. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;
4. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
5. Choose freely a point E_b on the circle $k(N, M_a)$ (rule WOncircle);
6. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
8. Choose freely a point A (rule free);
9. Using the point A and the point M_c, construct a point B (rule W01); ;
10. Using the point A and the point M_b, construct a point C (rule W01); .

Non-degenerate conditions: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: points E_b and M_b must be different; points E_b and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points E_c and M_c are not the same.

Rules used: [W01,W02,W03,W05a,W06,W14,WOncircle1,free]

Lemmas used: [D20,D22,D32,GD02,GL01,GL03,GL04,L17,L18,L19,L20,L21,L23,L24,L41,L42,L44,L45,L50,L51

Solving time: 199.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point M_{c} 50 67.5
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_lt M_{c}
cmark_r E_{b}
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0


% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N
```

```
% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{b} on the circle with center N through point E_{c}
oncircle E_{b} N E_{c}
cmark_r E_{b}
color 200 200 200
drawcircle N E_{c}
color 0 0 0


% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
```

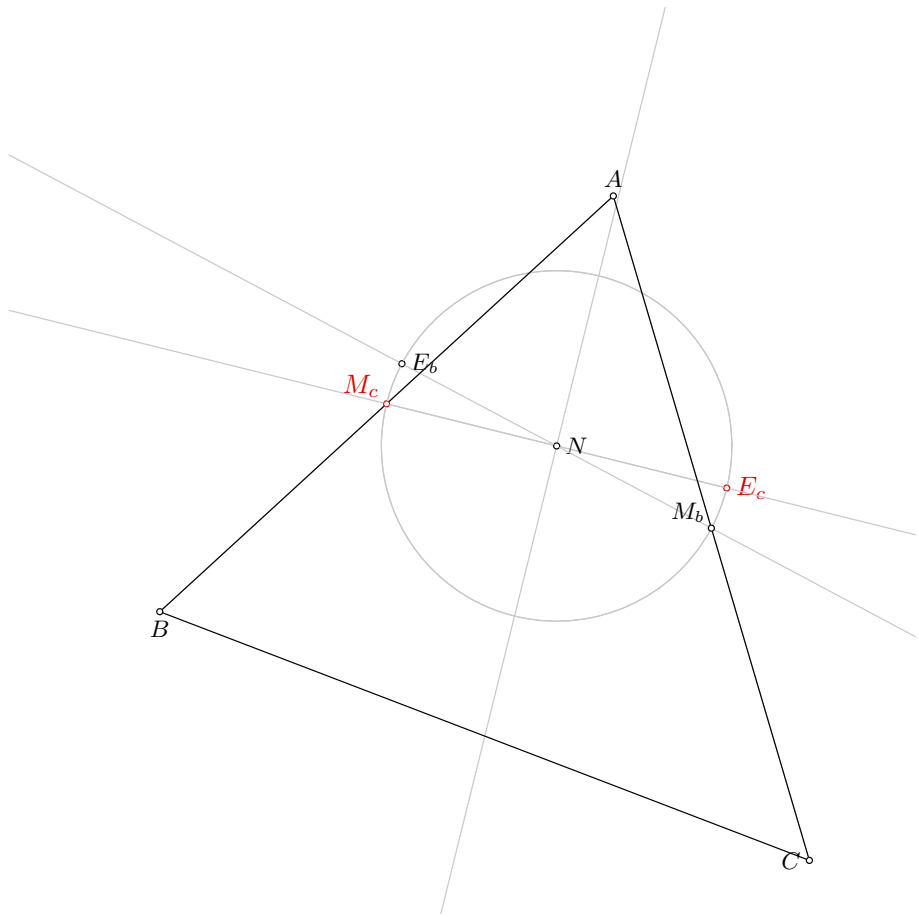

Figure 1: Illustration of the problem 0875

```
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; points E_{c} and N
     are not the same; lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel
% Determination conditions: points E_{b} and M_{b} must be different; points E_{b} and N are not
    the same; lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the same; points E_{c} and M_{c} are
    not the same; points E_{c} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.051 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving M_c=_M_c

NDG conditions are:

$S_{M^0_{m(E_cM_c)}E_cM_c} \neq S_{T^1_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^0_{m(E_cM_c)}T^1_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving M_c=_M_c

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 876

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 876: Given a point E_c, a point N and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
2. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
3. Choose freely a point E_b on the circle $k(N, M_a)$ (rule WOncircle);
4. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
5. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
6. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
7. Choose freely a point A (rule free);
8. Using the point A and the point M_c, construct a point B (rule W01); ;
9. Using the point A and the point M_b, construct a point C (rule W01); .

Non-degenerate conditions: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: points E_b and M_b must be different; points E_c and M_c must be different; points E_b and N are not the same; points E_c and N are not the same.

Rules used: [W01,W02,W05a,W06,WOncircle1,free]

Lemmas used: [D20,D22,D32,GD02,GL01,GL03,GL04,L17,L18,L19,L20,L21,L23,L24,L41,L42,L44,L45,L50,L51

Solving time: 150.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point N 72.5 61.93
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_r N
cmark_r E_{b}
color 0 0 0
fontsize 8

% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{b} on the circle with center N through point E_{c}
oncircle E_{b} N E_{c}
cmark_r E_{b}
color 200 200 200
drawcircle N E_{c}
color 0 0 0


% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
```

```
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}


% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; line m(H_{b}H_{a})
     and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: points E_{b} and M_{b} must be different; points E_{c} and M_{c} must
    be different; points E_{b} and N are not the same; points E_{c} and N are not the same
```

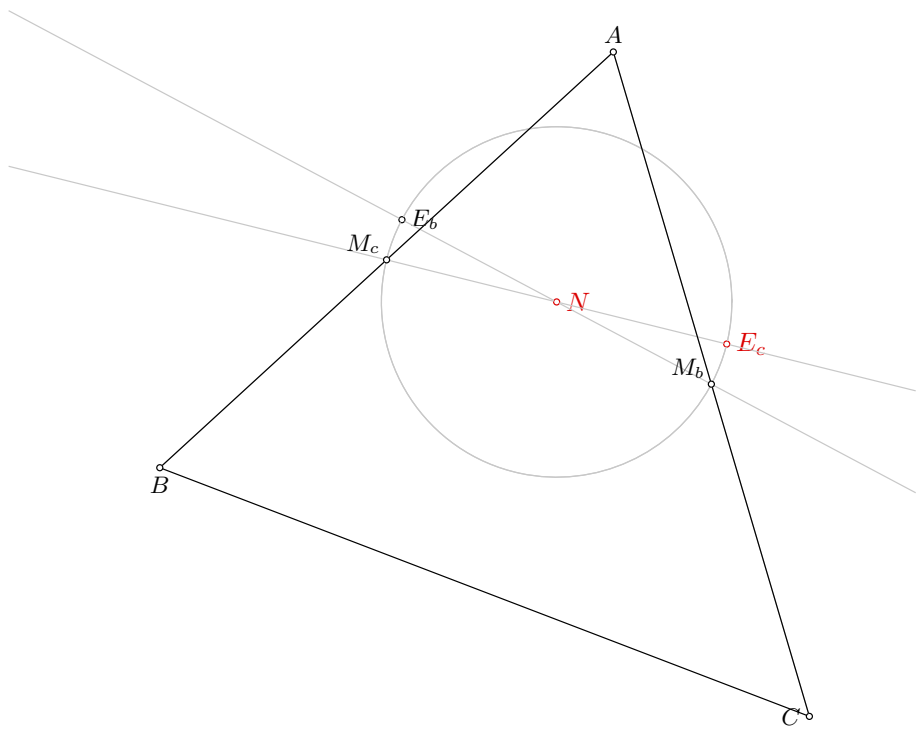

Figure 1: Illustration of the problem 0876

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 877

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 877: Given a point E_b, a point E_c and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 878

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 878: Given a point E_b, a point E_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 879

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 879: Given a point E_b, a point E_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 880

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 880: Given a point E_b, a point E_c and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 881

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 881: Given a point E_b, a point G and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H, construct a point B (rule W01); ;
2. Using the point G and the point H, construct a point N (rule W01); ;
3. Using the point G and the point H, construct a point O (rule W01); ;
4. Using the point G and the point B, construct a point M_b (rule W01); ;
5. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
6. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points E_b and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L16,L20,L23,L56,L58]

Solving time: 7.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point G 70 58.33
point H 80 72.73

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_t G
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point N such that GN/GH=0.25
towards N G H 0.25
cmark_r N
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a point M_{b} such that GM_{b}/GB=-0.5
```

```
towards M_{b} G B -0.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G70721} which is a foot of the point N on the line h_{b}
foot P_{\_G70721} N h_{b}
cmark_r P_{\_G70721}
color 200 200 200
drawline N P_{\_G70721}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G70721}
sim H_{b} P_{\_G70721} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points E_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points E_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving H=_H

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving H=_H

Proving failed

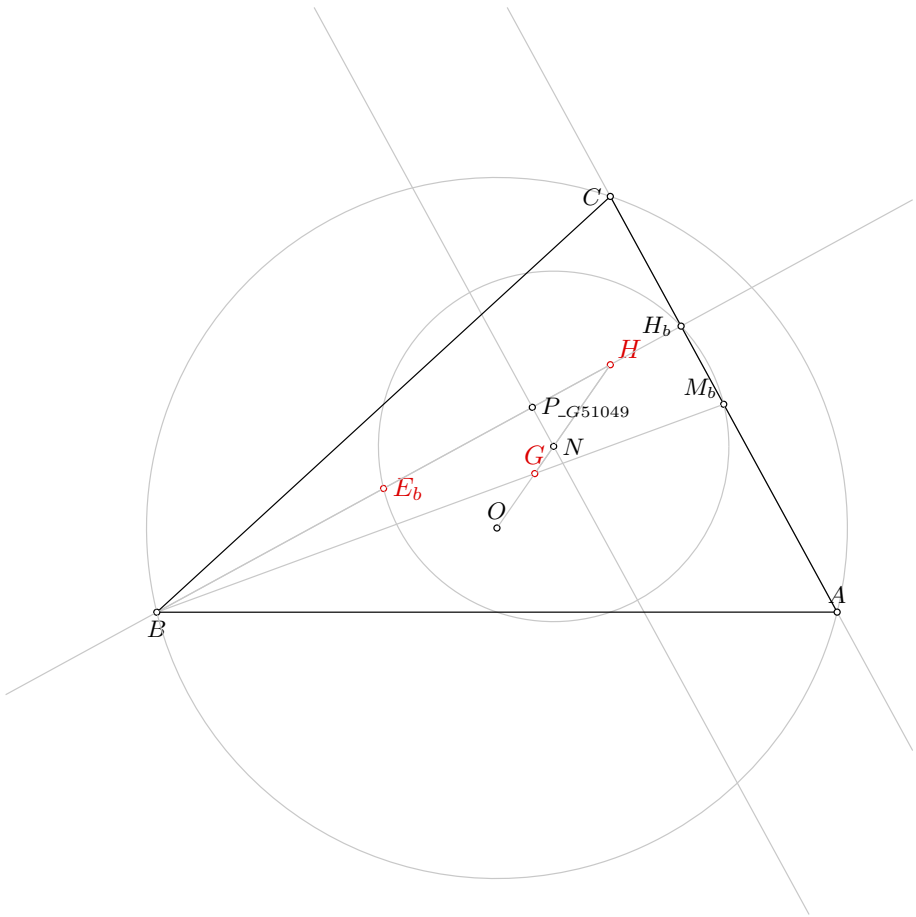

Figure 1: Illustration of the problem 0881

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving H=_H

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving H=_H

Proving failed

Problem 882

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 882: Given a point E_b, a point G and a point H_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 883

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 883: Given a point E_b, a point G and a point H_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Using the point H_b and the line h_b, construct a line b (rule W10a); ;
3. Using the point G, the line h_b and the point E_b, construct a line $h_{G,-1/2}(h_b)$ (rule W15); ;
4. Using the line $h_{G,-1/2}(h_b)$ and the line b, construct a point M_b (rule W03); % NDG: lines $h_{G,-1/2}(h_b)$ and b are not parallel % DET: lines $h_{G,-1/2}(h_b)$ and b are not the same;
5. Using the point M_b and the point G, construct a point B (rule W01); ;
6. Using the point E_b and the point B, construct a point H (rule W01); ;
7. Using the point G and the point H, construct a point O (rule W01); ;
8. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
9. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; lines $h_{G,-1/2}(h_b)$ and b are not parallel.

Determination conditions: lines $h_{G,-1/2}(h_b)$ and b are not the same; points E_b and H_b are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W15]

Lemmas used: [D22,D26,D29,D3,D6,D9,GD01,GL02,GL03,GL04,GL09,L11,L12,L56,L58]

Solving time: 4.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point G 70 58.33
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_t G
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0




% Constructing a line b which is perpendicular to line h_{b} and which passes through point H_{b}
perp b H_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0




% Constructing a point P_{\_G103345} such that GP_{\_G103345}/GE_{b}=-0.5
towards P_{\_G103345} G E_{b} -0.5
cmark_r P_{\_G103345}
color 200 200 200
drawsegment E_{b} P_{\_G103345}
color 0 0 0

% Constructing a line h_{G,-1/2}(h_{b}) which contains the point P_{\_G103345} and is parallel to
    the line h_{b}
parallel h_{G,-1/2}(h_{b}) P_{\_G103345} h_{b}

color 200 200 200
drawline h_{G,-1/2}(h_{b})
color 0 0 0
```

```
% NDG: lines h_{G,-1/2}(h_{b}) and b are not parallel% DET: lines h_{G,-1/2}(h_{b}) and b are not
    the same
% Constructing a point M_{b} which belongs to line h_{G,-1/2}(h_{b}) and line b
intersec M_{b} h_{G,-1/2}(h_{b}) b
cmark_lt M_{b}



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



% Constructing a point H such that E_{b}H/E_{b}B=-1
towards H E_{b} B -1
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

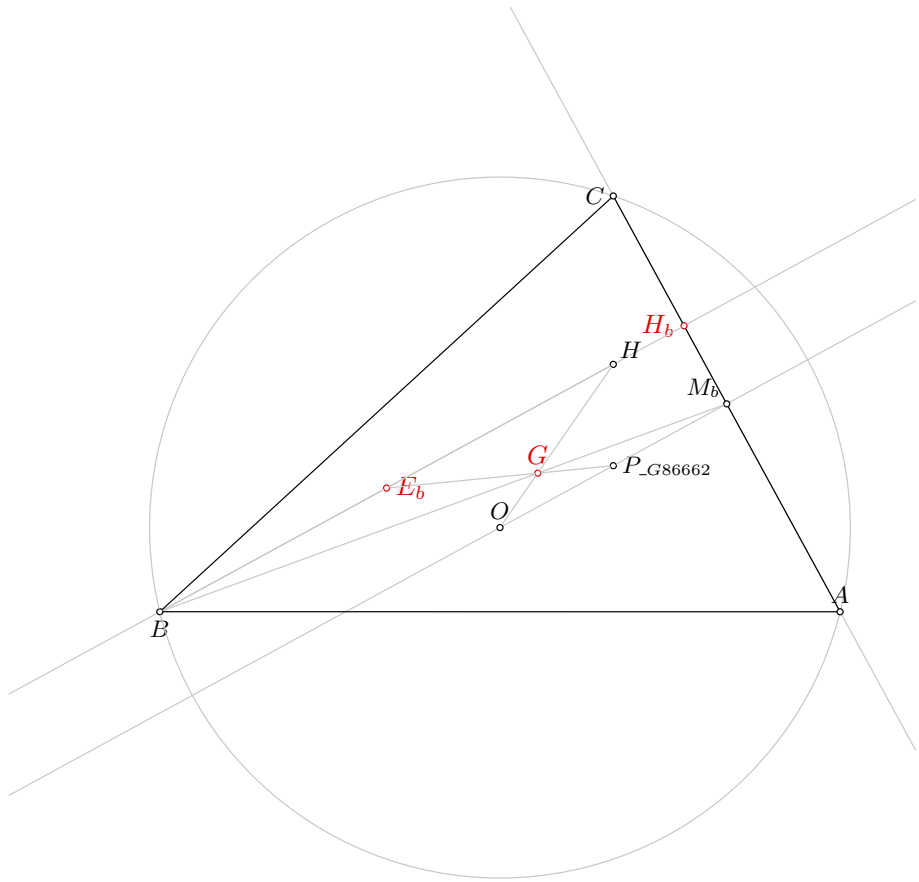

Figure 1: Illustration of the problem 0883

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    lines h_{G,-1/2}(h_{b}) and b are not parallel
% Determination conditions: lines h_{G,-1/2}(h_{b}) and b are not the same; points E_{b} and H_{b}
    are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 884

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 884: Given a point E_b, a point G and a point H_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 885

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 885: Given a point E_b, a point G and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 886

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 886: Given a point E_b, a point G and a point M_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 887

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 887: Given a point E_b, a point G and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point M_b, construct a point B (rule W01); ;
2. Using the point E_b and the point B, construct a point H (rule W01); ;
3. Using the point G and the point H, construct a point N (rule W01); ;
4. Using the point G and the point H, construct a point O (rule W01); ;
5. Using the point E_b and the point B, construct a line h_b (rule W02); % DET: points E_b and B are not the same;
6. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points E_b and B are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L16,L20,L23,L56,L58]

Solving time: 7.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point G 70 58.33
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_t G
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point B such that GB/GM_{b}=-2
towards B G M_{b} -2
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



% Constructing a point H such that E_{b}H/E_{b}B=-1
towards H E_{b} B -1
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point N such that GN/GH=0.25
towards N G H 0.25
cmark_r N
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
```

```
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points E_{b} and B are not the same
% Constructing a line h_{b} which passes through point E_{b} and point B
line h_{b} E_{b} B

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G146870} which is a foot of the point N on the line h_{b}
foot P_{\_G146870} N h_{b}
cmark_r P_{\_G146870}
color 200 200 200
drawline N P_{\_G146870}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G146870}
sim H_{b} P_{\_G146870} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points E_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points E_{b} and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving M_b=_M_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving M_b=_M_b

Proving failed

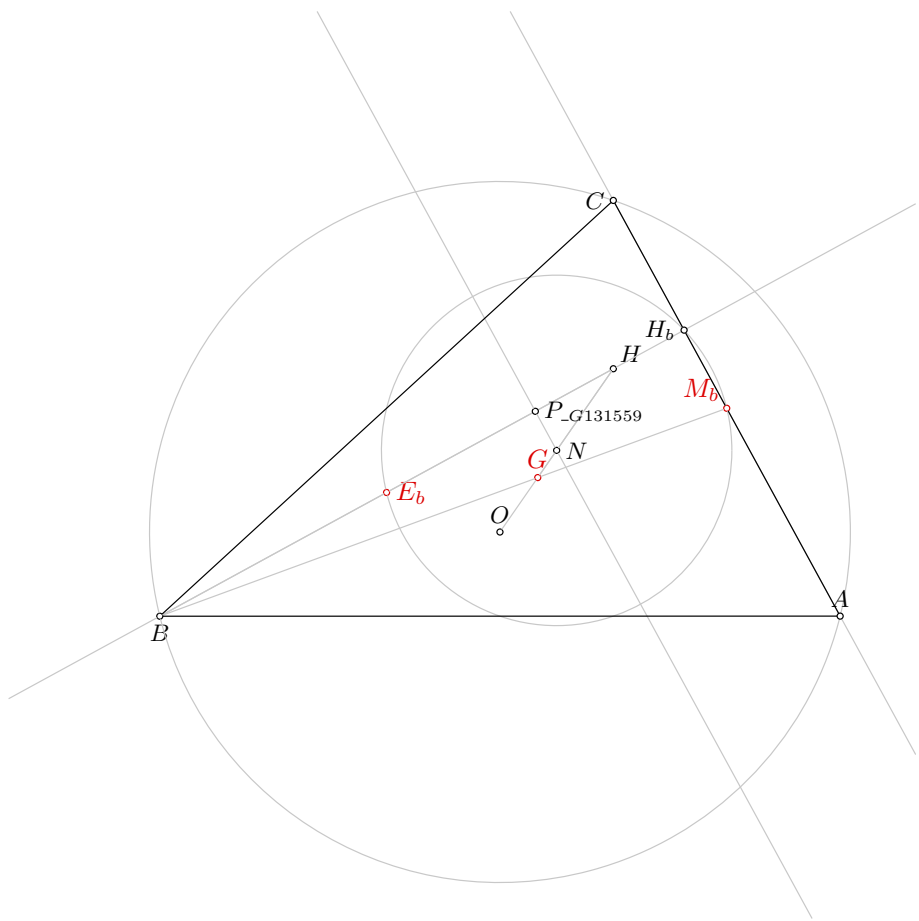

Figure 1: Illustration of the problem 0887

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving M_b=_M_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 888

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 888: Given a point E_b, a point G and a point M_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 889

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 889: Given a point E_b, a point G and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point N, construct a point H (rule W01); ;
2. Using the point E_b and the point H, construct a point B (rule W01); ;
3. Using the point G and the point N, construct a point O (rule W01); ;
4. Using the point G and the point B, construct a point M_b (rule W01); ;
5. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
6. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points E_b and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L20,L23,L56]

Solving time: 7.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point G 70 58.33
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_t G
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point O such that GO/GN=-2
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0



% Constructing a point M_{b} such that GM_{b}/GB=-0.5
```

```
towards M_{b} G B -0.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G193713} which is a foot of the point N on the line h_{b}
foot P_{\_G193713} N h_{b}
cmark_r P_{\_G193713}
color 200 200 200
drawline N P_{\_G193713}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G193713}
sim H_{b} P_{\_G193713} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points E_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points E_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving N=_N

Proving failed

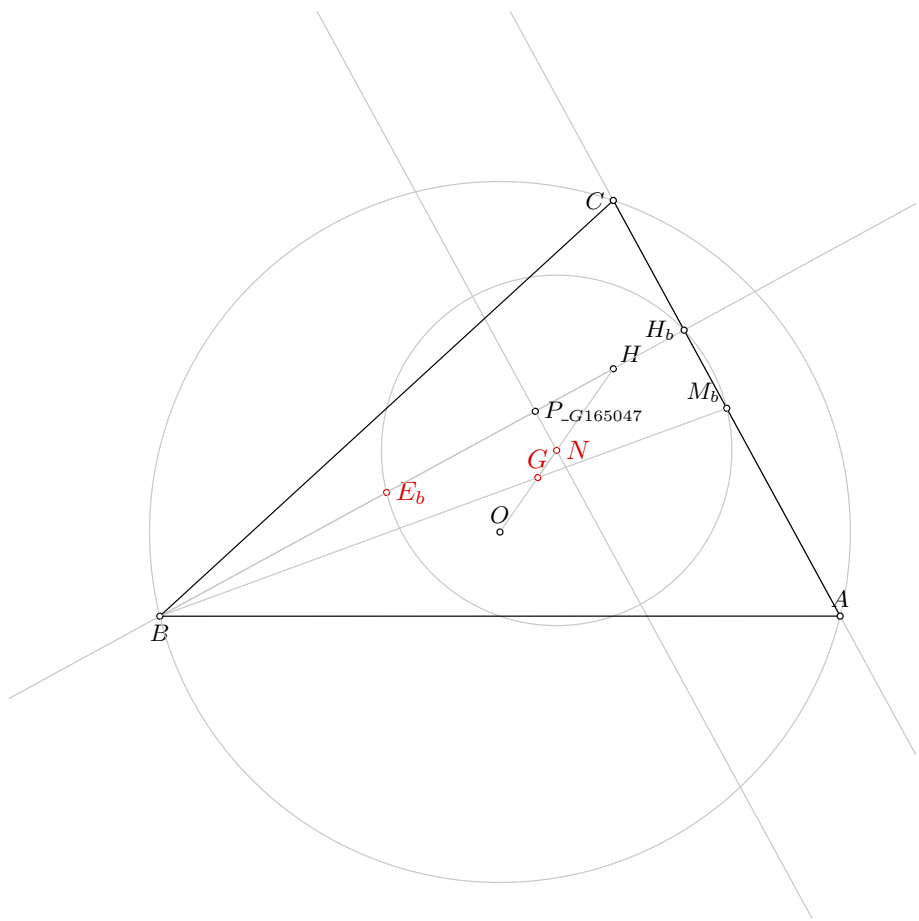

Figure 1: Illustration of the problem 0889

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 890

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 890: Given a point E_b, a point G and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point O, construct a point N (rule W01); ;
2. Using the point G and the point O, construct a point H (rule W01); ;
3. Using the point E_b and the point H, construct a point B (rule W01); ;
4. Using the point G and the point B, construct a point M_b (rule W01); ;
5. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
6. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points E_b and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L15,L20,L23,L56,L58]

Solving time: 7.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point G 70 58.33
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_t G
cmark_t O
color 0 0 0
fontsize 8


% Constructing a point N such that GN/GO=-0.5
towards N G O -0.5
cmark_r N
color 200 200 200
drawsegment O N
color 0 0 0



% Constructing a point H such that GH/GO=-2
towards H G O -2
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point M_{b} such that GM_{b}/GB=-0.5
```

```
towards M_{b} G B -0.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G225880} which is a foot of the point N on the line h_{b}
foot P_{\_G225880} N h_{b}
cmark_r P_{\_G225880}
color 200 200 200
drawline N P_{\_G225880}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G225880}
sim H_{b} P_{\_G225880} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points E_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points E_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving O=_O

Proving failed

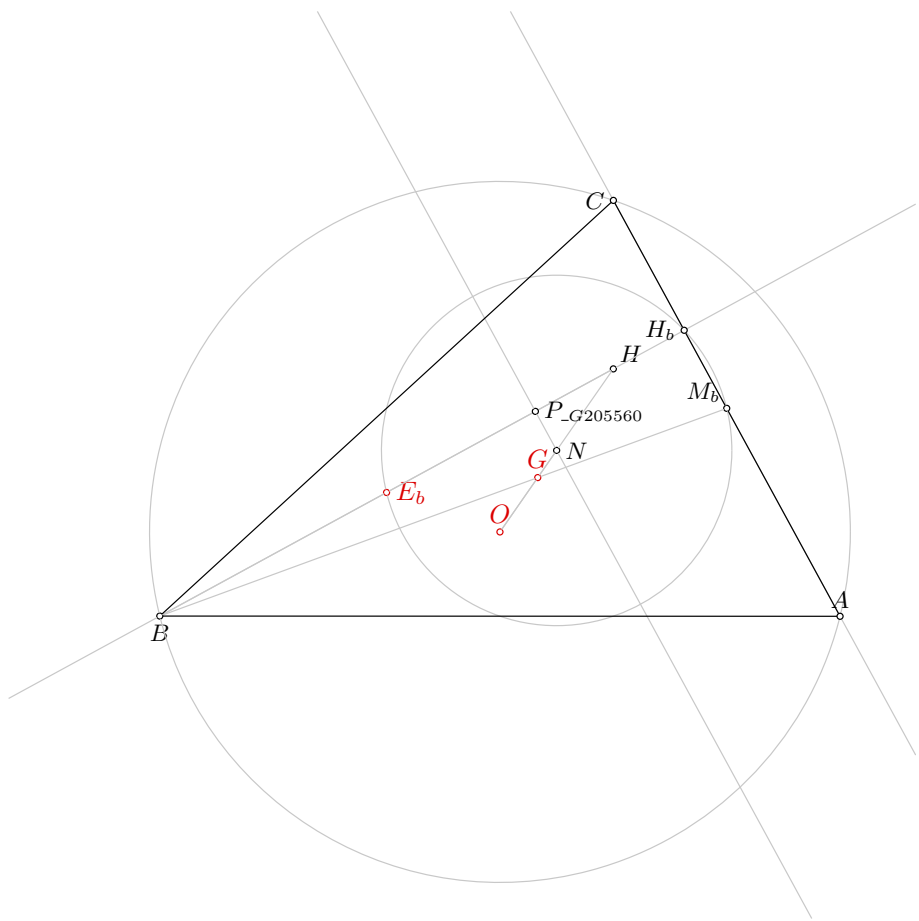

Figure 1: Illustration of the problem 0890

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 891

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 891: Given a point E_b, a point G and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 892

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 892: Given a point E_b, a point G and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 893

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 893: Given a point E_b, a point G and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 894

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 894: Given a point H, a point H_a and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point H_a, construct a line h_a (rule W02); % DET: points H and H_a are not the same;
2. Using the point H_a and the line h_a, construct a line a (rule W10a); ;
3. Using the point H, the line a and the point H_a, construct a line $h_{H,1/2}(a)$ (rule W15); ;
4. Choose freely a point E_b on the line $h_{H,1/2}(a)$ (rule WOnline4);
5. Using the point E_b and the point H, construct a point B (rule W01); ;
6. Using the point H and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H and E_b are not the same;
7. Choose freely a point A on the line h_a (rule WOnline1) ;
8. Using the point A and the point B, construct a line c (rule W02); % DET: points A and B are not the same;
9. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
10. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
11. Using the line a and the line h_c, construct a point C (rule W03); % NDG: lines a and h_c are not parallel % DET: lines a and h_c are not the same.

Non-degenerate conditions: lines a and h_c are not parallel; line c and circle $k(E_b, B)$ intersect; points H and E_b are not the same.

Determination conditions: lines a and h_c are not the same; points H_c and H are not the same; points B and H_c must be different; points A and B are not the same; points H and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,W15,WOnline1,WOnline4]

Lemmas used: [D10,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,L3,L49,L51]

Solving time: 689.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{a} 80 40
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_rt H
cmark_r H_{a}
cmark_r E_{b}
color 0 0 0
fontsize 8

% DET: points H and H_{a} are not the same
% Constructing a line h_{a} which passes through point H and point H_{a}
line h_{a} H H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Constructing a line a which is perpendicular to line h_{a} and which passes through point H_{a}
perp a H_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0




% Constructing a point P_{\_G37215} such that HP_{\_G37215}/HH_{a}=0.5
towards P_{\_G37215} H H_{a} 0.5
cmark_r P_{\_G37215}
color 200 200 200
drawsegment H H_{a}
color 0 0 0
```

```
% Constructing a line h_{H,1/2}(a) which contains the point P_{\_G37215} and is parallel to the
    line a
parallel h_{H,1/2}(a) P_{\_G37215} a

color 200 200 200
drawline h_{H,1/2}(a)
color 0 0 0




% Constructing a point P_{\_G37522} such that HP_{\_G37522}/HH_{a}=0.5
towards P_{\_G37522} H H_{a} 0.5
cmark_r P_{\_G37522}
color 200 200 200
drawsegment H H_{a}
color 0 0 0

% Generating random value V[_G37461]
random V[_G37461]


% Calculating value V[_G37482] using formula V[_G37461]*20
expression V[_G37482] { V[_G37461]*20 }


% Constructing a point E_{b} which is a point for which holds P_{\_G37522}E_{b} = V[_G37482] and
    angle HP_{\_G37522}E_{b} = 90
turtle E_{b} H P_{\_G37522} 90 V[_G37482]
cmark_r E_{b}



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% NDG: points H and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
circle k(E_{b},B) E_{b} H

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0




% Choosing randomly a point A on the line HH_{a}
online A H H_{a}
cmark_t A
color 200 200 200
```

```
drawline H H_{a}
color 0 0 0


% DET: points A and B are not the same
% Constructing a line c which passes through point A and point B
line c A B

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G38087} which is a foot of the point E_{b} on the line c
foot P_{\_G38087} E_{b} c
cmark_r P_{\_G38087}
color 200 200 200
drawline E_{b} P_{\_G38087}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    38087}
sim H_{c} P_{\_G38087} B
cmark_rt H_{c}


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines a and h_{c} are not parallel% DET: lines a and h_{c} are not the same
% Constructing a point C which belongs to line a and line h_{c}
intersec C a h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{c} are not parallel; line c and circle k(E_{b},B)
    intersect; points H and E_{b} are not the same
% Determination conditions: lines a and h_{c} are not the same; points H_{c} and H are not the same
    ; points B and H_{c} must be different; points A and B are not the same; points H and H_{a} are
     not the same
```

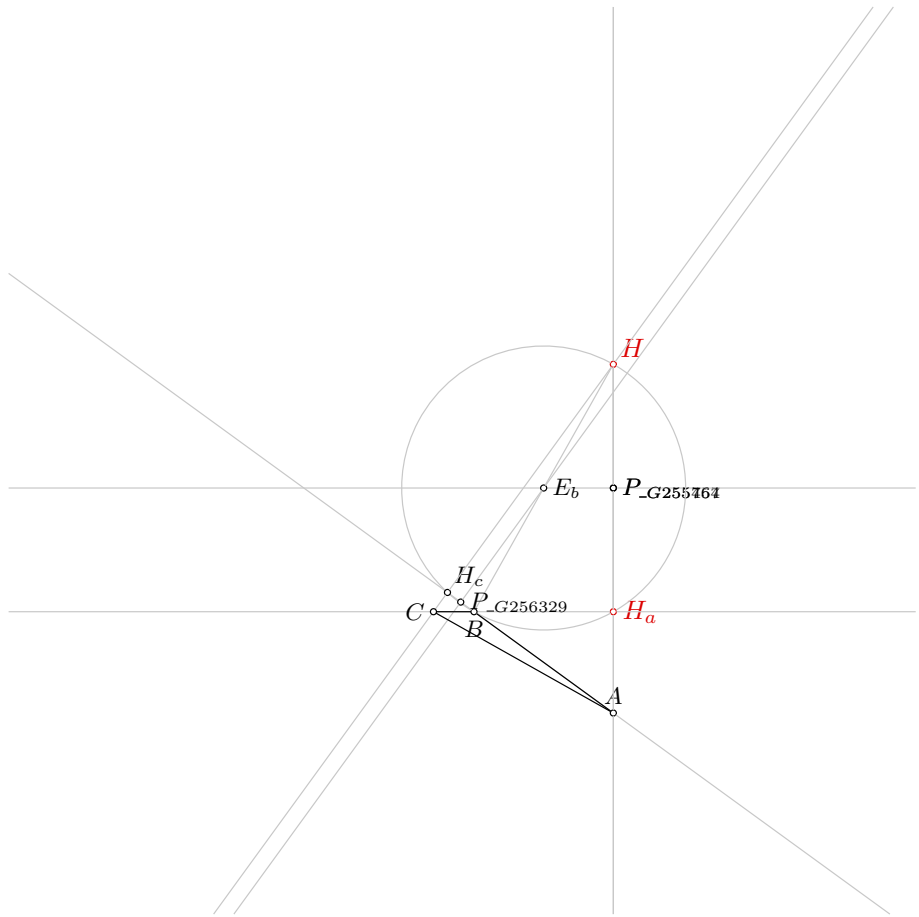

Figure 1: Illustration of the problem 0894

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 895

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 895: Given a point H, a point H_b and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
2. Choose freely a point E_b on the line h_b (rule WOnline1) ;
3. Using the point E_b and the point H, construct a point B (rule W01); ;
4. Using the point H and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H and E_b are not the same;
5. Using the point H_b and the line h_b, construct a line b (rule W10a); ;
6. Choose freely a point A on the line b (rule WOnline2);
7. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
8. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H and H_a must be different;
9. Using the point B and the point H_a, construct a line a (rule W02); % DET: points B and H_a are not the same;
10. Using the line b and the line a, construct a point C (rule W03); % NDG: lines b and a are not parallel % DET: lines b and a are not the same.

Non-degenerate conditions: lines b and a are not parallel; line h_a and circle $k(E_b, B)$ intersect; points H and E_b are not the same.

Determination conditions: lines b and a are not the same; points B and H_a are not the same; points H and H_a must be different; points A and H are not the same; points H and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,WOnline1,WOnline2]

Lemmas used: [D29,D3,D5,D6,D8,D9,GD01,GD02,GL03,GL04,L49,L50]

Solving time: 171.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{b} 89.36 77.83
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_rt H
cmark_l H_{b}
cmark_r E_{b}
color 0 0 0
fontsize 8

% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0




% Choosing randomly a point E_{b} on the line HH_{b}
online E_{b} H H_{b}
cmark_r E_{b}
color 200 200 200
drawline H H_{b}
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0
```

```
% NDG: points H and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
circle k(E_{b},B) E_{b} H

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0




% Constructing a line b which is perpendicular to line h_{b} and which passes through point H_{b}
perp b H_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0




% Generating random value V[_G63840]
random V[_G63840]


% Calculating value V[_G63861] using formula V[_G63840]*20
expression V[_G63861] { V[_G63840]*20 }


% Constructing a point A which is a point for which holds H_{b}A = V[_G63861] and angle E_{b}H_{b}A
     = 90
turtle A E_{b} H_{b} 90 V[_G63861]
cmark_t A


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G64133} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G64133} E_{b} h_{a}
cmark_r P_{\_G64133}
color 200 200 200
drawline E_{b} P_{\_G64133}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    64133}
sim H_{a} P_{\_G64133} H
```

```
cmark_r H_{a}


% DET: points B and H_{a} are not the same
% Constructing a line a which passes through point B and point H_{a}
line a B H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines b and a are not parallel% DET: lines b and a are not the same
% Constructing a point C which belongs to line b and line a
intersec C b a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and a are not parallel; line h_{a} and circle k(E_{b},B)
    intersect; points H and E_{b} are not the same
% Determination conditions: lines b and a are not the same; points B and H_{a} are not the same;
    points H and H_{a} must be different; points A and H are not the same; points H and H_{b} are
    not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 61 terms.

Time Complexity: Time spent by the prover is 0.567 seconds.

NDG conditions Points A and B are not identical

Points A and B are not identical

Line through points H_b and B is not perpendicular to line through points B and H

Line through points A and C is not parallel with line through points E_b and H

Point C is not the midpoint of segment with endpoints H_b and B

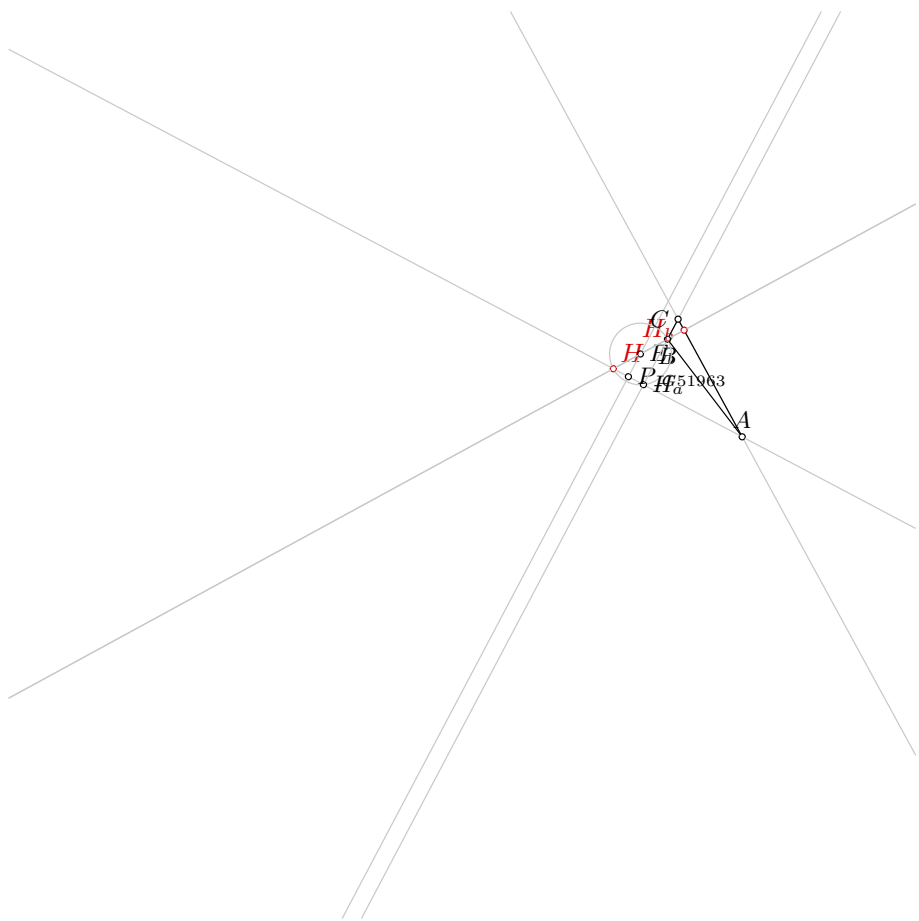

Figure 1: Illustration of the problem 0895

4.1.2 Proving H_b=_H_b

Status: Theorem has been proved.
Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.
Time Complexity: Time spent by the prover is 0.15 seconds.
NDG conditions Points A and B are not identical
Points A and B are not identical
Line through points H_b and B is not perpendicular to line through points B and H
Line through points A and C is not parallel with line through points E_b and H

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Status: The conjecture has not been proved nor disproved.
Space Complexity: The biggest polynomial obtained during proof process contained 9 terms.
Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving H_b=_H_b

Status: The conjecture has not been proved nor disproved.
Space Complexity: The biggest polynomial obtained during proof process contained 16 terms.
Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.3 Proving E_b=_E_b

Status: The conjecture has not been proved nor disproved.
Space Complexity: The biggest polynomial obtained during proof process contained 13 terms.
Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Status: The conjecture has not been proved nor disproved.
Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.
Time Complexity: Time spent by the prover is 0.090 seconds.There are no ndg conditions.

4.4.2 Proving H_b=_H_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.080 seconds.There are no ndg conditions.

4.4.3 Proving E_b=_E_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.090 seconds.There are no ndg conditions.

Problem 896

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 896: Given a point H, a point H_c and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
2. Using the point H_c and the line h_c, construct a line c (rule W10a); ;
3. Using the point H, the line c and the point H_c, construct a line $h_{H,1/2}(c)$ (rule W15); ;
4. Choose freely a point E_b on the line $h_{H,1/2}(c)$ (rule WOnline4);
5. Using the point E_b and the point H, construct a point B (rule W01); ;
6. Using the point H and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H and E_b are not the same;
7. Choose freely a point A on the line c (rule WOnline1) ;
8. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
9. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H and H_a must be different;
10. Using the point B and the point H_a, construct a line a (rule W02); % DET: points B and H_a are not the same;
11. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; line h_a and circle $k(E_b, B)$ intersect; points H and E_b are not the same.

Determination conditions: lines h_c and a are not the same; points B and H_a are not the same; points H and H_a must be different; points A and H are not the same; points H and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,W15,WOnline1,WOnline4]

Lemmas used: [D10,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,L3,L49,L50]

Solving time: 687.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{c} 68.91 84.83
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_rt H
cmark_rt H_{c}
cmark_r E_{b}
color 0 0 0
fontsize 8

% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0




% Constructing a line c which is perpendicular to line h_{c} and which passes through point H_{c}
perp c H_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0




% Constructing a point P_{\_G93791} such that HP_{\_G93791}/HH_{c}=0.5
towards P_{\_G93791} H H_{c} 0.5
cmark_r P_{\_G93791}
color 200 200 200
drawsegment H H_{c}
color 0 0 0
```

```
% Constructing a line h_{H,1/2}(c) which contains the point P_{\_G93791} and is parallel to the
    line c
parallel h_{H,1/2}(c) P_{\_G93791} c

color 200 200 200
drawline h_{H,1/2}(c)
color 0 0 0




% Constructing a point P_{\_G94098} such that HP_{\_G94098}/HH_{c}=0.5
towards P_{\_G94098} H H_{c} 0.5
cmark_r P_{\_G94098}
color 200 200 200
drawsegment H H_{c}
color 0 0 0

% Generating random value V[_G94037]
random V[_G94037]


% Calculating value V[_G94058] using formula V[_G94037]*20
expression V[_G94058] { V[_G94037]*20 }


% Constructing a point E_{b} which is a point for which holds P_{\_G94098}E_{b} = V[_G94058] and
    angle HP_{\_G94098}E_{b} = 90
turtle E_{b} H P_{\_G94098} 90 V[_G94058]
cmark_r E_{b}



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% NDG: points H and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
circle k(E_{b},B) E_{b} H

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0




% Choosing randomly a point A on the line H_{c}B
online A H_{c} B
cmark_t A
color 200 200 200
```

```
drawline H_{c} B
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G94663} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G94663} E_{b} h_{a}
cmark_r P_{\_G94663}
color 200 200 200
drawline E_{b} P_{\_G94663}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    94663}
sim H_{a} P_{\_G94663} H
cmark_r H_{a}


% DET: points B and H_{a} are not the same
% Constructing a line a which passes through point B and point H_{a}
line a B H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; line h_{a} and circle k(E_{b},B)
    intersect; points H and E_{b} are not the same
% Determination conditions: lines h_{c} and a are not the same; points B and H_{a} are not the same
    ; points H and H_{a} must be different; points A and H are not the same; points H and H_{c} are
     not the same
```

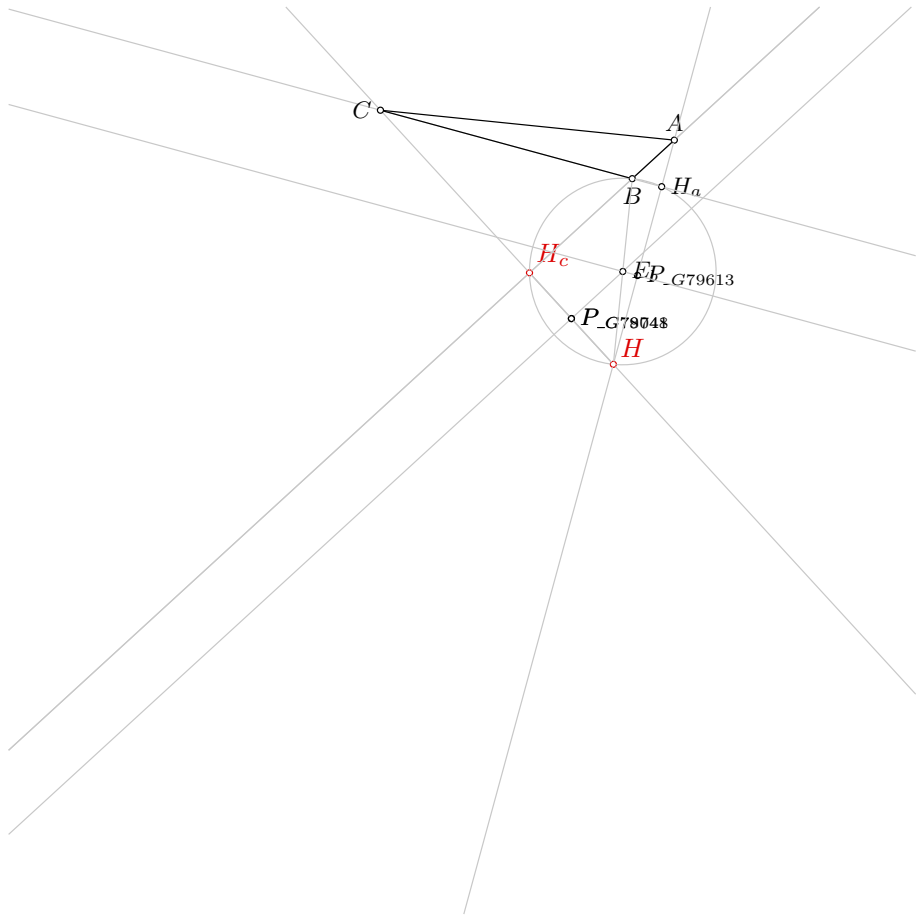

Figure 1: Illustration of the problem 0896

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Construction steps:

- Free point H
- Free point H_c
- Line h_c through two points H and H_c
- Line c through point H_c perpendicular to line h_c
- Segment division point $P_{\_G88827}$ of segment HH_c with division coefficient 1.0

- Line $h_{H,1/2}(c)$ through point $P_{\_G88827}$ parallel with line c
- Segment division point $P_{\_G88959}$ of segment HH_c with division coefficient -0.5
- Line $L_{\_G88962}$ through point $P_{\_G88959}$ parallel with line $h_{H,1/2}(c)$
- Random point E_b from line $L_{\_G88962}$
- Segment division point B of segment E_bH with division coefficient -0.5
- Circle $k(E_b, B)$ with center E_b and one point H
- Random point A from line c
- Line h_a through two points A and H
- Line footPointPerpLine650 through point E_b perpendicular to line h_a
- Intersection point $P_{\_G89221}$ of point sets footPointPerpLine650 and h_a
- Cental symmetric point H_a of point H with respect to center of symmetry $P_{\_G89221}$
- Line a through two points B and H_a
- Intersection point C of point sets h_c and a
- Line $\_b$ through two points A and C
- Line $\_a$ through two points B and C
- Line $\_h_a$ through point A perpendicular to line $\_a$
- Line $\_h_b$ through point B perpendicular to line $\_b$
- Intersection point $\_H$ of point sets $\_h_a$ and $\_h_b$
- Line $\_c$ through two points A and B
- Line $\_h_c$ through point C perpendicular to line $\_c$
- Intersection point $\_H_c$ of point sets $\_c$ and $\_h_c$

Theorem statement:

- Points H and $\_H$ are identical

Info: Attempting to add the construction of new random point tempPoint-537$h_{H,1/2}(c)$ necessary for completion of construction of line $L_{\_G88962}$

Warrning: Generated new random point tempPoint-537$h_{H,1/2}(c)$ on line $h_{H,1/2}(c)$ in order to complete the construction of parallel line $L_{\_G88962}$

Validation result: Theorem protocol is valid.

NDG conditions Point H has been assigned following coordinates: (0, 0)

4.1.2 Proving H_c=$\_H_c$

Construction steps:

- Free point H
- Free point H_c
- Line h_c through two points H and H_c
- Line c through point H_c perpendicular to line h_c
- Segment division point $P_{\_G90122}$ of segment HH_c with division coefficient 1.0
- Line $h_{H,1/2}(c)$ through point $P_{\_G90122}$ parallel with line c
- Segment division point $P_{\_G90254}$ of segment HH_c with division coefficient -0.5
- Line $L_{\_G90257}$ through point $P_{\_G90254}$ parallel with line $h_{H,1/2}(c)$
- Random point E_b from line $L_{\_G90257}$

- Segment division point B of segment E_bH with division coefficient -0.5
- Circle $k(E_b, B)$ with center E_b and one point H
- Random point A from line c
- Line h_a through two points A and H
- Line footPointPerpLine693 through point E_b perpendicular to line h_a
- Intersection point $P_{\_G90516}$ of point sets footPointPerpLine693 and h_a
- Cental symmetric point H_a of point H with respect to center of symmetry $P_{\_G90516}$
- Line a through two points B and H_a
- Intersection point C of point sets h_c and a
- Line $\_b$ through two points A and C
- Line $\_a$ through two points B and C
- Line $\_h_a$ through point A perpendicular to line $\_a$
- Line $\_h_b$ through point B perpendicular to line $\_b$
- Intersection point $\_H$ of point sets $\_h_a$ and $\_h_b$
- Line $\_c$ through two points A and B
- Line $\_h_c$ through point C perpendicular to line $\_c$
- Intersection point $\_H_c$ of point sets $\_c$ and $\_h_c$

Theorem statement:

- Points H_c and $\_H_c$ are identical

Info: Attempting to add the construction of new random point tempPoint-329$h_{H,1/2}(c)$ necessary for completion of construction of line $L_{\_G90257}$

Warrning: Generated new random point tempPoint-329$h_{H,1/2}(c)$ on line $h_{H,1/2}(c)$ in order to complete the construction of parallel line $L_{\_G90257}$

Validation result: Theorem protocol is valid.

NDG conditions Point H has been assigned following coordinates: (0, 0)

4.1.3 Proving E_b=$\_E_b$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=$\_H$

Proving failed

4.2.2 Proving H_c=$\_H_c$

Proving failed

4.2.3 Proving E_b=$\_E_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=$\_H$

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 897

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 897: Given a point E_b, a point H and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 898

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 898: Given a point E_b, a point H and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H, construct a point B (rule W01); ;
2. Using the point M_a and the point B, construct a point C (rule W01); ;
3. Using the point H and the point C, construct a line h_c (rule W02); % DET: points H and C are not the same;
4. Using the point M_a and the point B, construct a line a (rule W02); % DET: points M_a and B are not the same;
5. Using the point H and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H and E_b are not the same;
6. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H and H_c must be different;
7. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
8. Using the circle $k(E_b, B)$, the line a, the point E_b and the point B, construct a point H_a (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points B and H_a must be different;
9. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
10. Using the line c and the line h_a, construct a point A (rule W03); % NDG: lines c and h_a are not parallel % DET: lines c and h_a are not the same.

Non-degenerate conditions: lines c and h_a are not parallel; line a and circle $k(E_b, B)$ intersect; line h_c and circle $k(E_b, B)$ intersect; points H and E_b are not the same.

Determination conditions: lines c and h_a are not the same; points H_a and H are not the same; points B and H_a must be different; points H_c and B are not the same; points H and H_c must be different; points M_a and B are not the same; points H and C are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D21,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 12.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H 80 72.73
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points H and C are not the same
% Constructing a line h_{c} which passes through point H and point C
line h_{c} H C

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% DET: points M_{a} and B are not the same
% Constructing a line a which passes through point M_{a} and point B
line a M_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: points H and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
circle k(E_{b},B) E_{b} H

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G128645} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G128645} E_{b} h_{c}
cmark_r P_{\_G128645}
color 200 200 200
drawline E_{b} P_{\_G128645}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    128645}
sim H_{c} P_{\_G128645} H
cmark_rt H_{c}


% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points B and H_{a} must be different
% Constructing a point P_{\_G128883} which is a foot of the point E_{b} on the line a
foot P_{\_G128883} E_{b} a
cmark_r P_{\_G128883}
color 200 200 200
drawline E_{b} P_{\_G128883}
color 0 0 0

% Constructing a point H_{a} which is an image of the point B in the symmetry to point/line P_{\_G
    128883}
sim H_{a} P_{\_G128883} B
cmark_r H_{a}
```

```
% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines c and h_{a} are not parallel% DET: lines c and h_{a} are not the same
% Constructing a point A which belongs to line c and line h_{a}
intersec A c h_{a}
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{a} are not parallel; line a and circle k(E_{b},B)
    intersect; line h_{c} and circle k(E_{b},B) intersect; points H and E_{b} are not the same
% Determination conditions: lines c and h_{a} are not the same; points H_{a} and H are not the same
    ; points B and H_{a} must be different; points H_{c} and B are not the same; points H and H_{c}
     must be different; points M_{a} and B are not the same; points H and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.108 seconds.

NDG conditions There are no NDG conditions for this theorem

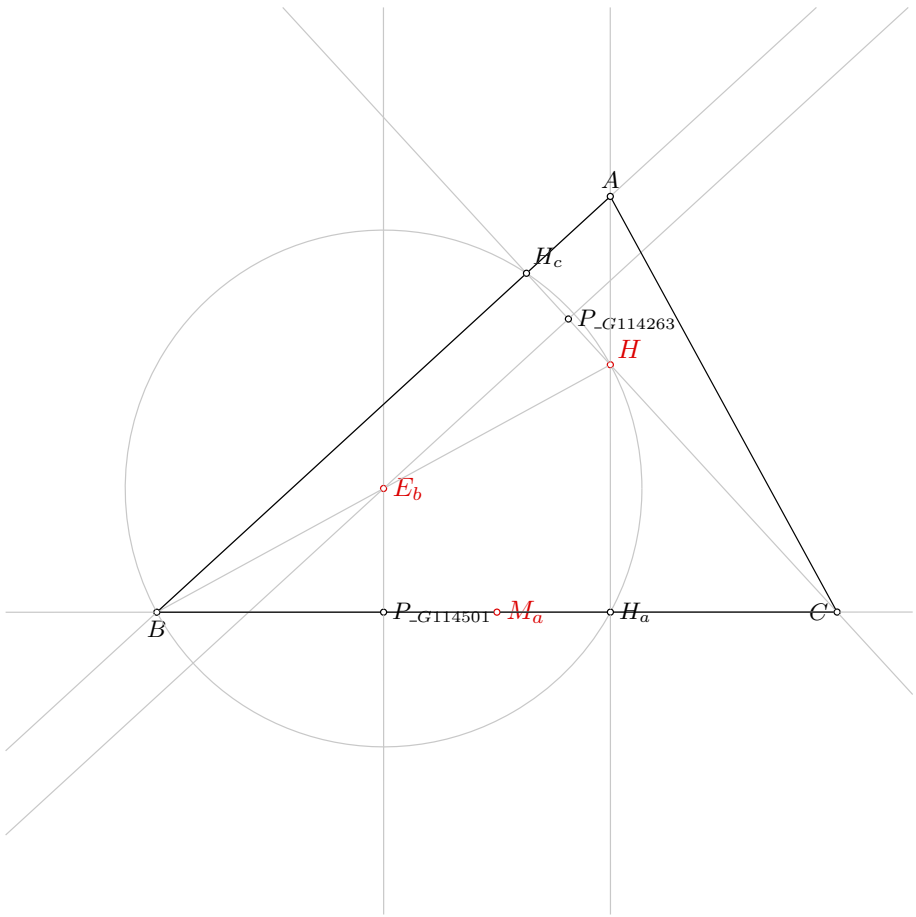

Figure 1: Illustration of the problem 0898

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 3075 terms.

Time Complexity: Time spent by the prover is 21.650 seconds.There are no ndg conditions.

4.3.2 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 570 terms.

Time Complexity: Time spent by the prover is 0.780 seconds.There are no ndg conditions.

4.3.3 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 899

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 899: Given a point E_b, a point H and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H, construct a point B (rule W01); ;
2. Using the point M_b and the point B, construct a point G (rule W01); ;
3. Using the point H and the point G, construct a point N (rule W01); ;
4. Using the point H and the point G, construct a point O (rule W01); ;
5. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
6. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points E_b and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L16,L20,L23,L56,L58]

Solving time: 6.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H 80 72.73
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a line L_{\_G156767} which passes through point M_{b} and point B
line L_{\_G156767} M_{b} B

color 200 200 200
drawline L_{\_G156767}
color 0 0 0


% Constructing a point P_{\_G156868} with coordinates (0,0)
point P_{\_G156868} 0 0
cmark_r P_{\_G156868}

% Constructing a point P_{\_G156792} such that M_{b}P_{\_G156792}/M_{b}P_{\_G156868}=1
towards P_{\_G156792} M_{b} P_{\_G156868} 1
cmark_r P_{\_G156792}
color 200 200 200
drawsegment M_{b} P_{\_G156792}
color 0 0 0
```

```
% Constructing a point P_{\_G156837} such that M_{b}P_{\_G156837}/M_{b}P_{\_G156868}=3
towards P_{\_G156837} M_{b} P_{\_G156868} 3
cmark_r P_{\_G156837}
color 200 200 200
drawsegment M_{b} P_{\_G156837}
color 0 0 0

% Constructing a line L_{\_G156798} which passes through point B and point P_{\_G156837}
line L_{\_G156798} B P_{\_G156837}

color 200 200 200
drawline L_{\_G156798}
color 0 0 0


% Constructing a line L_{\_G156761} which contains the point P_{\_G156792} and is parallel to the
    line L_{\_G156798}
parallel L_{\_G156761} P_{\_G156792} L_{\_G156798}

color 200 200 200
drawline L_{\_G156761}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G156761} and line L_{\_G156767}
intersec G L_{\_G156761} L_{\_G156767}
cmark_t G



% Constructing a point N such that HN/HG=0.75
towards N H G 0.75
cmark_r N
color 200 200 200
drawsegment H G
color 0 0 0



% Constructing a point O such that HO/HG=1.5
towards O H G 1.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G157787} which is a foot of the point N on the line h_{b}
foot P_{\_G157787} N h_{b}
cmark_r P_{\_G157787}
color 200 200 200
drawline N P_{\_G157787}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G157787}
sim H_{b} P_{\_G157787} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

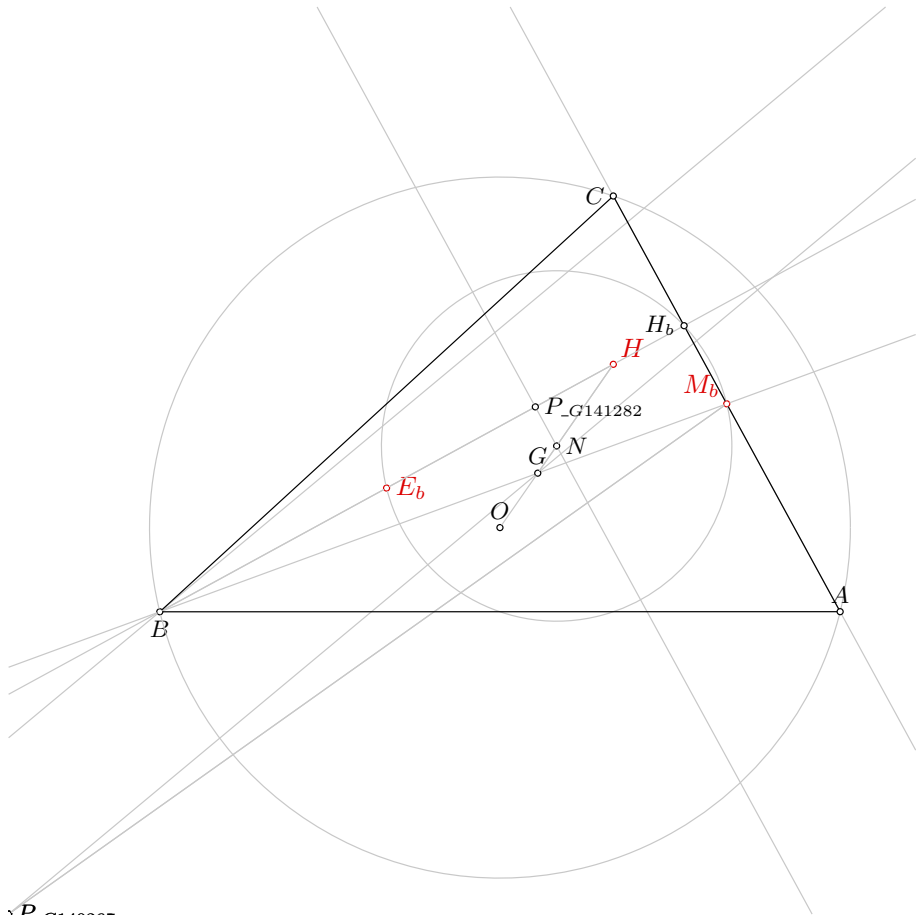

Figure 1: Illustration of the problem 0899

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points E_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points E_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving M_b=_M_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving M_b=_M_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving M_b=_M_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 900

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 900: Given a point E_b, a point H and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H, construct a point B (rule W01); ;
2. Using the point M_c and the point B, construct a point A (rule W01); ;
3. Using the point H and the point A, construct a line h_a (rule W02); % DET: points H and A are not the same;
4. Using the point M_c and the point B, construct a line c (rule W02); % DET: points M_c and B are not the same;
5. Using the point H and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H and E_b are not the same;
6. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H and H_a must be different;
7. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
8. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
9. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
10. Using the line a and the line h_c, construct a point C (rule W03); % NDG: lines a and h_c are not parallel % DET: lines a and h_c are not the same.

Non-degenerate conditions: lines a and h_c are not parallel; line c and circle $k(E_b, B)$ intersect; line h_a and circle $k(E_b, B)$ intersect; points H and E_b are not the same.

Determination conditions: lines a and h_c are not the same; points H_c and H are not the same; points B and H_c must be different; points H_a and B are not the same; points H and H_a must be different; points M_c and B are not the same; points H and A are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D20,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 12.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H 80 72.73
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point A such that M_{c}A/M_{c}B=-1
towards A M_{c} B -1
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points H and A are not the same
% Constructing a line h_{a} which passes through point H and point A
line h_{a} H A

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% DET: points M_{c} and B are not the same
% Constructing a line c which passes through point M_{c} and point B
line c M_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: points H and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
circle k(E_{b},B) E_{b} H

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G185433} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G185433} E_{b} h_{a}
cmark_r P_{\_G185433}
color 200 200 200
drawline E_{b} P_{\_G185433}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    185433}
sim H_{a} P_{\_G185433} H
cmark_r H_{a}


% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G185671} which is a foot of the point E_{b} on the line c
foot P_{\_G185671} E_{b} c
cmark_r P_{\_G185671}
color 200 200 200
drawline E_{b} P_{\_G185671}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    185671}
sim H_{c} P_{\_G185671} B
cmark_rt H_{c}
```

```
% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines a and h_{c} are not parallel% DET: lines a and h_{c} are not the same
% Constructing a point C which belongs to line a and line h_{c}
intersec C a h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{c} are not parallel; line c and circle k(E_{b},B)
    intersect; line h_{a} and circle k(E_{b},B) intersect; points H and E_{b} are not the same
% Determination conditions: lines a and h_{c} are not the same; points H_{c} and H are not the same
    ; points B and H_{c} must be different; points H_{a} and B are not the same; points H and H_{a}
     must be different; points M_{c} and B are not the same; points H and A are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.109 seconds.

NDG conditions There are no NDG conditions for this theorem

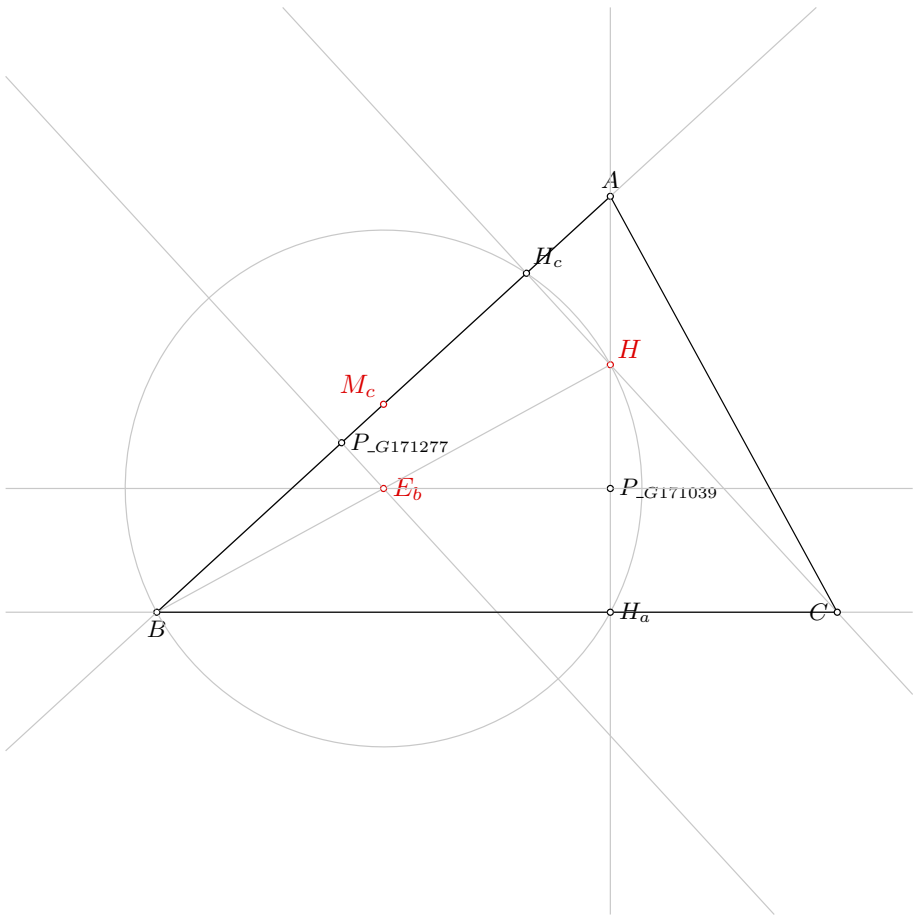

Figure 1: Illustration of the problem 0900

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving M_c=_M_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 3075 terms.

Time Complexity: Time spent by the prover is 21.640 seconds.There are no ndg conditions.

4.3.2 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 570 terms.

Time Complexity: Time spent by the prover is 0.790 seconds.There are no ndg conditions.

4.3.3 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 901

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 901: Given a point E_b, a point H and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H, construct a point B (rule W01); ;
2. Using the point H and the point N, construct a point O (rule W01); ;
3. Using the point H and the point N, construct a point G (rule W01); ;
4. Using the point B and the point G, construct a point M_b (rule W01); ;
5. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
6. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points E_b and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L16,L20,L23,L56]

Solving time: 7.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H 80 72.73
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G227457} which passes through point H and point N
line L_{\_G227457} H N

color 200 200 200
drawline L_{\_G227457}
color 0 0 0


% Constructing a point P_{\_G227558} with coordinates (0,0)
point P_{\_G227558} 0 0
```

```
cmark_r P_{\_G227558}

% Constructing a point P_{\_G227482} such that HP_{\_G227482}/HP_{\_G227558}=4
towards P_{\_G227482} H P_{\_G227558} 4
cmark_r P_{\_G227482}
color 200 200 200
drawsegment H P_{\_G227482}
color 0 0 0

% Constructing a point P_{\_G227527} such that HP_{\_G227527}/HP_{\_G227558}=3
towards P_{\_G227527} H P_{\_G227558} 3
cmark_r P_{\_G227527}
color 200 200 200
drawsegment H P_{\_G227527}
color 0 0 0

% Constructing a line L_{\_G227488} which passes through point N and point P_{\_G227527}
line L_{\_G227488} N P_{\_G227527}

color 200 200 200
drawline L_{\_G227488}
color 0 0 0


% Constructing a line L_{\_G227451} which contains the point P_{\_G227482} and is parallel to the
    line L_{\_G227488}
parallel L_{\_G227451} P_{\_G227482} L_{\_G227488}

color 200 200 200
drawline L_{\_G227451}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G227451} and line L_{\_G227457}
intersec G L_{\_G227451} L_{\_G227457}
cmark_t G



% Constructing a point M_{b} such that BM_{b}/BG=1.5
towards M_{b} B G 1.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G228394} which is a foot of the point N on the line h_{b}
foot P_{\_G228394} N h_{b}
cmark_r P_{\_G228394}
color 200 200 200
drawline N P_{\_G228394}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G228394}
sim H_{b} P_{\_G228394} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

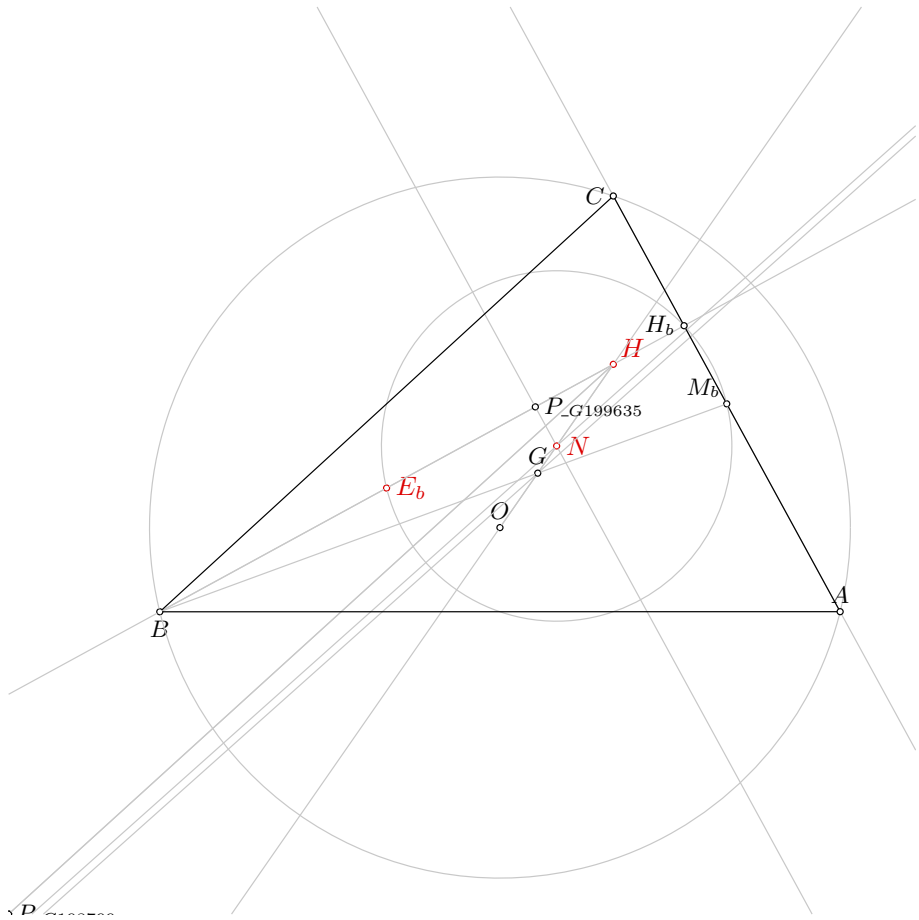

Figure 1: Illustration of the problem 0901

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points E_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points E_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 902

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 902: Given a point E_b, a point H and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H, construct a point B (rule W01); ;
2. Using the point H and the point O, construct a point N (rule W01); ;
3. Using the point H and the point O, construct a point G (rule W01); ;
4. Using the point B and the point G, construct a point M_b (rule W01); ;
5. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
6. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points E_b and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L20,L23,L56,L58]

Solving time: 7.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H 80 72.73
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H
cmark_t O
color 0 0 0
fontsize 8


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point N such that HN/HO=0.5
towards N H O 0.5
cmark_r N
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G261328} which passes through point H and point O
line L_{\_G28210} H O

color 200 200 200
drawline L_{\_G28210}
color 0 0 0


% Constructing a point P_{\_G261429} with coordinates (0,0)
point P_{\_G28214} 0 0
```

```
cmark_r P_{\_G28214}

% Constructing a point P_{\_G261353} such that HP_{\_G261353}/HP_{\_G261429}=2
towards P_{\_G28211} H P_{\_G28214} 2
cmark_r P_{\_G28211}
color 200 200 200
drawsegment H P_{\_G28211}
color 0 0 0

% Constructing a point P_{\_G261398} such that HP_{\_G261398}/HP_{\_G261429}=3
towards P_{\_G28213} H P_{\_G28214} 3
cmark_r P_{\_G28213}
color 200 200 200
drawsegment H P_{\_G28213}
color 0 0 0

% Constructing a line L_{\_G261359} which passes through point O and point P_{\_G261398}
line L_{\_G28212} O P_{\_G28213}

color 200 200 200
drawline L_{\_G28212}
color 0 0 0


% Constructing a line L_{\_G261322} which contains the point P_{\_G261353} and is parallel to the
    line L_{\_G261359}
parallel L_{\_G28209} P_{\_G28211} L_{\_G28212}

color 200 200 200
drawline L_{\_G28209}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G261322} and line L_{\_G261328}
intersec G L_{\_G28209} L_{\_G28210}
cmark_t G



% Constructing a point M_{b} such that BM_{b}/BG=1.5
towards M_{b} B G 1.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G28951} which is a foot of the point N on the line h_{b}
foot P_{\_G28951} N h_{b}
cmark_r P_{\_G28951}
color 200 200 200
drawline N P_{\_G28951}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G28951}
sim H_{b} P_{\_G28951} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

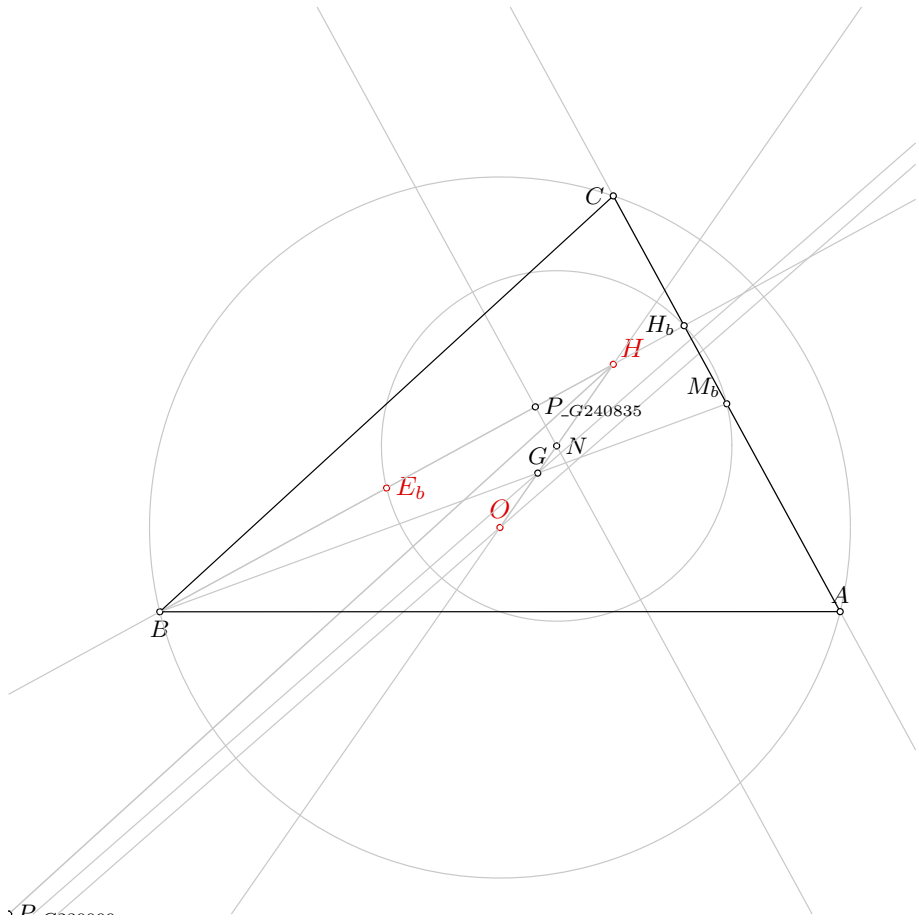

Figure 1: Illustration of the problem 0902

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points E_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points E_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 903

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 903: Given a point E_b, a point H and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 904

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 904: Given a point E_b, a point H and a point T_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H, construct a point B (rule W01); ;
2. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
3. Using the point T_b and the point B, construct a line s_b (rule W02); % DET: points T_b and B are not the same;
4. Using the point T_b and the line h_b, construct a line b (rule W10a); ;
5. Using the line b and the line h_b, construct a point H_b (rule W03); % NDG: lines b and h_b are not parallel % DET: lines b and h_b are not the same;
6. Using the point H and the point H_b, construct a line $m(HH_b)$ (rule W14); % DET: points H and H_b are not the same;
7. Using the point E_b, the point B, the point T_b, the line s_b and the line h_b, construct a line BO (rule W17); % NDG: points B and T_b are not the same; points E_b and B are not the same % DET: points B and T_b are not the same;
8. Using the point E_b and the line BO, construct a line $m(H_aH_c)$ (rule W16); ;
9. Using the line $m(H_aH_c)$ and the line b, construct a point M_b (rule W03); % NDG: lines $m(H_aH_c)$ and b are not parallel % DET: lines $m(H_aH_c)$ and b are not the same;
10. Using the point M_b and the point B, construct a point G (rule W01); ;
11. Using the point H and the point G, construct a point N (rule W01); ;

12. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;

13. Using the circle $k(N, M_a)$ and the line $m(HH_b)$, construct a point E_a and a point E_c (rule W04); % NDG: line $m(HH_b)$ and circle $k(N, M_a)$ intersect;

14. Using the point E_a and the point H, construct a point A (rule W01); ;

15. Using the point H and the point E_c, construct a point C (rule W01); .

Non-degenerate conditions: line $m(HH_b)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same; lines $m(H_aH_c)$ and b are not parallel; points B and T_b are not the same; points E_b and B are not the same; lines b and h_b are not parallel.

Determination conditions: lines $m(H_aH_c)$ and b are not the same; points B and T_b are not the same; points H and H_b are not the same; lines b and h_b are not the same; points T_b and B are not the same; points E_b and H are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W14,W16,W17]

Lemmas used: [D22,D24,D28,D29,D3,D30,D32,D6,D9,GD01,GD02,GL01,GL03,GL04,GL09,GL17,L105,L16,L2

Solving time: 125.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H 80 72.73
point T_{b} 94.25 68.88

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H
cmark_t T_{b}
color 0 0 0
fontsize 8


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% DET: points T_{b} and B are not the same
% Constructing a line s_{b} which passes through point T_{b} and point B
line s_{b} T_{b} B

color 200 200 200
drawline s_{b}
color 0 0 0



% Constructing a line b which is perpendicular to line h_{b} and which passes through point T_{b}
perp b T_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines b and h_{b} are not parallel% DET: lines b and h_{b} are not the same
% Constructing a point H_{b} which belongs to line b and line h_{b}
intersec H_{b} b h_{b}
cmark_l H_{b}


% DET: points H and H_{b} are not the same
% Constructing bisector m(HH_{b}) of the segment HH_{b}
med m(HH_{b}) H H_{b}

color 200 200 200
drawline m(HH_{b})
color 0 0 0

color 200 200 200
drawsegment H H_{b}
color 0 0 0


% NDG: points B and T_{b} are not the same; points E_{b} and B are not the same% DET: points B and
    T_{b} are not the same
% Constructing an angle V[_G73894] which is equal to the angle E_{b}BT_{b}
angle_o V[_G73894] E_{b} B T_{b}


% Calculating value angle[_G73973] using formula 1/pow(2,0)*V[_G73894]+0/pow(2,0)*180
expression angle[_G73973] { 1/pow(2,0)*V[_G73894]+0/pow(2,0)*180 }


% Constructing a point P_{\_G73970} which is an image of the point T_{b} in a rotation around the
    point B for the angle 1/pow(2,0)*V[_G73894]+0/pow(2,0)*180
rotate P_{\_G73970} B angle[_G73973] T_{b}
cmark_r P_{\_G73970}
```

```
color 200 200 200
drawarc_p B T_{b} angle[_G73973]
color 0 0 0

% Constructing a line BO which passes through point B and point P_{\_G73970}
line BO B P_{\_G73970}

color 200 200 200
drawline BO
color 0 0 0




% Constructing a line m(H_{a}H_{c}) which contains the point E_{b} and is parallel to the line BO
parallel m(H_{a}H_{c}) E_{b} BO

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: lines m(H_{a}H_{c}) and b are not parallel% DET: lines m(H_{a}H_{c}) and b are not the same
% Constructing a point M_{b} which belongs to line m(H_{a}H_{c}) and line b
intersec M_{b} m(H_{a}H_{c}) b
cmark_lt M_{b}



% Constructing a line L_{\_G74489} which passes through point M_{b} and point B
line L_{\_G74489} M_{b} B

color 200 200 200
drawline L_{\_G74489}
color 0 0 0


% Constructing a point P_{\_G74590} with coordinates (0,0)
point P_{\_G74590} 0 0
cmark_r P_{\_G74590}

% Constructing a point P_{\_G74514} such that M_{b}P_{\_G74514}/M_{b}P_{\_G74590}=1
towards P_{\_G74514} M_{b} P_{\_G74590} 1
cmark_r P_{\_G74514}
color 200 200 200
drawsegment M_{b} P_{\_G74514}
color 0 0 0

% Constructing a point P_{\_G74559} such that M_{b}P_{\_G74559}/M_{b}P_{\_G74590}=3
towards P_{\_G74559} M_{b} P_{\_G74590} 3
cmark_r P_{\_G74559}
color 200 200 200
drawsegment M_{b} P_{\_G74559}
color 0 0 0
```

```
% Constructing a line L_{\_G74520} which passes through point B and point P_{\_G74559}
line L_{\_G74520} B P_{\_G74559}

color 200 200 200
drawline L_{\_G74520}
color 0 0 0


% Constructing a line L_{\_G74483} which contains the point P_{\_G74514} and is parallel to the
    line L_{\_G74520}
parallel L_{\_G74483} P_{\_G74514} L_{\_G74520}

color 200 200 200
drawline L_{\_G74483}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G74483} and line L_{\_G74489}
intersec G L_{\_G74483} L_{\_G74489}
cmark_t G



% Constructing a point N such that HN/HG=0.75
towards N H G 0.75
cmark_r N
color 200 200 200
drawsegment H G
color 0 0 0


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(HH_{b}) and circle k(N,M_{a}) intersect
% Constructing points E_{a} and E_{c} which are in intersection of k(N,M_{a}) and m(HH_{b})
intersec2 E_{a} E_{c} k(N,M_{a}) m(HH_{b})
cmark_r E_{a}
cmark_r E_{c}



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0
```

```
% Constructing a point C such that HC/HE_{c}=2
towards C H E_{c} 2
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(HH_{b}) and circle k(N,M_{a}) intersect; points E_{b} and N are
     not the same; lines m(H_{a}H_{c}) and b are not parallel; points B and T_{b} are not the same;
     points E_{b} and B are not the same; lines b and h_{b} are not parallel
% Determination conditions: lines m(H_{a}H_{c}) and b are not the same; points B and T_{b} are not
    the same; points H and H_{b} are not the same; lines b and h_{b} are not the same; points T_{b}
     and B are not the same; points E_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving T_b=_T_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving T_b=_T_b

Proving failed

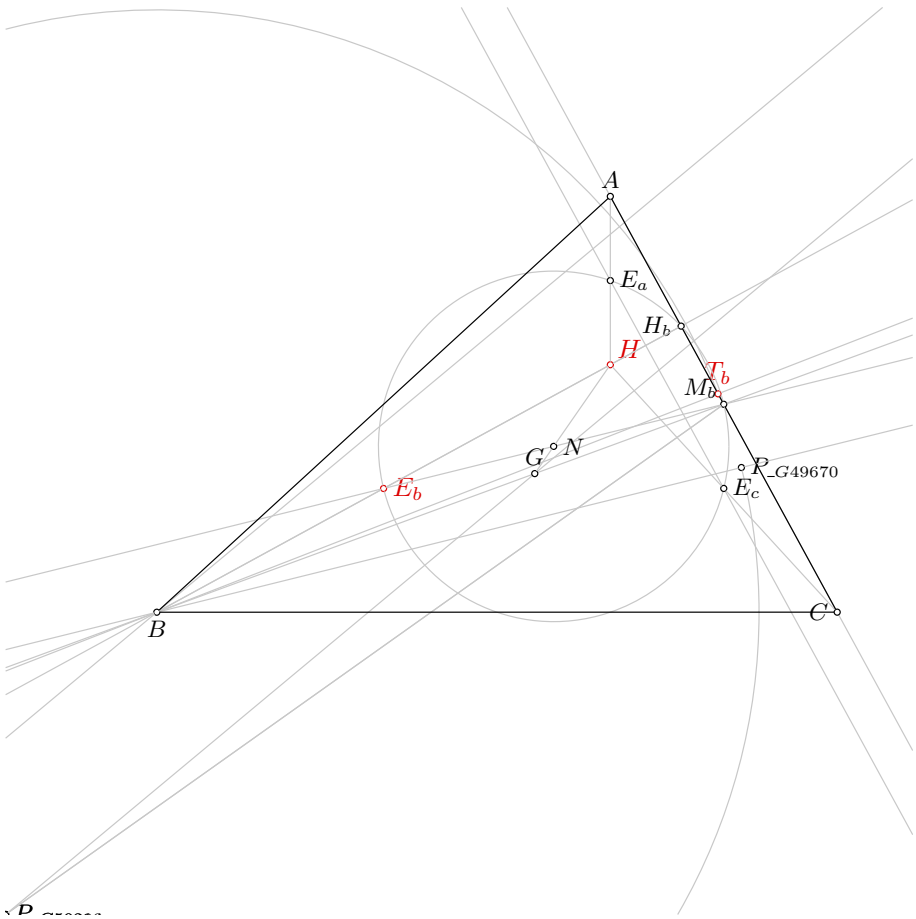

Figure 1: Illustration of the problem 0904

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H=_H

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 974 terms.

Time Complexity: Time spent by the prover is 3.480 seconds.There are no ndg conditions.

4.3.3 Proving T_b=_T_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving T_b=_T_b

Proving failed

Problem 905

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 905: Given a point E_b, a point H and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 906

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 906: Given a point E_b, a point H_a and a point H_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;
3. Using the circle $k(E_b, B)$ and the line h_b, construct a point B and a point H (rule W04); % NDG: line h_b and circle $k(E_b, B)$ intersect;
4. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
5. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
6. Using the point H_b and the line h_b, construct a line b (rule W10a); ;
7. Using the line b and the line a, construct a point C (rule W03); % NDG: lines b and a are not parallel % DET: lines b and a are not the same;
8. Using the line h_a and the line b, construct a point A (rule W03); % NDG: lines h_a and b are not parallel % DET: lines h_a and b are not the same.

Non-degenerate conditions: lines h_a and b are not parallel; lines b and a are not parallel; line h_b and circle $k(E_b, B)$ intersect; points H_a and E_b are not the same.

Determination conditions: lines h_a and b are not the same; lines b and a are not the same; points H_a and H are not the same; points H_a and B are not the same; points E_b and H_b are not the same.

Rules used: [W02,W03,W04,W06,W10a]
Lemmas used: [D29,D3,D5,D6,D8,D9,GD01,GD02,GL09,L49,L50]
Solving time: 6.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{a} 80 40
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r H_{a}
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{b} and circle k(E_{b},B) intersect
% Constructing points B and H which are in intersection of k(E_{b},B) and h_{b}
intersec2 B H k(E_{b},B) h_{b}
cmark_b B
cmark_rt H


% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
```

```
color 0 0 0



% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0




% Constructing a line b which is perpendicular to line h_{b} and which passes through point H_{b}
perp b H_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines b and a are not parallel% DET: lines b and a are not the same
% Constructing a point C which belongs to line b and line a
intersec C b a
cmark_l C


% NDG: lines h_{a} and b are not parallel% DET: lines h_{a} and b are not the same
% Constructing a point A which belongs to line h_{a} and line b
intersec A h_{a} b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and b are not parallel; lines b and a are not parallel;
    line h_{b} and circle k(E_{b},B) intersect; points H_{a} and E_{b} are not the same
% Determination conditions: lines h_{a} and b are not the same; lines b and a are not the same;
    points H_{a} and H are not the same; points H_{a} and B are not the same; points E_{b} and H_{b
    } are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

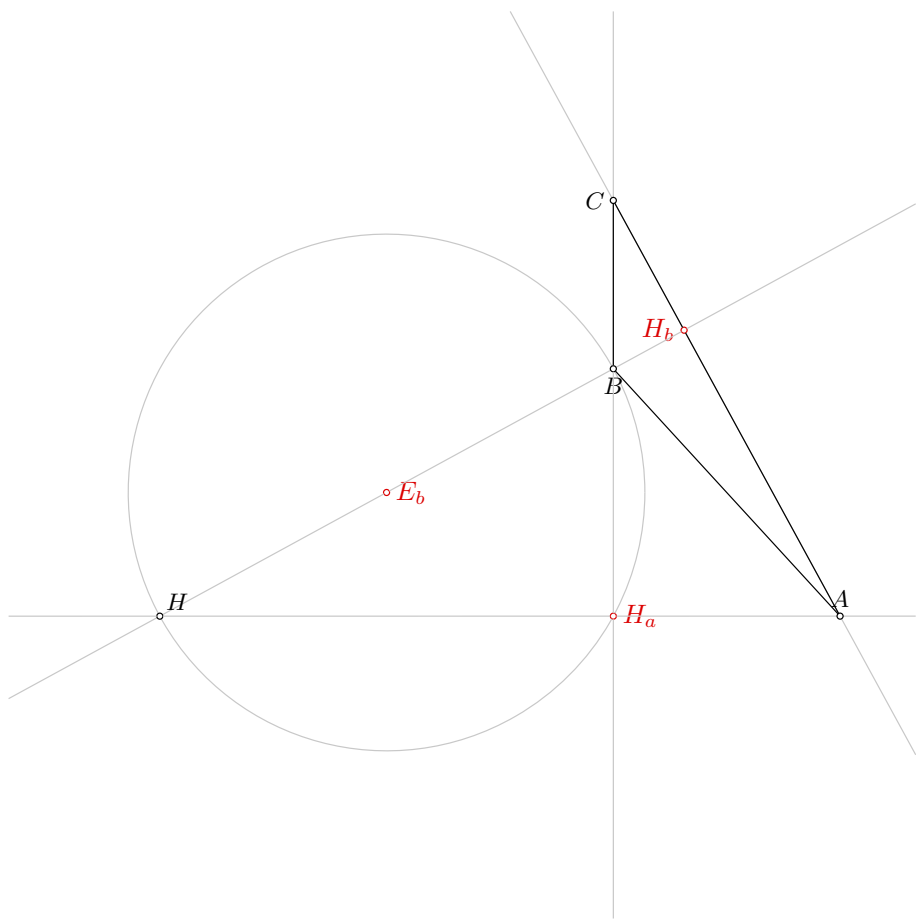

Figure 1: Illustration of the problem 0906

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 907

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 907: Given a point E_b, a point H_c and a point H_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
2. Choose freely a point H_a on the circle $k(E_b, B)$ (rule WOncircle);
3. Using the point H_a and the point E_b, construct a line $m(H_aE_b)$ (rule W14); % DET: points H_a and E_b are not the same;
4. Using the point H_a and the point H_c, construct a line $m(H_aH_c)$ (rule W14); % DET: points H_a and H_c are not the same;
5. Using the line $m(H_aH_c)$ and the line $m(H_aE_b)$, construct a point N (rule W03); % NDG: lines $m(H_aH_c)$ and $m(H_aE_b)$ are not parallel % DET: lines $m(H_aH_c)$ and $m(H_aE_b)$ are not the same;
6. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
8. Choose freely a point A on the circle $k(M_b, C)$ (rule WOncircle);
9. Using the point A and the point M_b, construct a point C (rule W01); ;
10. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

11. Using the point H_c and the point C, construct a line h_c (rule W02); % DET: points H_c and C are not the same;

12. Using the line h_a and the line h_c, construct a point H (rule W03); % NDG: lines h_a and h_c are not parallel % DET: lines h_a and h_c are not the same;

13. Using the point E_b and the point H, construct a point B (rule W01); .

Non-degenerate conditions: lines h_a and h_c are not parallel; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points H_a and N are not the same; lines $m(H_aH_c)$ and $m(H_aE_b)$ are not parallel; points H_c and E_b are not the same.

Determination conditions: lines h_a and h_c are not the same; points H_c and C are not the same; points A and H_a are not the same; points E_b and M_b must be different; lines $m(H_aH_c)$ and $m(H_aE_b)$ are not the same; points H_a and H_c are not the same; points H_a and E_b are not the same.

Rules used: [W01,W02,W03,W05a,W06,W14,WOncircle1]

Lemmas used: [D10,D22,D29,D3,D32,D5,D7,D8,GD02,GL01,GL03,GL04,L17,L19,L21,L23,L3,L44,L45,L50,L5

Solving time: 64.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{c} 68.91 84.83
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H_{c}
cmark_r H_{a}
color 0 0 0
fontsize 8

% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0




% Choosing randomly a point H_{a} on the circle with center E_{b} through point H_{c}
oncircle H_{a} E_{b} H_{c}
cmark_r H_{a}
color 200 200 200
```

```
drawcircle E_{b} H_{c}
color 0 0 0


% DET: points H_{a} and E_{b} are not the same
% Constructing bisector m(H_{a}E_{b}) of the segment H_{a}E_{b}
med m(H_{a}E_{b}) H_{a} E_{b}

color 200 200 200
drawline m(H_{a}E_{b})
color 0 0 0

color 200 200 200
drawsegment H_{a} E_{b}
color 0 0 0


% DET: points H_{a} and H_{c} are not the same
% Constructing bisector m(H_{a}H_{c}) of the segment H_{a}H_{c}
med m(H_{a}H_{c}) H_{a} H_{c}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0

color 200 200 200
drawsegment H_{a} H_{c}
color 0 0 0


% NDG: lines m(H_{a}H_{c}) and m(H_{a}E_{b}) are not parallel% DET: lines m(H_{a}H_{c}) and m(H_{a}
    E_{b}) are not the same
% Constructing a point N which belongs to line m(H_{a}H_{c}) and line m(H_{a}E_{b})
intersec N m(H_{a}H_{c}) m(H_{a}E_{b})
cmark_r N


% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}



% Choosing randomly a point A on the circle with center M_{b} through point H_{a}
```

```
oncircle A M_{b} H_{a}
cmark_t A
color 200 200 200
drawcircle M_{b} H_{a}
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% DET: points H_{c} and C are not the same
% Constructing a line h_{c} which passes through point H_{c} and point C
line h_{c} H_{c} C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines h_{a} and h_{c} are not parallel% DET: lines h_{a} and h_{c} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{c}
intersec H h_{a} h_{c}
cmark_rt H



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C
```

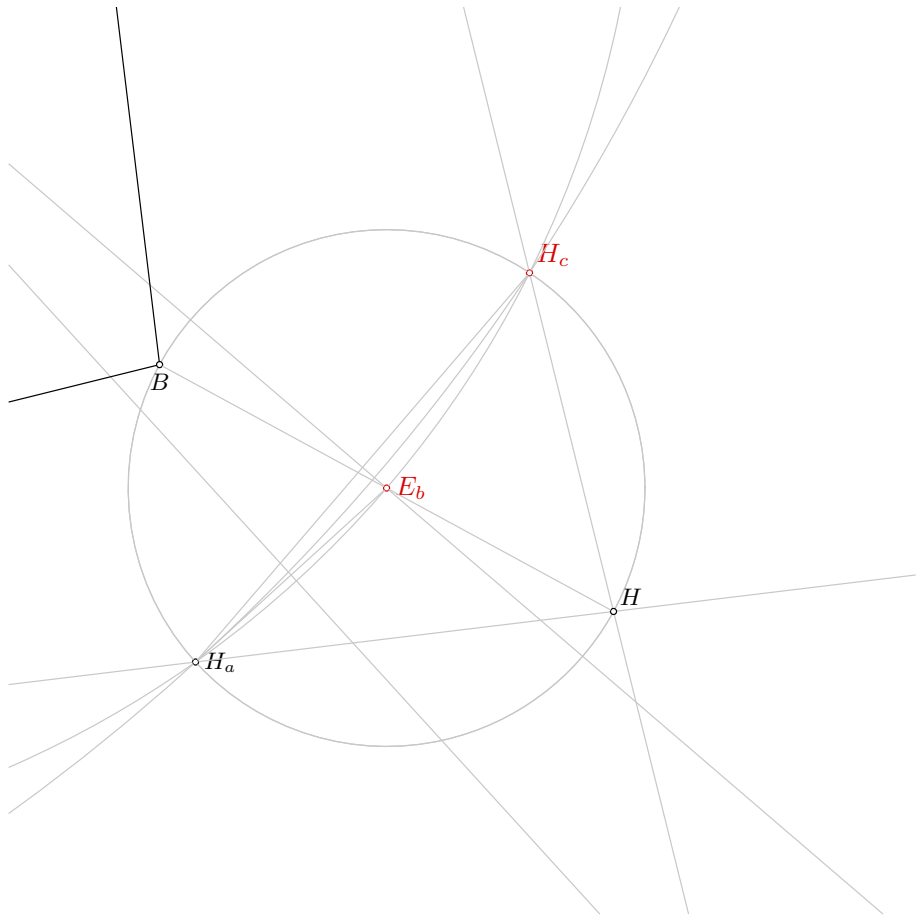

Figure 1: Illustration of the problem 0907

```
% Non-degenerate conditions: lines h_{a} and h_{c} are not parallel; line m(H_{a}H_{c}) and circle
    k(N,M_{a}) intersect; points H_{a} and N are not the same; lines m(H_{a}H_{c}) and m(H_{a}E_{b
    }) are not parallel; points H_{c} and E_{b} are not the same
% Determination conditions: lines h_{a} and h_{c} are not the same; points H_{c} and C are not the
    same; points A and H_{a} are not the same; points E_{b} and M_{b} must be different; lines m(H
    _{a}H_{c}) and m(H_{a}E_{b}) are not the same; points H_{a} and H_{c} are not the same; points
    H_{a} and E_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

4.1.3 Proving H_a=_H_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 908

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 908: Given a point E_b, a point H_a and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 909

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 909: Given a point E_b, a point H_a and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
2. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;
3. Using the circle $k(E_b, B)$, the line a, the point E_b and the point H_a, construct a point B (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points H_a and B must be different;
4. Using the point B and the point E_b, construct a point H (rule W01); ;
5. Using the point M_a and the point B, construct a point C (rule W01); ;
6. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
7. Using the point H and the point C, construct a line h_c (rule W02); % DET: points H and C are not the same;
8. Using the circle $k(E_b, B)$, the line h_c, the point E_b and the point H, construct a point H_c (rule W05); % NDG: line h_c and circle $k(E_b, B)$ intersect % DET: points H and H_c must be different;
9. Using the point B and the point H_c, construct a line c (rule W02); % DET: points B and H_c are not the same;
10. Using the line h_a and the line c, construct a point A (rule W03); % NDG: lines h_a and c are not parallel % DET: lines h_a and c are not the same.

Non-degenerate conditions: lines h_a and c are not parallel; line h_c and circle $k(E_b, B)$ intersect; line a and circle $k(E_b, B)$ intersect; points H_a and E_b are not the same.

Determination conditions: lines h_a and c are not the same; points B and H_c are not the same; points H and H_c must be different; points H and C are not the same; points H_a and H are not the same; points H_a and B must be different; points H_a and M_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D21,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 9.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{a} 80 40
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r H_{a}
cmark_r M_{a}
color 0 0 0
fontsize 8

% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points H_{a} and B must be different
% Constructing a point P_{\_G163776} which is a foot of the point E_{b} on the line a
foot P_{\_G163776} E_{b} a
cmark_r P_{\_G163776}
color 200 200 200
drawline E_{b} P_{\_G163776}
color 0 0 0
```

```
% Constructing a point B which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    163776}
sim B P_{\_G163776} H_{a}
cmark_b B



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% DET: points H and C are not the same
% Constructing a line h_{c} which passes through point H and point C
line h_{c} H C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{c} and circle k(E_{b},B) intersect% DET: points H and H_{c} must be different
% Constructing a point P_{\_G164213} which is a foot of the point E_{b} on the line h_{c}
foot P_{\_G164213} E_{b} h_{c}
cmark_r P_{\_G164213}
color 200 200 200
drawline E_{b} P_{\_G164213}
color 0 0 0

% Constructing a point H_{c} which is an image of the point H in the symmetry to point/line P_{\_G
    164213}
sim H_{c} P_{\_G164213} H
```

```
cmark_rt H_{c}


% DET: points B and H_{c} are not the same
% Constructing a line c which passes through point B and point H_{c}
line c B H_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines h_{a} and c are not parallel% DET: lines h_{a} and c are not the same
% Constructing a point A which belongs to line h_{a} and line c
intersec A h_{a} c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and c are not parallel; line h_{c} and circle k(E_{b},B)
    intersect; line a and circle k(E_{b},B) intersect; points H_{a} and E_{b} are not the same
% Determination conditions: lines h_{a} and c are not the same; points B and H_{c} are not the same
    ; points H and H_{c} must be different; points H and C are not the same; points H_{a} and H are
     not the same; points H_{a} and B must be different; points H_{a} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.182 seconds.

NDG conditions Points M_a and H_a are not identical

Points M_a and H_a are not identical

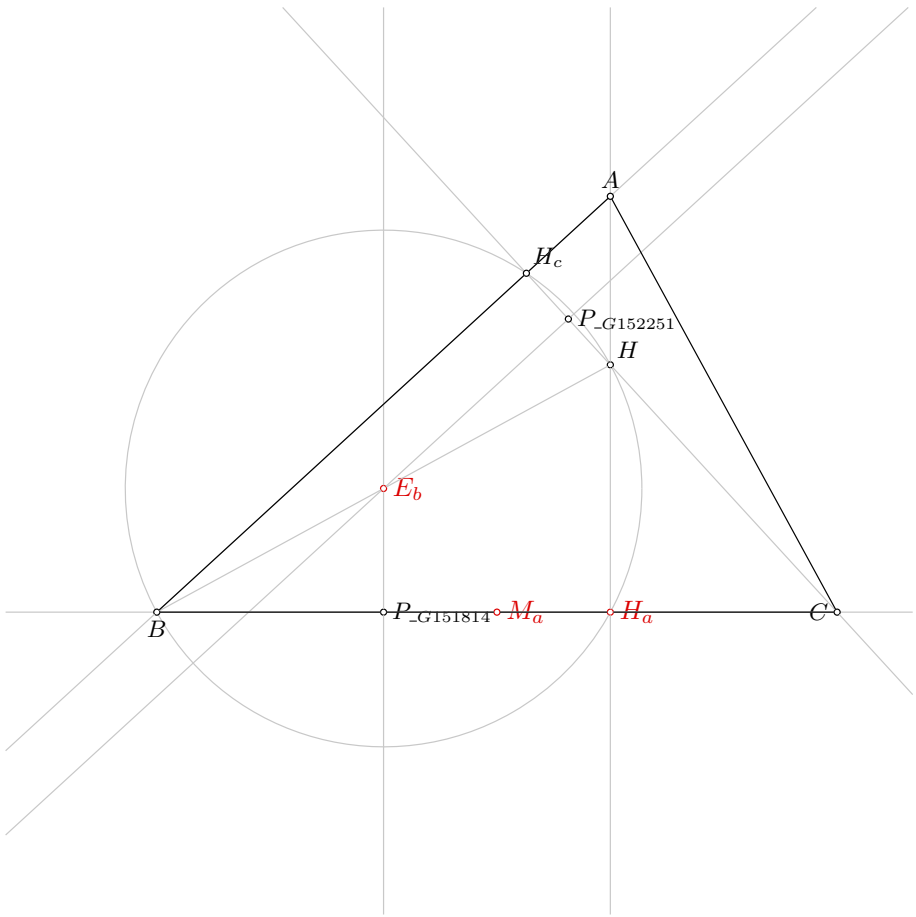

Figure 1: Illustration of the problem 0909

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving M_a=_M_a

NDG conditions are:

$S_{H_aBH_c} \neq S_{HBH_c}$ i.e., lines H_aH and BH_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 910

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 910: Given a point E_b, a point M_b and a point H_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
2. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;
3. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;
4. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
5. Choose freely a point H_a on the circle $k(N, M_a)$ (rule WOncircle);
6. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;
7. Using the circle $k(N, M_a)$, the circle $k(E_b, B)$, the point H_a, the point N and the point E_b, construct a point H_c (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_b, B)$ intersect % DET: circles $k(N, M_a)$ and $k(E_b, B)$ are not the same; points H_a and H_c must be different;
8. Choose freely a point A on the circle $k(M_b, C)$ (rule WOncircle);
9. Using the point A and the point M_b, construct a point C (rule W01); ;
10. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

11. Using the point H_c and the point C, construct a line h_c (rule W02); % DET: points H_c and C are not the same;

12. Using the line h_a and the line h_c, construct a point H (rule W03); % NDG: lines h_a and h_c are not parallel % DET: lines h_a and h_c are not the same;

13. Using the point E_b and the point H, construct a point B (rule W01); .

Non-degenerate conditions: lines h_a and h_c are not parallel; circles $k(N, M_a)$ and $k(E_b, B)$ intersect; points H_a and E_b are not the same; points E_b and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel.

Determination conditions: lines h_a and h_c are not the same; points H_c and C are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(E_b, B)$ are not the same; points H_a and H_c must be different; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points E_b and M_b are not the same.

Rules used: [W01,W02,W03,W06,W08,W14,WOncircle1]

Lemmas used: [D10,D22,D29,D3,D32,D5,D7,D8,GD02,GL01,GL03,GL04,L17,L19,L21,L23,L3,L44,L45,L50,L5

Solving time: 64.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point M_{b} 95 67.5
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_lt M_{b}
cmark_r H_{a}
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
```

```
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0


% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{a} on the circle with center N through point E_{b}
oncircle H_{a} N E_{b}
cmark_r H_{a}
color 200 200 200
drawcircle N E_{b}
color 0 0 0


% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(E_{b},B) intersect% DET: circles k(N,M_{a}) and k(E_{b},B) are not
    the same; points H_{a} and H_{c} must be different
% Constructing a line L_{\_G193160} which passes through point N and point E_{b}
line L_{\_G193160} N E_{b}

color 200 200 200
drawline L_{\_G193160}
color 0 0 0


% Constructing a point H_{c} which is an image of the point H_{a} in the symmetry to point/line L
    _{\_G193160}
```

```
sim H_{c} L_{\_G193160} H_{a}
cmark_rt H_{c}


% Choosing randomly a point A on the circle with center M_{b} through point H_{a}
oncircle A M_{b} H_{a}
cmark_t A
color 200 200 200
drawcircle M_{b} H_{a}
color 0 0 0


% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0


% DET: points H_{c} and C are not the same
% Constructing a line h_{c} which passes through point H_{c} and point C
line h_{c} H_{c} C

color 200 200 200
drawline h_{c}
color 0 0 0


% NDG: lines h_{a} and h_{c} are not parallel% DET: lines h_{a} and h_{c} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{c}
intersec H h_{a} h_{c}
cmark_rt H


% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0
```

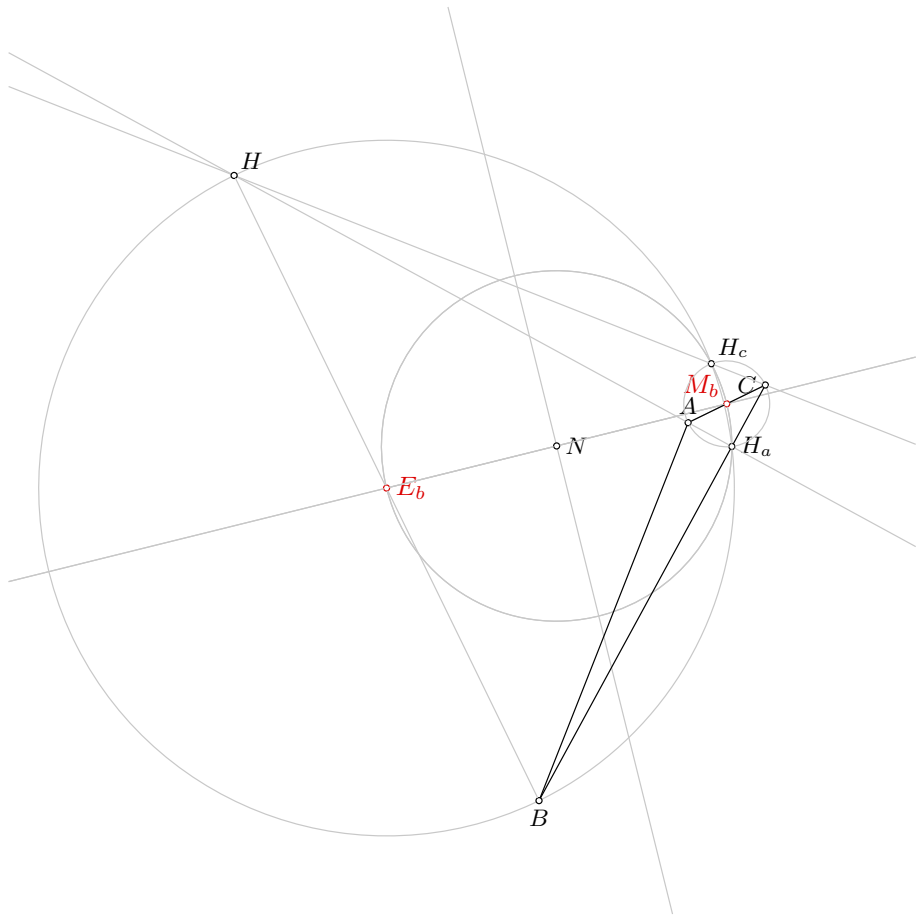

Figure 1: Illustration of the problem 0910

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{c} are not parallel; circles k(N,M_{a}) and k(E_{b
    },B) intersect; points H_{a} and E_{b} are not the same; points E_{b} and N are not the same;
    lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel
% Determination conditions: lines h_{a} and h_{c} are not the same; points H_{c} and C are not the
    same; points A and H_{a} are not the same; circles k(N,M_{a}) and k(E_{b},B) are not the same;
    points H_{a} and H_{c} must be different; lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the
    same; points E_{b} and M_{b} are not the same; points E_{b} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.149 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving H_a=_H_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving M_b=_M_b

NDG conditions are:

$S_{M^0_{m(E_bM_b)}E_bM_b} \neq S_{T^1_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^0_{m(E_bM_b)}T^1_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{AH_cC} \neq S_{H_aH_cC}$ i.e., lines AH_a and H_cC are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

$S_{BAF^2_{\_h_a}} \neq S_{CAF^2_{\_h_a}}$ i.e., lines BC and $AF^2_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 42

Time spent by the prover: 0.000 seconds

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 911

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 911: Given a point E_b, a point H_a and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;
2. Using the point H_a and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points H_a and M_c are not the same;
3. Using the circle $k(E_b, B)$, the circle $k(M_c, A)$, the point H_a, the point E_b and the point M_c, construct a point B (rule W08); % NDG: circles $k(E_b, B)$ and $k(M_c, A)$ intersect % DET: circles $k(E_b, B)$ and $k(M_c, A)$ are not the same; points H_a and B must be different;
4. Using the point B and the point E_b, construct a point H (rule W01); ;
5. Using the point M_c and the point B, construct a point A (rule W01); ;
6. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
7. Using the point M_c and the point B, construct a line c (rule W02); % DET: points M_c and B are not the same;
8. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
9. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
10. Using the line a and the line h_c, construct a point C (rule W03); % NDG: lines a and h_c are not parallel % DET: lines a and h_c are not the same.

Non-degenerate conditions: lines a and h_c are not parallel; line c and circle $k(E_b, B)$ intersect; circles $k(E_b, B)$ and $k(M_c, A)$ intersect; points H_a and M_c are not the same; points H_a and E_b are not the same.

Determination conditions: lines a and h_c are not the same; points H and H_c are not the same; points B and H_c must be different; points M_c and B are not the same; points H_a and B are not the same; circles $k(E_b, B)$ and $k(M_c, A)$ are not the same; points H_a and B must be different.

Rules used: [W01,W02,W03,W05,W06,W08]

Lemmas used: [D10,D20,D29,D5,D7,GD01,GD02,GL03,GL04,GL09,L3,L40,L42,L50,L51]

Solving time: 9.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{a} 80 40
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r H_{a}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: points H_{a} and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point H
    _{a}
circle k(M_{c},A) M_{c} H_{a}

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: circles k(E_{b},B) and k(M_{c},A) intersect% DET: circles k(E_{b},B) and k(M_{c},A) are not
    the same; points H_{a} and B must be different
% Constructing a line L_{\_G220527} which passes through point E_{b} and point M_{c}
line L_{\_G220527} E_{b} M_{c}
```

```
color 200 200 200
drawline L_{\_G220527}
color 0 0 0


% Constructing a point B which is an image of the point H_{a} in the symmetry to point/line L_{\_G
    220527}
sim B L_{\_G220527} H_{a}
cmark_b B



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point A such that M_{c}A/M_{c}B=-1
towards A M_{c} B -1
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% DET: points M_{c} and B are not the same
% Constructing a line c which passes through point M_{c} and point B
line c M_{c} B

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G220944} which is a foot of the point E_{b} on the line c
foot P_{\_G220944} E_{b} c
cmark_r P_{\_G220944}
color 200 200 200
drawline E_{b} P_{\_G220944}
```

```
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    220944}
sim H_{c} P_{\_G220944} B
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines a and h_{c} are not parallel% DET: lines a and h_{c} are not the same
% Constructing a point C which belongs to line a and line h_{c}
intersec C a h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{c} are not parallel; line c and circle k(E_{b},B)
    intersect; circles k(E_{b},B) and k(M_{c},A) intersect; points H_{a} and M_{c} are not the same
    ; points H_{a} and E_{b} are not the same
% Determination conditions: lines a and h_{c} are not the same; points H and H_{c} are not the same
    ; points B and H_{c} must be different; points M_{c} and B are not the same; points H_{a} and B
     are not the same; circles k(E_{b},B) and k(M_{c},A) are not the same; points H_{a} and B must
    be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

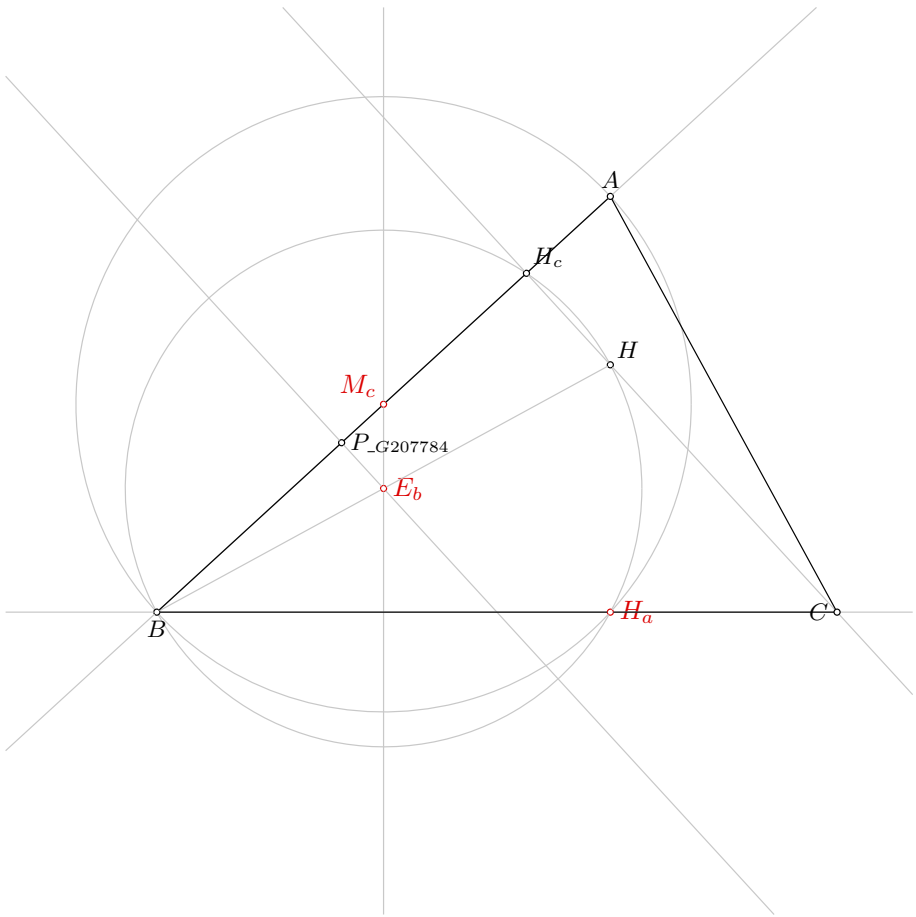

Figure 1: Illustration of the problem 0911

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.166 seconds.

NDG conditions Points M_c and E_b are not identical

Points M_c and E_b are not identical

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving M_c=_M_c

NDG conditions are:

$S_{H_aHH_c} \neq S_{BHH_c}$ i.e., lines H_aB and HH_c are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 44
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 912

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 912: Given a point H_a, a point N and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;
2. Choose freely a point E_b on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
4. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
5. Using the point H_a and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_a and E_b are not the same;
6. Using the circle $k(N, M_a)$, the circle $k(E_b, B)$, the point H_a, the point N and the point E_b, construct a point H_c (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_b, B)$ intersect % DET: circles $k(N, M_a)$ and $k(E_b, B)$ are not the same; points H_a and H_c must be different;
7. Choose freely a point A on the circle $k(M_b, C)$ (rule WOncircle);
8. Using the point A and the point M_b, construct a point C (rule W01); ;
9. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;
10. Using the point H_c and the point C, construct a line h_c (rule W02); % DET: points H_c and C are not the same;

11. Using the line h_a and the line h_c, construct a point H (rule W03); % NDG: lines h_a and h_c are not parallel % DET: lines h_a and h_c are not the same;

12. Using the point E_b and the point H, construct a point B (rule W01); .

Non-degenerate conditions: lines h_a and h_c are not parallel; circles $k(N, M_a)$ and $k(E_b, B)$ intersect; points H_a and E_b are not the same; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points H_a and N are not the same.

Determination conditions: lines h_a and h_c are not the same; points H_c and C are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(E_b, B)$ are not the same; points H_a and H_c must be different; points E_b and M_b must be different; points E_b and N are not the same.

Rules used: [W01,W02,W03,W05a,W06,W08,WOncircle1]

Lemmas used: [D10,D22,D29,D3,D32,D5,D7,D8,GD02,GL01,GL03,GL04,L17,L19,L21,L23,L3,L44,L45,L50,L5

Solving time: 57.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{a} 80 40
point N 72.5 61.93
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_r H_{a}
cmark_r N
cmark_r E_{b}
color 0 0 0
fontsize 8

% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{b} on the circle with center N through point H_{a}
oncircle E_{b} N H_{a}
cmark_r E_{b}
color 200 200 200
drawcircle N H_{a}
color 0 0 0


% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
```

```
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0


% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}


% NDG: points H_{a} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{a}
circle k(E_{b},B) E_{b} H_{a}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0


% NDG: circles k(N,M_{a}) and k(E_{b},B) intersect% DET: circles k(N,M_{a}) and k(E_{b},B) are not
    the same; points H_{a} and H_{c} must be different
% Constructing a line L_{\_G257976} which passes through point N and point E_{b}
line L_{\_G257976} N E_{b}

color 200 200 200
drawline L_{\_G257976}
color 0 0 0


% Constructing a point H_{c} which is an image of the point H_{a} in the symmetry to point/line L
    _{\_G257976}
sim H_{c} L_{\_G257976} H_{a}
cmark_rt H_{c}


% Choosing randomly a point A on the circle with center M_{b} through point H_{a}
oncircle A M_{b} H_{a}
cmark_t A
color 200 200 200
drawcircle M_{b} H_{a}
color 0 0 0


% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
```

```
drawsegment A C
color 0 0 0


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% DET: points H_{c} and C are not the same
% Constructing a line h_{c} which passes through point H_{c} and point C
line h_{c} H_{c} C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines h_{a} and h_{c} are not parallel% DET: lines h_{a} and h_{c} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{c}
intersec H h_{a} h_{c}
cmark_rt H



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{c} are not parallel; circles k(N,M_{a}) and k(E_{b
    },B) intersect; points H_{a} and E_{b} are not the same; line m(H_{a}H_{c}) and circle k(N,M_{a
    }) intersect; points H_{a} and N are not the same
% Determination conditions: lines h_{a} and h_{c} are not the same; points H_{c} and C are not the
    same; points A and H_{a} are not the same; circles k(N,M_{a}) and k(E_{b},B) are not the same;
    points H_{a} and H_{c} must be different; points E_{b} and M_{b} must be different; points E_{b
    } and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

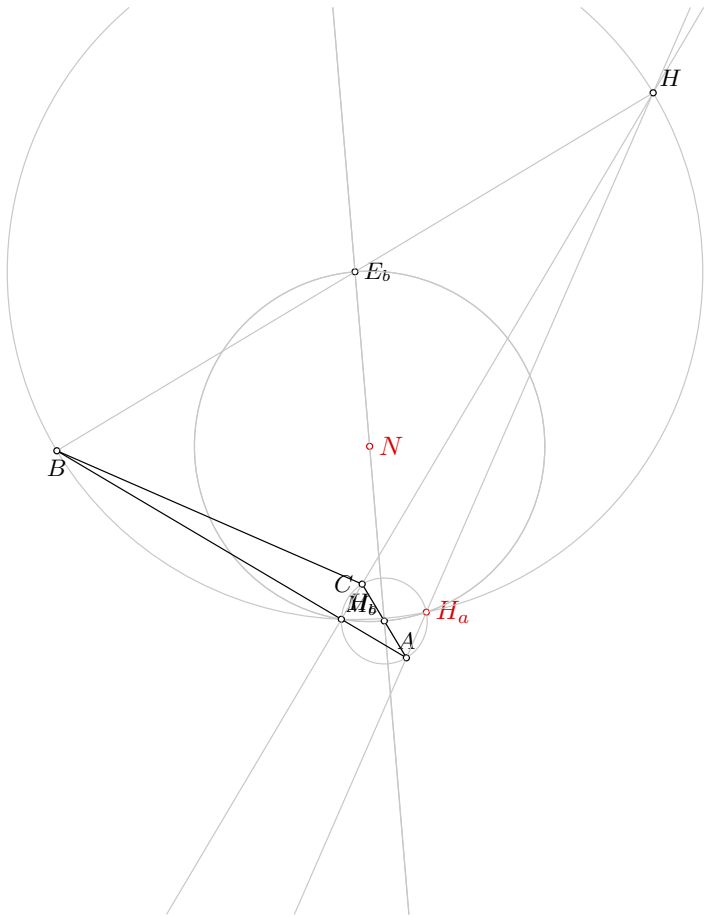

Figure 1: Illustration of the problem 0912

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_a=_H_a

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_a=_H_a

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_a=_H_a

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_a=_H_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 913

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 913: Given a point E_b, a point H_a and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 914

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 914: Given a point E_b, a point H_a and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 915

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 915: Given a point E_b, a point H_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 916

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 916: Given a point E_b, a point H_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 917

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 917: Given a point E_b, a point H_b and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
3. Using the circle $k(E_b, B)$ and the line h_b, construct a point B and a point H (rule W04); % NDG: line h_b and circle $k(E_b, B)$ intersect;
4. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
5. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
6. Using the point H_b and the line h_b, construct a line b (rule W10a); ;
7. Using the line b and the line c, construct a point A (rule W03); % NDG: lines b and c are not parallel % DET: lines b and c are not the same;
8. Using the line h_c and the line b, construct a point C (rule W03); % NDG: lines h_c and b are not parallel % DET: lines h_c and b are not the same.

Non-degenerate conditions: lines h_c and b are not parallel; lines b and c are not parallel; line h_b and circle $k(E_b, B)$ intersect; points H_c and E_b are not the same.

Determination conditions: lines h_c and b are not the same; lines b and c are not the same; points H_c and H are not the same; points H_c and B are not the same; points E_b and H_b are not the same.

Rules used: [W02,W03,W04,W06,W10a]

Lemmas used: [D10,D29,D3,D6,D7,D9,GD01,GD02,GL09,L3,L49,L51]
Solving time: 6.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{b} 89.36 77.83
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_l H_{b}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line h_{b} and circle k(E_{b},B) intersect
% Constructing points B and H which are in intersection of k(E_{b},B) and h_{b}
intersec2 B H k(E_{b},B) h_{b}
cmark_b B
cmark_rt H


% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0
```

```
% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% Constructing a line b which is perpendicular to line h_{b} and which passes through point H_{b}
perp b H_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines b and c are not parallel% DET: lines b and c are not the same
% Constructing a point A which belongs to line b and line c
intersec A b c
cmark_t A


% NDG: lines h_{c} and b are not parallel% DET: lines h_{c} and b are not the same
% Constructing a point C which belongs to line h_{c} and line b
intersec C h_{c} b
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and b are not parallel; lines b and c are not parallel;
    line h_{b} and circle k(E_{b},B) intersect; points H_{c} and E_{b} are not the same
% Determination conditions: lines h_{c} and b are not the same; lines b and c are not the same;
    points H_{c} and H are not the same; points H_{c} and B are not the same; points E_{b} and H_{b
    } are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

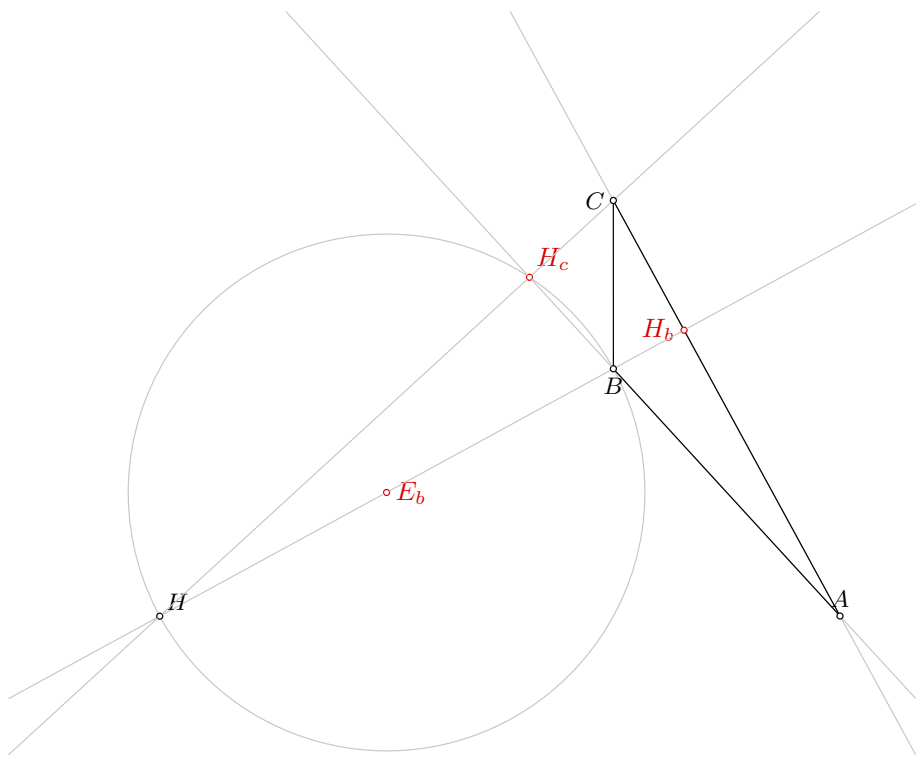

Figure 1: Illustration of the problem 0917

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 42 terms.

Time Complexity: Time spent by the prover is 0.38 seconds.

NDG conditions Point H is not the midpoint of segment with endpoints B and H_c

Points A, C and E_b are not collinear

Line through points B and H_b is not perpendicular to line through points H_b and E_b

4.1.2 Proving H_b=_H_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.099 seconds.

NDG conditions Point H is not the midpoint of segment with endpoints B and H_c

Points A, C and E_b are not collinear

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 65 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.3.2 Proving H_b=_H_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving H_c=_H_c

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 395 terms.

Time Complexity: Time spent by the prover is 0.450 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_b=_H_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 0 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving H_c=_H_c

Proving failed

Problem 918

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 918: Given a point E_b, a point H_b and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 919

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 919: Given a point E_b, a point H_b and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Using the point H_b and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points H_b and M_a are not the same;
3. Using the circle $k(M_a, B)$, the line h_b, the point M_a and the point H_b, construct a point B (rule W05); % NDG: line h_b and circle $k(M_a, B)$ intersect % DET: points H_b and B must be different;
4. Using the point B and the point E_b, construct a point H (rule W01); ;
5. Using the point M_a and the point B, construct a point C (rule W01); ;
6. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
7. Using the point H and the point C, construct a line h_c (rule W02); % DET: points H and C are not the same;
8. Using the circle $k(M_a, B)$, the line h_c, the point M_a and the point C, construct a point H_c (rule W05); % NDG: line h_c and circle $k(M_a, B)$ intersect % DET: points C and H_c must be different;
9. Using the point B and the point H_c, construct a line c (rule W02); % DET: points B and H_c are not the same;
10. Using the line b and the line c, construct a point A (rule W03); % NDG: lines b and c are not parallel % DET: lines b and c are not the same.

Non-degenerate conditions: lines b and c are not parallel; line h_c and circle $k(M_a, B)$ intersect; line h_b and circle $k(M_a, B)$ intersect; points H_b and M_a are not the same.

Determination conditions: lines b and c are not the same; points B and H_c are not the same; points C and H_c must be different; points H and C are not the same; points H_b and C are not the same; points H_b and B must be different; points E_b and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D21,D29,D3,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L37,L38,L39]

Solving time: 8.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{b} 89.36 77.83
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_l H_{b}
cmark_r M_{a}
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{b} and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point H
    _{b}
circle k(M_{a},B) M_{a} H_{b}

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: line h_{b} and circle k(M_{a},B) intersect% DET: points H_{b} and B must be different
% Constructing a point P_{\_G95861} which is a foot of the point M_{a} on the line h_{b}
foot P_{\_G95861} M_{a} h_{b}
cmark_r P_{\_G95861}
color 200 200 200
drawline M_{a} P_{\_G95861}
color 0 0 0
```

```
% Constructing a point B which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    95861}
sim B P_{\_G95861} H_{b}
cmark_b B



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% DET: points H and C are not the same
% Constructing a line h_{c} which passes through point H and point C
line h_{c} H C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{c} and circle k(M_{a},B) intersect% DET: points C and H_{c} must be different
% Constructing a point P_{\_G96298} which is a foot of the point M_{a} on the line h_{c}
foot P_{\_G96298} M_{a} h_{c}
cmark_r P_{\_G96298}
color 200 200 200
drawline M_{a} P_{\_G96298}
color 0 0 0

% Constructing a point H_{c} which is an image of the point C in the symmetry to point/line P_{\_G
    96298}
sim H_{c} P_{\_G96298} C
```

```
cmark_rt H_{c}


% DET: points B and H_{c} are not the same
% Constructing a line c which passes through point B and point H_{c}
line c B H_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines b and c are not parallel% DET: lines b and c are not the same
% Constructing a point A which belongs to line b and line c
intersec A b c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and c are not parallel; line h_{c} and circle k(M_{a},B)
    intersect; line h_{b} and circle k(M_{a},B) intersect; points H_{b} and M_{a} are not the same
% Determination conditions: lines b and c are not the same; points B and H_{c} are not the same;
    points C and H_{c} must be different; points H and C are not the same; points H_{b} and C are
    not the same; points H_{b} and B must be different; points E_{b} and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.12 seconds.

NDG conditions There are no NDG conditions for this theorem

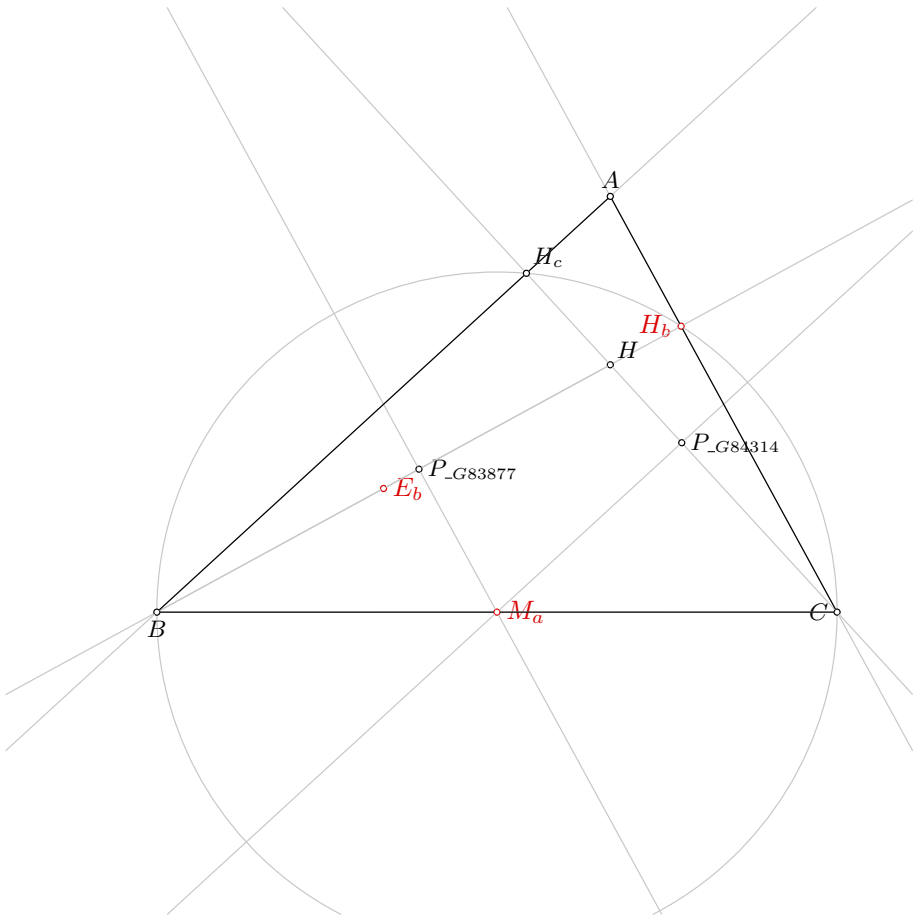

Figure 1: Illustration of the problem 0919

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving M_a=_M_a

NDG conditions are:

$S_{H_bBH_c} \neq S_{CBH_c}$ i.e., lines H_bC and BH_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 920

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 920: Given a point H_b, a point M_b and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
2. Using the point H_b and the line b, construct a line h_b (rule W10b); ;
3. Choose freely a point E_b on the line h_b (rule WOnline2);
4. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
5. Using the point E_b and the point H_b, construct a line $m(E_bH_b)$ (rule W14); % DET: points E_b and H_b are not the same;
6. Using the line $m(E_bH_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bH_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bH_b)$ and $m(H_aH_c)$ are not the same;
7. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
8. Choose freely a point A on the line b (rule WOnline1) ;
9. Using the point A and the point M_b, construct a point C (rule W01); ;
10. Using the point A and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points A and M_b are not the same;

11. Using the circle $k(N, M_a)$ and the circle $k(M_b, C)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_b, C)$ intersect % DET: circles $k(N, M_a)$ and $k(M_b, C)$ are not the same;

12. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

13. Using the line h_b and the line h_a, construct a point H (rule W03); % NDG: lines h_b and h_a are not parallel % DET: lines h_b and h_a are not the same;

14. Using the point E_b and the point H, construct a point B (rule W01); .

Non-degenerate conditions: lines h_b and h_a are not parallel; circles $k(N, M_a)$ and $k(M_b, C)$ intersect; points A and M_b are not the same; points E_b and N are not the same; lines $m(E_bH_b)$ and $m(H_aH_c)$ are not parallel.

Determination conditions: lines h_b and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; lines $m(E_bH_b)$ and $m(H_aH_c)$ are not the same; points E_b and H_b are not the same; points E_b and M_b are not the same; points H_b and M_b are not the same.

Rules used: [W01,W02,W03,W06,W07,W10b,W14,WOnline1,WOnline2]

Lemmas used: [D22,D29,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L19,L20,L21,L23,L43,L44

Solving time: 687.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{b} 89.36 77.83
point M_{b} 95 67.5
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_l H_{b}
cmark_lt M_{b}
cmark_r E_{b}
color 0 0 0
fontsize 8

% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% Constructing a line h_{b} which is perpendicular to line b and which passes through point H_{b}
```

```
perp h_{b} H_{b} b

color 200 200 200
drawline h_{b}
color 0 0 0




% Generating random value V[_G125648]
random V[_G125648]


% Calculating value V[_G125669] using formula V[_G125648]*20
expression V[_G125669] { V[_G125648]*20 }


% Constructing a point E_{b} which is a point for which holds H_{b}E_{b} = V[_G125669] and angle M
    _{b}H_{b}E_{b} = 90
turtle E_{b} M_{b} H_{b} 90 V[_G125669]
cmark_r E_{b}


% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% DET: points E_{b} and H_{b} are not the same
% Constructing bisector m(E_{b}H_{b}) of the segment E_{b}H_{b}
med m(E_{b}H_{b}) E_{b} H_{b}

color 200 200 200
drawline m(E_{b}H_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} H_{b}
color 0 0 0


% NDG: lines m(E_{b}H_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}H_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}H_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}H_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% Choosing randomly a point A on the line H_{b}M_{b}
online A H_{b} M_{b}
cmark_t A
color 200 200 200
drawline H_{b} M_{b}
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% NDG: points A and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point A
circle k(M_{b},C) M_{b} A

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{b},C) intersect% DET: circles k(N,M_{a}) and k(M_{b},C) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{b},C)
intersec2 H_{a} H_{c} k(N,M_{a}) k(M_{b},C)
cmark_r H_{a}
cmark_rt H_{c}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{b} and h_{a} are not parallel% DET: lines h_{b} and h_{a} are not the same
% Constructing a point H which belongs to line h_{b} and line h_{a}
intersec H h_{b} h_{a}
```

```
cmark_rt H



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{b
    },C) intersect; points A and M_{b} are not the same; points E_{b} and N are not the same; lines
     m(E_{b}H_{b}) and m(H_{a}H_{c}) are not parallel
% Determination conditions: lines h_{b} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{b},C) are not the same; lines m(E_{b}H_{b}) and m(H_{a}H_{c})
     are not the same; points E_{b} and H_{b} are not the same; points E_{b} and M_{b} are not the
    same; points H_{b} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_b=_H_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 13 terms.

Time Complexity: Time spent by the prover is 0.213 seconds.

NDG conditions Points M_b and A are not identical

Points M_b and N are not identical

Line through points H_b and M_b is not perpendicular to line through points M_b and N

Line through points M_b and A is not perpendicular to line through points A and H_b

Points A, C and E_b are not collinear

4.1.2 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.036 seconds.

NDG conditions There are no NDG conditions for this theorem

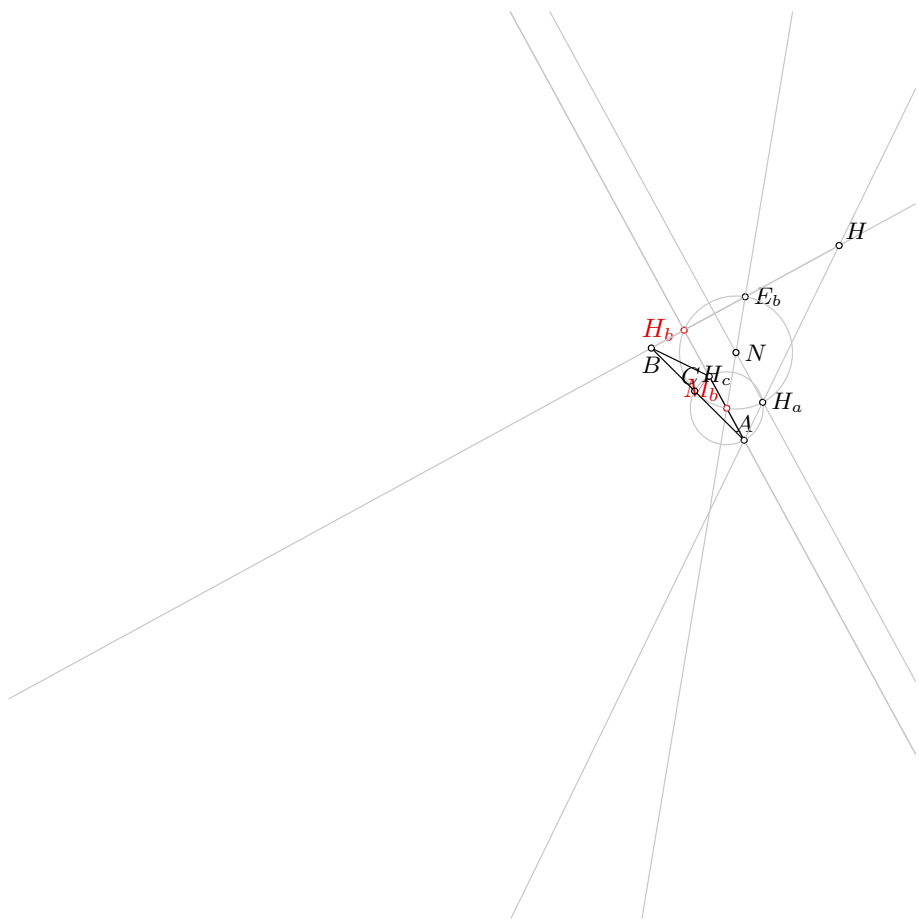

Figure 1: Illustration of the problem 0920

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_b=_H_b

Proving failed

4.2.2 Proving M_b=_M_b

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_b=_H_b

Proving failed

4.3.2 Proving M_b=_M_b

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_b=_H_b

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 921

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 921: Given a point E_b, a point H_b and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Using the point H_b and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points H_b and M_c are not the same;
3. Using the circle $k(M_c, A)$, the line h_b, the point M_c and the point H_b, construct a point B (rule W05); % NDG: line h_b and circle $k(M_c, A)$ intersect % DET: points H_b and B must be different;
4. Using the point B and the point E_b, construct a point H (rule W01); ;
5. Using the point M_c and the point B, construct a point A (rule W01); ;
6. Using the point H_b and the point A, construct a line b (rule W02); % DET: points H_b and A are not the same;
7. Using the point H and the point A, construct a line h_a (rule W02); % DET: points H and A are not the same;
8. Using the circle $k(M_c, A)$, the line h_a, the point M_c and the point A, construct a point H_a (rule W05); % NDG: line h_a and circle $k(M_c, A)$ intersect % DET: points A and H_a must be different;
9. Using the point B and the point H_a, construct a line a (rule W02); % DET: points B and H_a are not the same;
10. Using the line b and the line a, construct a point C (rule W03); % NDG: lines b and a are not parallel % DET: lines b and a are not the same.

Non-degenerate conditions: lines b and a are not parallel; line h_a and circle $k(M_c, A)$ intersect; line h_b and circle $k(M_c, A)$ intersect; points H_b and M_c are not the same.

Determination conditions: lines b and a are not the same; points B and H_a are not the same; points A and H_a must be different; points H and A are not the same; points H_b and A are not the same; points H_b and B must be different; points E_b and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D20,D29,D3,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L40,L41,L42]

Solving time: 8.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{b} 89.36 77.83
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_l H_{b}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{b} and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point H
    _{b}
circle k(M_{c},A) M_{c} H_{b}

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: line h_{b} and circle k(M_{c},A) intersect% DET: points H_{b} and B must be different
% Constructing a point P_{\_G151819} which is a foot of the point M_{c} on the line h_{b}
foot P_{\_G151819} M_{c} h_{b}
cmark_r P_{\_G151819}
color 200 200 200
drawline M_{c} P_{\_G151819}
color 0 0 0
```

```
% Constructing a point B which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    151819}
sim B P_{\_G151819} H_{b}
cmark_b B



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point A such that M_{c}A/M_{c}B=-1
towards A M_{c} B -1
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points H_{b} and A are not the same
% Constructing a line b which passes through point H_{b} and point A
line b H_{b} A

color 200 200 200
drawline b
color 0 0 0



% DET: points H and A are not the same
% Constructing a line h_{a} which passes through point H and point A
line h_{a} H A

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(M_{c},A) intersect% DET: points A and H_{a} must be different
% Constructing a point P_{\_G152256} which is a foot of the point M_{c} on the line h_{a}
foot P_{\_G152256} M_{c} h_{a}
cmark_r P_{\_G152256}
color 200 200 200
drawline M_{c} P_{\_G152256}
color 0 0 0

% Constructing a point H_{a} which is an image of the point A in the symmetry to point/line P_{\_G
    152256}
sim H_{a} P_{\_G152256} A
```

```
cmark_r H_{a}


% DET: points B and H_{a} are not the same
% Constructing a line a which passes through point B and point H_{a}
line a B H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines b and a are not parallel% DET: lines b and a are not the same
% Constructing a point C which belongs to line b and line a
intersec C b a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and a are not parallel; line h_{a} and circle k(M_{c},A)
    intersect; line h_{b} and circle k(M_{c},A) intersect; points H_{b} and M_{c} are not the same
% Determination conditions: lines b and a are not the same; points B and H_{a} are not the same;
    points A and H_{a} must be different; points H and A are not the same; points H_{b} and A are
    not the same; points H_{b} and B must be different; points E_{b} and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.115 seconds.

NDG conditions There are no NDG conditions for this theorem

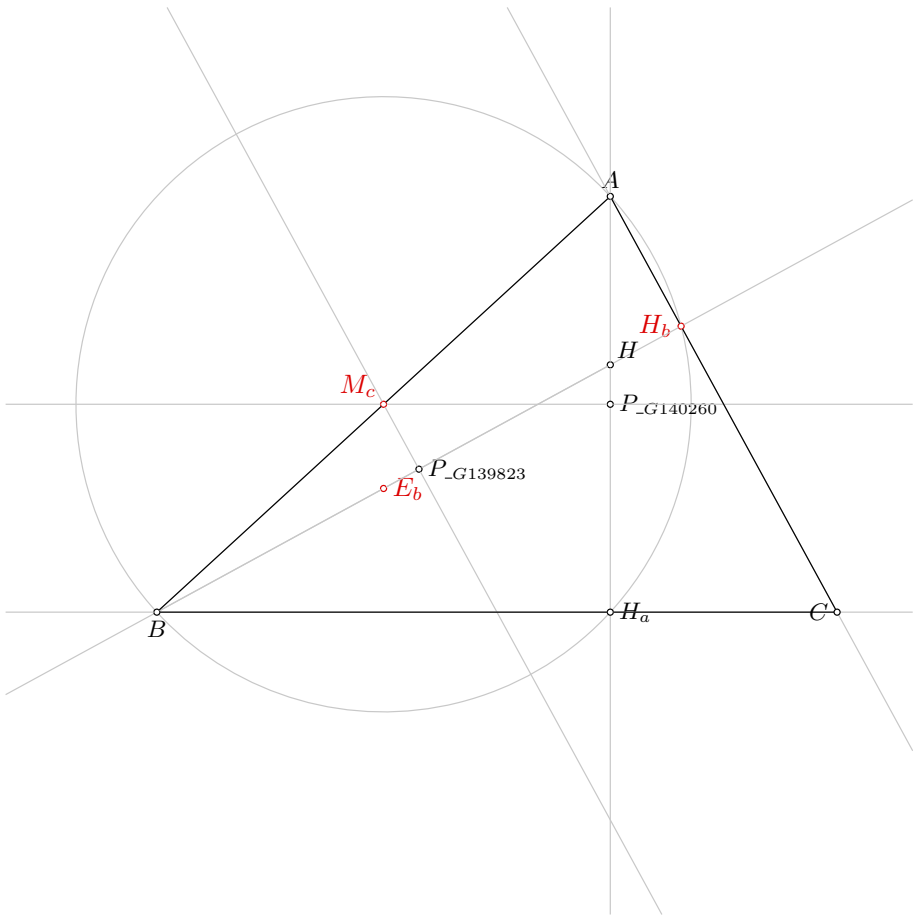

Figure 1: Illustration of the problem 0921

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving M_c=_M_c

NDG conditions are:

$S_{H_bBH_a} \neq S_{ABH_a}$ i.e., lines H_bA and BH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 922

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 922: Given a point H_b, a point N and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;
2. Choose freely a point E_b on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
4. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
5. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
6. Using the point M_b and the point H_b, construct a line b (rule W02); % DET: points M_b and H_b are not the same;
7. Choose freely a point A on the line b (rule WOnline1) ;
8. Using the point A and the point M_b, construct a point C (rule W01); ;
9. Using the point A and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points A and M_b are not the same;
10. Using the circle $k(N, M_a)$ and the circle $k(M_b, C)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_b, C)$ intersect % DET: circles $k(N, M_a)$ and $k(M_b, C)$ are not the same;

11. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

12. Using the line h_b and the line h_a, construct a point H (rule W03); % NDG: lines h_b and h_a are not parallel % DET: lines h_b and h_a are not the same;

13. Using the point E_b and the point H, construct a point B (rule W01); .

Non-degenerate conditions: lines h_b and h_a are not parallel; circles $k(N, M_a)$ and $k(M_b, C)$ intersect; points A and M_b are not the same; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points H_b and N are not the same.

Determination conditions: lines h_b and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points M_b and H_b are not the same; points E_b and M_b must be different; points E_b and N are not the same; points E_b and H_b are not the same.

Rules used: [W01,W02,W03,W05a,W06,W07,WOncircle1,WOnline1]

Lemmas used: [D22,D29,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L17,L19,L20,L21,L23,L43

Solving time: 564.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{b} 89.36 77.83
point N 72.5 61.93
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_l H_{b}
cmark_r N
cmark_r E_{b}
color 0 0 0
fontsize 8

% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{b} on the circle with center N through point H_{b}
oncircle E_{b} N H_{b}
cmark_r E_{b}
color 200 200 200
drawcircle N H_{b}
color 0 0 0
```

```
% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}


% DET: points M_{b} and H_{b} are not the same
% Constructing a line b which passes through point M_{b} and point H_{b}
line b M_{b} H_{b}

color 200 200 200
drawline b
color 0 0 0



% Choosing randomly a point A on the line H_{b}M_{b}
online A H_{b} M_{b}
cmark_t A
color 200 200 200
drawline H_{b} M_{b}
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0
```

```
% NDG: points A and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point A
circle k(M_{b},C) M_{b} A

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{b},C) intersect% DET: circles k(N,M_{a}) and k(M_{b},C) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{b},C)
intersec2 H_{a} H_{c} k(N,M_{a}) k(M_{b},C)
cmark_r H_{a}
cmark_rt H_{c}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{b} and h_{a} are not parallel% DET: lines h_{b} and h_{a} are not the same
% Constructing a point H which belongs to line h_{b} and line h_{a}
intersec H h_{b} h_{a}
cmark_rt H



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{b
    },C) intersect; points A and M_{b} are not the same; line m(H_{a}H_{c}) and circle k(N,M_{a})
    intersect; points H_{b} and N are not the same
% Determination conditions: lines h_{b} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{b},C) are not the same; points M_{b} and H_{b} are not the
    same; points E_{b} and M_{b} must be different; points E_{b} and N are not the same; points E_{
    b} and H_{b} are not the same
```

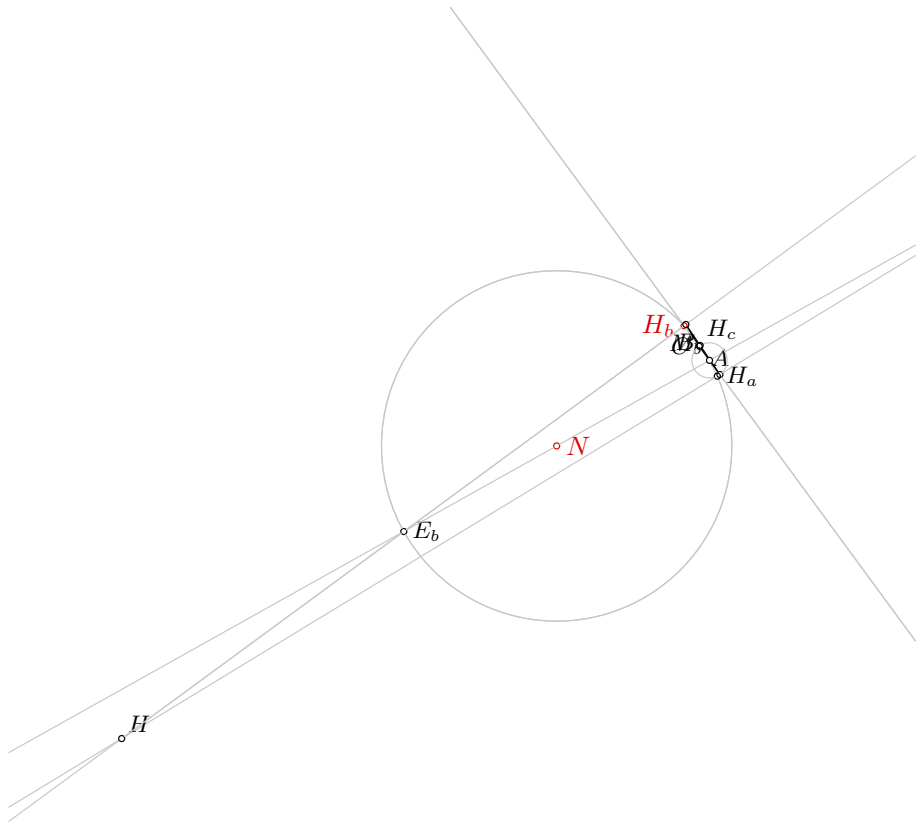

Figure 1: Illustration of the problem 0922

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_b=_H_b

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_b=_H_b

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_b=_H_b

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_b=_H_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 923

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 923: Given a point E_b, a point H_b and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
2. Using the point H_b and the line h_b, construct a line b (rule W10a); ;
3. Using the point O and the line b, construct a line m_b (rule W10b); ;
4. Using the line m_b and the line b, construct a point M_b (rule W03); % NDG: lines m_b and b are not parallel % DET: lines m_b and b are not the same;
5. Using the point M_b and the point E_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points M_b and E_b are not the same;
6. Using the point E_b and the point H_b, construct a line $m(E_bH_b)$ (rule W14); % DET: points E_b and H_b are not the same;
7. Using the line $m(E_bH_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bH_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bH_b)$ and $m(H_aH_c)$ are not the same;
8. Using the point O and the point N, construct a point H (rule W01); ;
9. Using the point E_b and the point H, construct a point B (rule W01); ;
10. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
11. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; lines $m(E_bH_b)$ and $m(H_aH_c)$ are not parallel; lines m_b and b are not parallel.

Determination conditions: lines $m(E_bH_b)$ and $m(H_aH_c)$ are not the same; points E_b and H_b are not the same; points M_b and E_b are not the same; lines m_b and b are not the same; points E_b and H_b are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W10b,W14]

Lemmas used: [D1,D12,D22,D26,D29,D3,D31,D32,D6,D9,GD01,GD02,GL01,GL03,GL04,GL09,L11,L12,L19,L

Solving time: 3.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{b} 89.36 77.83
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_l H_{b}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0




% Constructing a line b which is perpendicular to line h_{b} and which passes through point H_{b}
perp b H_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0




% Constructing a line m_{b} which is perpendicular to line b and which passes through point O
perp m_{b} O b

color 200 200 200
drawline m_{b}
color 0 0 0
```

```
% NDG: lines m_{b} and b are not parallel% DET: lines m_{b} and b are not the same
% Constructing a point M_{b} which belongs to line m_{b} and line b
intersec M_{b} m_{b} b
cmark_lt M_{b}


% DET: points M_{b} and E_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point M_{b} and point E_{b}
line m(H_{a}H_{c}) M_{b} E_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% DET: points E_{b} and H_{b} are not the same
% Constructing bisector m(E_{b}H_{b}) of the segment E_{b}H_{b}
med m(E_{b}H_{b}) E_{b} H_{b}

color 200 200 200
drawline m(E_{b}H_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} H_{b}
color 0 0 0


% NDG: lines m(E_{b}H_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}H_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}H_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}H_{b}) m(H_{a}H_{c})
cmark_r N



% Constructing a point H such that OH/ON=2
towards H O N 2
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0
```

```
% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    lines m(E_{b}H_{b}) and m(H_{a}H_{c}) are not parallel; lines m_{b} and b are not parallel
% Determination conditions: lines m(E_{b}H_{b}) and m(H_{a}H_{c}) are not the same; points E_{b}
    and H_{b} are not the same; points M_{b} and E_{b} are not the same; lines m_{b} and b are not
    the same; points E_{b} and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving O=_O

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 120 terms.

Time Complexity: Time spent by the prover is 0.692 seconds.

NDG conditions Points H_b and A are not identical

Points A, C and E_b are not collinear

Point C is not the midpoint of segment with endpoints H_b and B

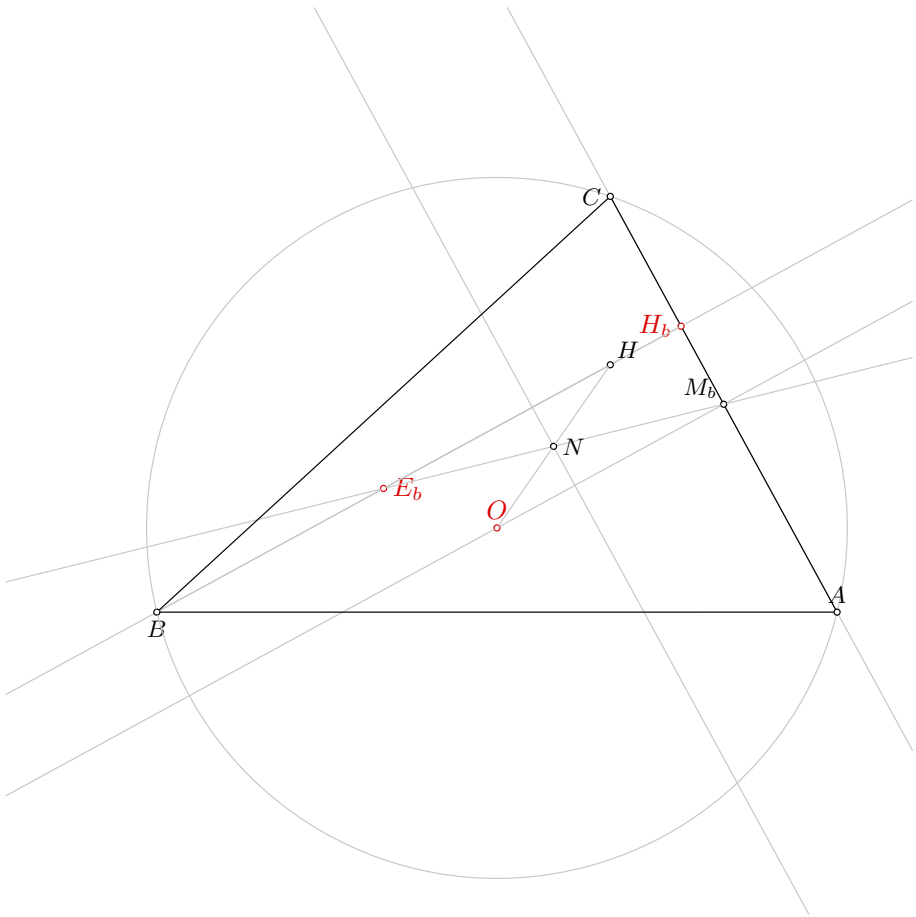

Figure 1: Illustration of the problem 0923

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 311 terms.

Time Complexity: Time spent by the prover is 0.360 seconds.There are no ndg conditions.

4.3.2 Proving H_b=_H_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 15 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 694 terms.

Time Complexity: Time spent by the prover is 0.860 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 924

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 924: Given a point E_b, a point H_b and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 925

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 925: Given a point H_b, a point T_b and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point T_b, construct a line b (rule W02); % DET: points H_b and T_b are not the same;
2. Using the point H_b and the line b, construct a line h_b (rule W10b); ;
3. Choose freely a point E_b on the line h_b (rule WOnline2);
4. Choose freely a point A on the line b (rule WOnline1) ;
5. Choose freely a point B on the line h_b (rule WOnline1) ;
6. Using the point B and the point E_b, construct a point H (rule W01); ;
7. Using the point B and the point A, construct a line c (rule W02); % DET: points B and A are not the same;
8. Using the point B and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points B and E_b are not the same;
9. Using the circle $k(E_b, B)$, the line c, the point E_b and the point B, construct a point H_c (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points B and H_c must be different;
10. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
11. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same.

Non-degenerate conditions: lines b and h_c are not parallel; line c and circle $k(E_b, B)$ intersect; points B and E_b are not the same.

Determination conditions: lines b and h_c are not the same; points H and H_c are not the same; points B and H_c must be different; points B and A are not the same; points H_b and T_b are not the same.

Rules used: [W01,W02,W03,W05,W06,W10b,WOnline1,WOnline2]

Lemmas used: [D10,D24,D29,D6,D7,D9,GD01,GD02,GL03,L3,L51]

Solving time: 215.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{b} 89.36 77.83
point T_{b} 94.25 68.88
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_l H_{b}
cmark_t T_{b}
cmark_r E_{b}
color 0 0 0
fontsize 8

% DET: points H_{b} and T_{b} are not the same
% Constructing a line b which passes through point H_{b} and point T_{b}
line b H_{b} T_{b}

color 200 200 200
drawline b
color 0 0 0




% Constructing a line h_{b} which is perpendicular to line b and which passes through point H_{b}
perp h_{b} H_{b} b

color 200 200 200
drawline h_{b}
color 0 0 0




% Generating random value V[_G251849]
random V[_G251849]


% Calculating value V[_G251870] using formula V[_G251849]*20
expression V[_G251870] { V[_G251849]*20 }
```

```
% Constructing a point E_{b} which is a point for which holds H_{b}E_{b} = V[_G251870] and angle T
    _{b}H_{b}E_{b} = 90
turtle E_{b} T_{b} H_{b} 90 V[_G251870]
cmark_r E_{b}


% Choosing randomly a point A on the line H_{b}T_{b}
online A H_{b} T_{b}
cmark_t A
color 200 200 200
drawline H_{b} T_{b}
color 0 0 0


% Choosing randomly a point B on the line E_{b}H_{b}
online B E_{b} H_{b}
cmark_b B
color 200 200 200
drawline E_{b} H_{b}
color 0 0 0


% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points B and A are not the same
% Constructing a line c which passes through point B and point A
line c B A

color 200 200 200
drawline c
color 0 0 0


% NDG: points B and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point B
circle k(E_{b},B) E_{b} B

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0


% NDG: line c and circle k(E_{b},B) intersect% DET: points B and H_{c} must be different
% Constructing a point P_{\_G252447} which is a foot of the point E_{b} on the line c
```

```
foot P_{\_G252447} E_{b} c
cmark_r P_{\_G252447}
color 200 200 200
drawline E_{b} P_{\_G252447}
color 0 0 0

% Constructing a point H_{c} which is an image of the point B in the symmetry to point/line P_{\_G
    252447}
sim H_{c} P_{\_G252447} B
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line c and circle k(E_{b},B)
    intersect; points B and E_{b} are not the same
% Determination conditions: lines b and h_{c} are not the same; points H and H_{c} are not the same
    ; points B and H_{c} must be different; points B and A are not the same; points H_{b} and T_{b}
     are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_b=_H_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.153 seconds.

NDG conditions Points A and B are not identical

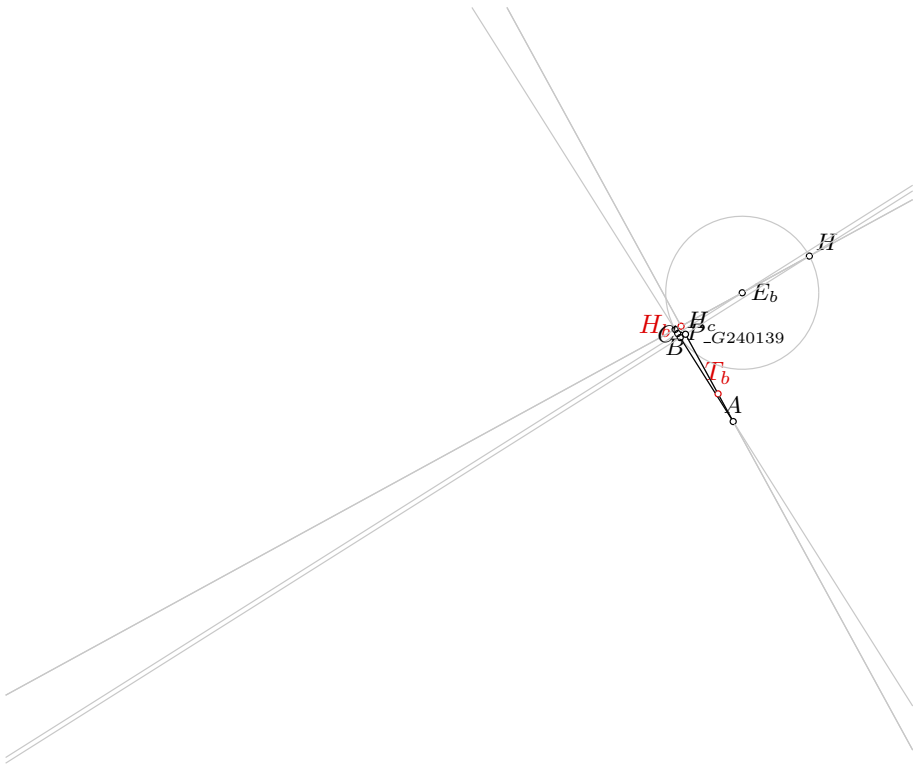

Figure 1: Illustration of the problem 0925

Points A and C are not identical

Line through points H_b and A is not parallel with line through points H_c and H

Line through points A and B is not perpendicular to line through points B and C

4.1.2 Proving T_b=_T_b

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_b=_H_b

Proving failed

4.2.2 Proving T_b=_T_b

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_b=_H_b

Proving failed

4.3.2 Proving T_b=_T_b

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_b=_H_b

Proving failed

4.4.2 Proving T_b=_T_b

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 926

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 926: Given a point E_b, a point H_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 927

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 927: Given a point E_b, a point H_c and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 928

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 928: Given a point E_b, a point H_c and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
2. Using the point H_c and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points H_c and M_a are not the same;
3. Using the circle $k(E_b, B)$, the circle $k(M_a, B)$, the point H_c, the point E_b and the point M_a, construct a point B (rule W08); % NDG: circles $k(E_b, B)$ and $k(M_a, B)$ intersect % DET: circles $k(E_b, B)$ and $k(M_a, B)$ are not the same; points H_c and B must be different;
4. Using the point B and the point E_b, construct a point H (rule W01); ;
5. Using the point M_a and the point B, construct a point C (rule W01); ;
6. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
7. Using the point M_a and the point B, construct a line a (rule W02); % DET: points M_a and B are not the same;
8. Using the circle $k(E_b, B)$, the line a, the point E_b and the point B, construct a point H_a (rule W05); % NDG: line a and circle $k(E_b, B)$ intersect % DET: points B and H_a must be different;
9. Using the point H and the point H_a, construct a line h_a (rule W02); % DET: points H and H_a are not the same;
10. Using the line c and the line h_a, construct a point A (rule W03); % NDG: lines c and h_a are not parallel % DET: lines c and h_a are not the same.

Non-degenerate conditions: lines c and h_a are not parallel; line a and circle $k(E_b, B)$ intersect; circles $k(E_b, B)$ and $k(M_a, B)$ intersect; points H_c and M_a are not the same; points H_c and E_b are not the same.

Determination conditions: lines c and h_a are not the same; points H and H_a are not the same; points B and H_a must be different; points M_a and B are not the same; points H_c and B are not the same; circles $k(E_b, B)$ and $k(M_a, B)$ are not the same; points H_c and B must be different.

Rules used: [W01,W02,W03,W05,W06,W08]

Lemmas used: [D21,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L39,L50,L51]

Solving time: 9.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{c} 68.91 84.83
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H_{c}
cmark_r M_{a}
color 0 0 0
fontsize 8

% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: points H_{c} and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point H
    _{c}
circle k(M_{a},B) M_{a} H_{c}

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: circles k(E_{b},B) and k(M_{a},B) intersect% DET: circles k(E_{b},B) and k(M_{a},B) are not
    the same; points H_{c} and B must be different
% Constructing a line L_{\_G57272} which passes through point E_{b} and point M_{a}
line L_{\_G57272} E_{b} M_{a}
```

```
color 200 200 200
drawline L_{\_G57272}
color 0 0 0


% Constructing a point B which is an image of the point H_{c} in the symmetry to point/line L_{\_G
    57272}
sim B L_{\_G57272} H_{c}
cmark_b B



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0


% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% DET: points M_{a} and B are not the same
% Constructing a line a which passes through point M_{a} and point B
line a M_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(E_{b},B) intersect% DET: points B and H_{a} must be different
% Constructing a point P_{\_G57689} which is a foot of the point E_{b} on the line a
foot P_{\_G57689} E_{b} a
cmark_r P_{\_G57689}
color 200 200 200
drawline E_{b} P_{\_G57689}
```

```
color 0 0 0

% Constructing a point H_{a} which is an image of the point B in the symmetry to point/line P_{\_G
    57689}
sim H_{a} P_{\_G57689} B
cmark_r H_{a}


% DET: points H and H_{a} are not the same
% Constructing a line h_{a} which passes through point H and point H_{a}
line h_{a} H H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines c and h_{a} are not parallel% DET: lines c and h_{a} are not the same
% Constructing a point A which belongs to line c and line h_{a}
intersec A c h_{a}
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{a} are not parallel; line a and circle k(E_{b},B)
    intersect; circles k(E_{b},B) and k(M_{a},B) intersect; points H_{c} and M_{a} are not the same
    ; points H_{c} and E_{b} are not the same
% Determination conditions: lines c and h_{a} are not the same; points H and H_{a} are not the same
    ; points B and H_{a} must be different; points M_{a} and B are not the same; points H_{c} and B
     are not the same; circles k(E_{b},B) and k(M_{a},B) are not the same; points H_{c} and B must
    be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

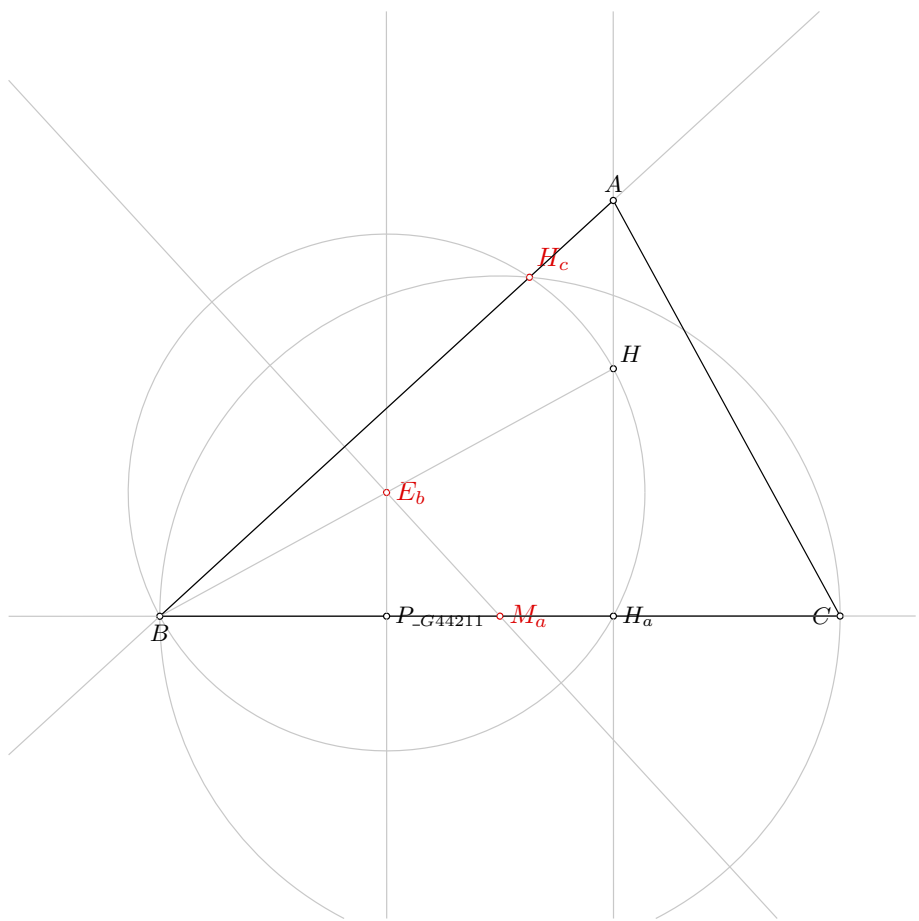

Figure 1: Illustration of the problem 0928

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.175 seconds.

NDG conditions Points E_b and M_a are not identical

Points E_b and M_a are not identical

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving M_a=_M_a

NDG conditions are:

$S_{H_cHH_a} \neq S_{BHH_a}$ i.e., lines H_cB and HH_a are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)

$S_{ACF^2_{\_h_c}} \neq S_{BCF^2_{\_h_c}}$ i.e., lines AB and $CF^2_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 929

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 929: Given a point E_b, a point M_b and a point H_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
2. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;
3. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;
4. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
5. Choose freely a point H_c on the circle $k(N, M_a)$ (rule WOncircle);
6. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
7. Using the circle $k(N, M_a)$, the circle $k(E_b, B)$, the point H_c, the point N and the point E_b, construct a point H_a (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_b, B)$ intersect % DET: circles $k(N, M_a)$ and $k(E_b, B)$ are not the same; points H_c and H_a must be different;
8. Choose freely a point A on the circle $k(M_b, C)$ (rule WOncircle);
9. Using the point A and the point M_b, construct a point C (rule W01); ;
10. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;

11. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;

12. Using the line c and the line a, construct a point B (rule W03); % NDG: lines c and a are not parallel % DET: lines c and a are not the same.

Non-degenerate conditions: lines c and a are not parallel; circles $k(N, M_a)$ and $k(E_b, B)$ intersect; points H_c and E_b are not the same; points E_b and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel.

Determination conditions: lines c and a are not the same; points H_a and C are not the same; points A and H_c are not the same; circles $k(N, M_a)$ and $k(E_b, B)$ are not the same; points H_c and H_a must be different; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points E_b and M_b are not the same.

Rules used: [W01,W02,W03,W06,W08,W14,WOncircle1]

Lemmas used: [D22,D32,D5,D7,GD01,GD02,GL01,GL03,GL04,L17,L19,L21,L23,L44,L45,L50,L51]

Solving time: 64.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point M_{b} 95 67.5
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_lt M_{b}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
color 0 0 0
```

```
color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0


% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{c} on the circle with center N through point E_{b}
oncircle H_{c} N E_{b}
cmark_rt H_{c}
color 200 200 200
drawcircle N E_{b}
color 0 0 0


% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(E_{b},B) intersect% DET: circles k(N,M_{a}) and k(E_{b},B) are not
    the same; points H_{c} and H_{a} must be different
% Constructing a line L_{\_G85472} which passes through point N and point E_{b}
line L_{\_G85472} N E_{b}

color 200 200 200
drawline L_{\_G85472}
color 0 0 0


% Constructing a point H_{a} which is an image of the point H_{c} in the symmetry to point/line L
    _{\_G85472}
sim H_{a} L_{\_G85472} H_{c}
cmark_r H_{a}
```

```
% Choosing randomly a point A on the circle with center M_{b} through point H_{c}
oncircle A M_{b} H_{c}
cmark_t A
color 200 200 200
drawcircle M_{b} H_{c}
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: lines c and a are not parallel% DET: lines c and a are not the same
% Constructing a point B which belongs to line c and line a
intersec B c a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and a are not parallel; circles k(N,M_{a}) and k(E_{b},B)
    intersect; points H_{c} and E_{b} are not the same; points E_{b} and N are not the same; lines
    m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel
% Determination conditions: lines c and a are not the same; points H_{a} and C are not the same;
    points A and H_{c} are not the same; circles k(N,M_{a}) and k(E_{b},B) are not the same; points
```

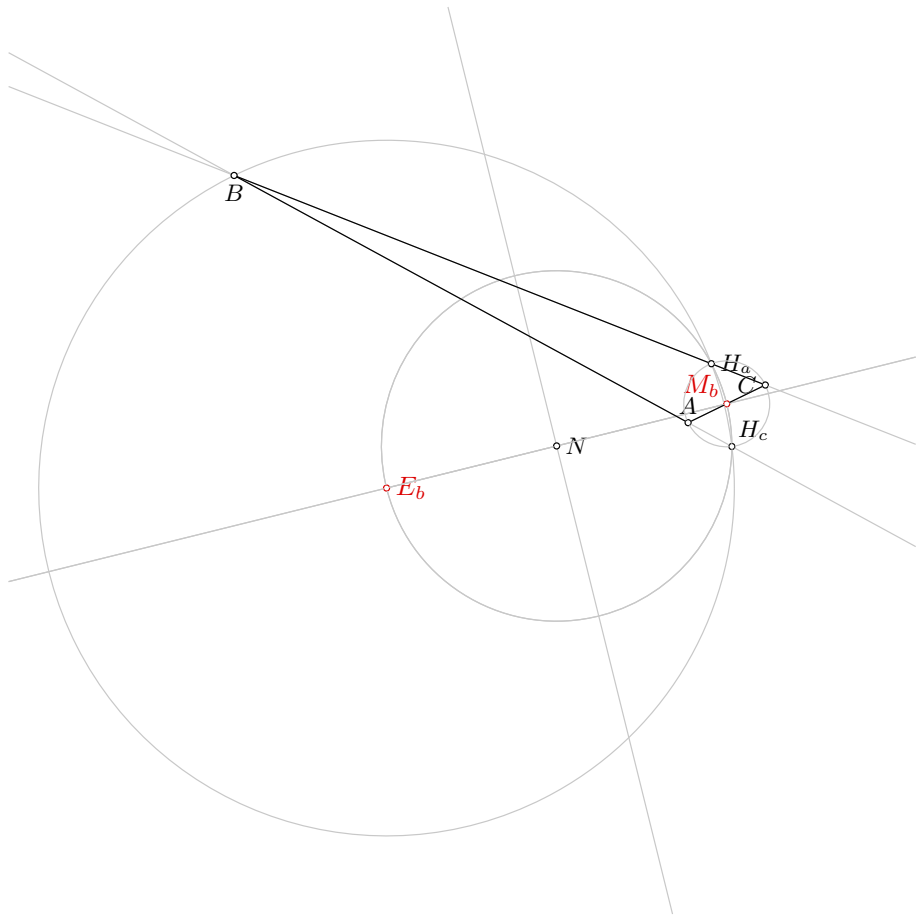

Figure 1: Illustration of the problem 0929

```
H_{c} and H_{a} must be different; lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the same;
points E_{b} and M_{b} are not the same; points E_{b} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.146 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving M_b=_M_b

NDG conditions are:

$S_{M^0_{m(E_bM_b)}E_bM_b} \neq S_{T^1_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^0_{m(E_bM_b)}T^1_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{AH_aC} \neq S_{H_cH_aC}$ i.e., lines AH_c and H_aC are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)

$S_{ACF^4_{\_h_c}} \neq S_{BCF^4_{\_h_c}}$ i.e., lines AB and $CF^4_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 42

Time spent by the prover: 0.000 seconds

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving H_c=_H_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 1148 terms.

Time Complexity: Time spent by the prover is 1.350 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 930

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 930: Given a point E_b, a point H_c and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
2. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
3. Using the circle $k(E_b, B)$, the line c, the point E_b and the point H_c, construct a point B (rule W05); % NDG: line c and circle $k(E_b, B)$ intersect % DET: points H_c and B must be different;
4. Using the point B and the point E_b, construct a point H (rule W01); ;
5. Using the point M_c and the point B, construct a point A (rule W01); ;
6. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
7. Using the point H and the point A, construct a line h_a (rule W02); % DET: points H and A are not the same;
8. Using the circle $k(E_b, B)$, the line h_a, the point E_b and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_b, B)$ intersect % DET: points H and H_a must be different;
9. Using the point B and the point H_a, construct a line a (rule W02); % DET: points B and H_a are not the same;
10. Using the line h_c and the line a, construct a point C (rule W03); % NDG: lines h_c and a are not parallel % DET: lines h_c and a are not the same.

Non-degenerate conditions: lines h_c and a are not parallel; line h_a and circle $k(E_b, B)$ intersect; line c and circle $k(E_b, B)$ intersect; points H_c and E_b are not the same.

Determination conditions: lines h_c and a are not the same; points B and H_a are not the same; points H and H_a must be different; points H and A are not the same; points H_c and H are not the same; points H_c and B must be different; points H_c and M_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D20,D29,D3,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L49,L50,L51]

Solving time: 9.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point H_{c} 68.91 84.83
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_rt H_{c}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: line c and circle k(E_{b},B) intersect% DET: points H_{c} and B must be different
% Constructing a point P_{\_G111239} which is a foot of the point E_{b} on the line c
foot P_{\_G111239} E_{b} c
cmark_r P_{\_G111239}
color 200 200 200
drawline E_{b} P_{\_G111239}
color 0 0 0
```

```
% Constructing a point B which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    111239}
sim B P_{\_G111239} H_{c}
cmark_b B



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point A such that M_{c}A/M_{c}B=-1
towards A M_{c} B -1
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% DET: points H and A are not the same
% Constructing a line h_{a} which passes through point H and point A
line h_{a} H A

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(E_{b},B) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G111676} which is a foot of the point E_{b} on the line h_{a}
foot P_{\_G111676} E_{b} h_{a}
cmark_r P_{\_G111676}
color 200 200 200
drawline E_{b} P_{\_G111676}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    111676}
sim H_{a} P_{\_G111676} H
```

```
cmark_r H_{a}


% DET: points B and H_{a} are not the same
% Constructing a line a which passes through point B and point H_{a}
line a B H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{c} and a are not parallel% DET: lines h_{c} and a are not the same
% Constructing a point C which belongs to line h_{c} and line a
intersec C h_{c} a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and a are not parallel; line h_{a} and circle k(E_{b},B)
    intersect; line c and circle k(E_{b},B) intersect; points H_{c} and E_{b} are not the same
% Determination conditions: lines h_{c} and a are not the same; points B and H_{a} are not the same
    ; points H and H_{a} must be different; points H and A are not the same; points H_{c} and H are
     not the same; points H_{c} and B must be different; points H_{c} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.181 seconds.

NDG conditions Points H_c and M_c are not identical

Points H_c and M_c are not identical

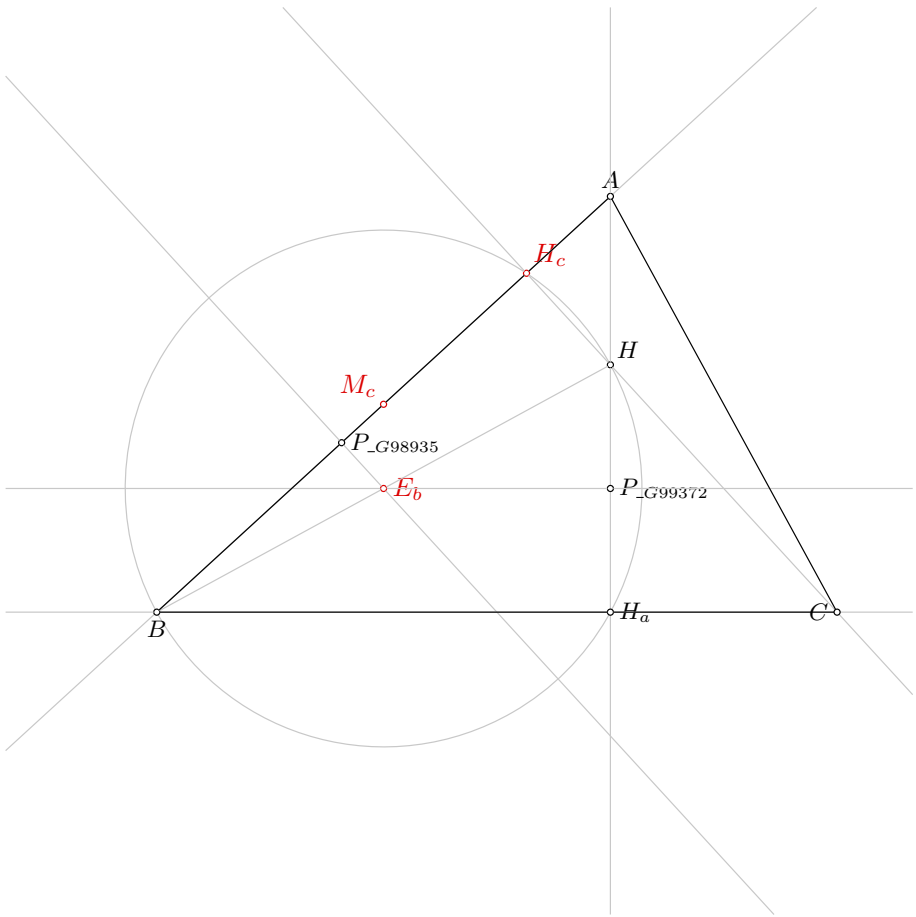

Figure 1: Illustration of the problem 0930

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving M_c=_M_c

NDG conditions are:

$S_{H_cBH_a} \neq S_{HBH_a}$ i.e., lines H_cH and BH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^2_{\_h_c}} \neq S_{BCF^2_{\_h_c}}$ i.e., lines AB and $CF^2_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 44
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 931

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 931: Given a point H_c, a point N and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;
2. Choose freely a point E_b on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
4. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
5. Using the point H_c and the point E_b, construct a circle $k(E_b, B)$ (rule W06); % NDG: points H_c and E_b are not the same;
6. Using the circle $k(N, M_a)$, the circle $k(E_b, B)$, the point H_c, the point N and the point E_b, construct a point H_a (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_b, B)$ intersect % DET: circles $k(N, M_a)$ and $k(E_b, B)$ are not the same; points H_c and H_a must be different;
7. Choose freely a point A on the circle $k(M_b, C)$ (rule WOncircle);
8. Using the point A and the point M_b, construct a point C (rule W01); ;
9. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;
10. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;

11. Using the line c and the line a, construct a point B (rule W03); % NDG: lines c and a are not parallel % DET: lines c and a are not the same.

Non-degenerate conditions: lines c and a are not parallel; circles $k(N, M_a)$ and $k(E_b, B)$ intersect; points H_c and E_b are not the same; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: lines c and a are not the same; points H_a and C are not the same; points A and H_c are not the same; circles $k(N, M_a)$ and $k(E_b, B)$ are not the same; points H_c and H_a must be different; points E_b and M_b must be different; points E_b and N are not the same.

Rules used: [W01,W02,W03,W05a,W06,W08,WOncircle1]

Lemmas used: [D22,D32,D5,D7,GD01,GD02,GL01,GL03,GL04,L17,L19,L21,L23,L44,L45,L50,L51]

Solving time: 57.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{c} 68.91 84.83
point N 72.5 61.93
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_rt H_{c}
cmark_r N
cmark_r E_{b}
color 0 0 0
fontsize 8

% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{b} on the circle with center N through point H_{c}
oncircle E_{b} N H_{c}
cmark_r E_{b}
color 200 200 200
drawcircle N H_{c}
color 0 0 0


% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N
```

```
color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0


% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}


% NDG: points H_{c} and E_{b} are not the same
% Constructing a circle k(E_{b},B) whose center is at point E_{b} and which passes through point H
    _{c}
circle k(E_{b},B) E_{b} H_{c}

color 200 200 200
drawcircle k(E_{b},B)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(E_{b},B) intersect% DET: circles k(N,M_{a}) and k(E_{b},B) are not
    the same; points H_{c} and H_{a} must be different
% Constructing a line L_{\_G147802} which passes through point N and point E_{b}
line L_{\_G147802} N E_{b}

color 200 200 200
drawline L_{\_G147802}
color 0 0 0


% Constructing a point H_{a} which is an image of the point H_{c} in the symmetry to point/line L
    _{\_G147802}
sim H_{a} L_{\_G147802} H_{c}
cmark_r H_{a}



% Choosing randomly a point A on the circle with center M_{b} through point H_{c}
oncircle A M_{b} H_{c}
cmark_t A
color 200 200 200
drawcircle M_{b} H_{c}
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0
```

```
% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: lines c and a are not parallel% DET: lines c and a are not the same
% Constructing a point B which belongs to line c and line a
intersec B c a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and a are not parallel; circles k(N,M_{a}) and k(E_{b},B)
    intersect; points H_{c} and E_{b} are not the same; line m(H_{a}H_{c}) and circle k(N,M_{a})
    intersect; points H_{c} and N are not the same
% Determination conditions: lines c and a are not the same; points H_{a} and C are not the same;
    points A and H_{c} are not the same; circles k(N,M_{a}) and k(E_{b},B) are not the same; points
     H_{c} and H_{a} must be different; points E_{b} and M_{b} must be different; points E_{b} and
    N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_c=_H_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2976 terms.

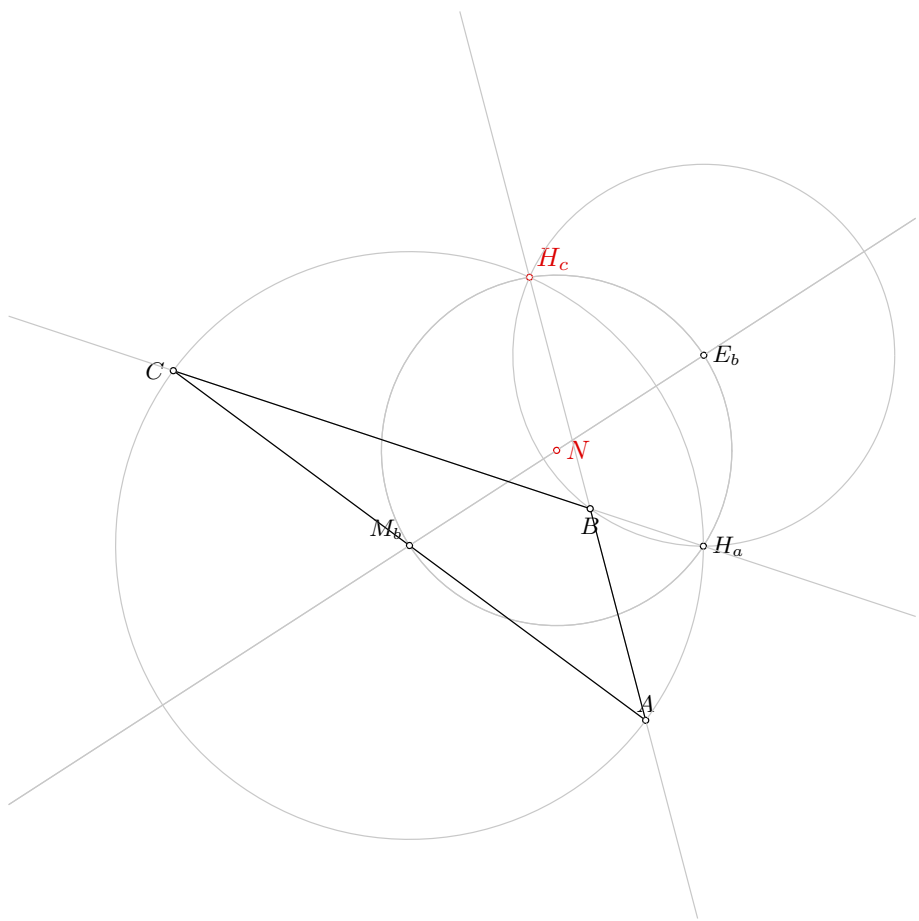

Figure 1: Illustration of the problem 0931

Time Complexity: Time spent by the prover is 13.175 seconds.
NDG conditions Points E_b and N are not identical
Line through points H_c and N is not perpendicular to line through points N and E_b
Line through points A and H_c is not parallel with line through points C and H_a
Points A, H_c and N are not collinear
Points A and B are not identical
Line through points A and B is not parallel with line through points H_c and N

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_c=_H_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_c=_H_c

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_c=_H_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 932

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 932: Given a point E_b, a point H_c and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 933

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 933: Given a point E_b, a point H_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 934

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 934: Given a point E_b, a point H_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 935

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 935: Given a point E_b, a point H_c and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 936

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 936: Given a point E_b, a point I and a point M_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 937

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 937: Given a point E_b, a point I and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;

2. Using the point I and the point M_b, construct a line IM_b (rule W02); % DET: points I and M_b are not the same;

3. Using the point I and the point M_b, construct a circle $k_over(I, M_b)$ (rule W09); % NDG: points I and M_b are not the same;

4. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;

5. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;

6. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;

7. Using the point I, the circle $k(N, M_a)$, the point N and the point E_b, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

8. Using the circle $k(I, P_a)$ and the circle $k_over(I, M_b)$, construct a point B_{fi} and a point P_b (rule W07); % NDG: circles $k(I, P_a)$ and $k_over(I, M_b)$ intersect % DET: circles $k(I, P_a)$ and $k_over(I, M_b)$ are not the same;

9. Using the point P_b and the point M_b, construct a point $P`_b$ (rule W01); ;

10. Using the circle $k(I, P_a)$, the point M_b and the point I, construct a line $x2$ and a line b (rule W12); % NDG: point M_b is outside the circle $k(I, P_a)$;

11. Using the circle $k(N, M_a)$, the line b, the point N and the point M_b, construct a point H_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points M_b and H_b must be different;

12. Using the point H_b and the point E_b, construct a line h_b (rule W02); % DET: points H_b and E_b are not the same;

13. Using the point M_b and the line b, construct a line m_b (rule W10b); ;

14. Using the point $P`_b$ and the line $IM_b$, construct a line $BP`_b$ (rule W16); ;

15. Using the line $BP`_b$ and the line $h_b$, construct a point $B$ (rule W03); % NDG: lines $BP`_b$ and h_b are not parallel % DET: lines $BP`_b$ and h_b are not the same;

16. Using the point I and the point B, construct a line s_b (rule W02); % DET: points I and B are not the same;

17. Using the line m_b and the line s_b, construct a point N_b (rule W03); % NDG: lines m_b and s_b are not parallel % DET: lines m_b and s_b are not the same;

18. Using the point I and the point N_b, construct a circle $k(N_b, A)$ (rule W06); % NDG: points I and N_b are not the same;

19. Using the circle $k(N_b, A)$ and the line b, construct a point A and a point C (rule W04); % NDG: line b and circle $k(N_b, A)$ intersect.

Non-degenerate conditions: line b and circle $k(N_b, A)$ intersect; points I and N_b are not the same; lines m_b and s_b are not parallel; lines $BP`_b$ and h_b are not parallel; line b and circle $k(N, M_a)$ intersect; point M_b is outside the circle $k(I, P_a)$; circles $k(I, P_a)$ and $k_over(I, M_b)$ intersect; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points E_b and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel; points I and M_b are not the same.

Determination conditions: lines m_b and s_b are not the same; points I and B are not the same; lines $BP`_b$ and h_b are not the same; points H_b and E_b are not the same; points M_b and H_b must be different; circles $k(I, P_a)$ and $k_over(I, M_b)$ are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points I and M_b are not the same; points E_b and M_b are not the same.

Rules used: [W01,W02,W03,W04,W05,W06,W07,W09,W10b,W12,W14,W16,W22]

Lemmas used: [D12,D2,D22,D27,D29,D3,D32,D48,D6,D66,D86,D9,GD01,GD02,GL01,GL03,GL09,L119,L13,L

Solving time: 52.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point I 74.37 61.15
point M_{b} 95 67.5
```

```
color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_b I
cmark_lt M_{b}
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% DET: points I and M_{b} are not the same
% Constructing a line IM_{b} which passes through point I and point M_{b}
line IM_{b} I M_{b}

color 200 200 200
drawline IM_{b}
color 0 0 0



% NDG: points I and M_{b} are not the same
% Constructing midpoint P_{\_G222054} of the segment IM_{b}
midpoint P_{\_G222054} I M_{b}
cmark_r P_{\_G222054}

% Constructing a circle k_over(I,M_{b}) whose center is at point P_{\_G222054} and which passes
    through point I
circle k_over(I,M_{b}) P_{\_G222054} I

color 200 200 200
drawcircle k_over(I,M_{b})
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0
```

```
% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G222609] from point N to point E_{b}
distance V[_G222609] N E_{b}


% Calculating distance V[_G222633] from point N to point I
distance V[_G222633] N I


% Calculating value V[_G222654] using formula V[_G222609]/V[_G222633]
expression V[_G222654] { V[_G222609]/V[_G222633] }


% Constructing a point P_{\_G222685} such that NP_{\_G222685}/NI=V[_G222609]/V[_G222633]
towards P_{\_G222685} N I V[_G222654]
cmark_r P_{\_G222685}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    222685}
circle k(I,P_{a}) I P_{\_G222685}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: circles k(I,P_{a}) and k_over(I,M_{b}) intersect% DET: circles k(I,P_{a}) and k_over(I,M_{b
    }) are not the same
% Constructing points B_{fi} and P_{b} which are in intersection of k(I,P_{a}) and k_over(I,M_{b})
intersec2 B_{fi} P_{b} k(I,P_{a}) k_over(I,M_{b})
cmark_r B_{fi}
cmark_r P_{b}



% Constructing a point P‘_{b} such that P_{b}P‘_{b}/P_{b}M_{b}=2
```

```
towards P‘_{b} P_{b} M_{b} 2
cmark_r P‘_{b}
color 200 200 200
drawsegment P_{b} P‘_{b}
color 0 0 0


% NDG: point M_{b} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G223291} of the segment M_{b}I
midpoint P_{\_G223291} M_{b} I
cmark_r P_{\_G223291}

% Constructing a circle C_{\_G223294} whose center is at point P_{\_G223291} and which passes
    through point M_{b}
circle C_{\_G223294} P_{\_G223291} M_{b}

color 200 200 200
drawcircle C_{\_G223294}
color 0 0 0


% Constructing points P_{\_G223297} and P_{\_G223300} which are in intersection of C_{\_G223294}
    and k(I,P_{a})
intersec2 P_{\_G223297} P_{\_G223300} C_{\_G223294} k(I,P_{a})
cmark_r P_{\_G223297}
cmark_r P_{\_G223300}

% Constructing a line x2 which passes through point M_{b} and point P_{\_G223297}
line x2 M_{b} P_{\_G223297}

color 200 200 200
drawline x2
color 0 0 0


% Constructing a line b which passes through point M_{b} and point P_{\_G223300}
line b M_{b} P_{\_G223300}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(N,M_{a}) intersect% DET: points M_{b} and H_{b} must be different
% Constructing a point P_{\_G223634} which is a foot of the point N on the line b
foot P_{\_G223634} N b
cmark_r P_{\_G223634}
color 200 200 200
drawline N P_{\_G223634}
color 0 0 0

% Constructing a point H_{b} which is an image of the point M_{b} in the symmetry to point/line P
    _{\_G223634}
sim H_{b} P_{\_G223634} M_{b}
cmark_l H_{b}
```

```
% DET: points H_{b} and E_{b} are not the same
% Constructing a line h_{b} which passes through point H_{b} and point E_{b}
line h_{b} H_{b} E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% Constructing a line m_{b} which is perpendicular to line b and which passes through point M_{b}
perp m_{b} M_{b} b

color 200 200 200
drawline m_{b}
color 0 0 0



% Constructing a line BP‘_{b} which contains the point P‘_{b} and is parallel to the line IM_{b}
parallel BP‘_{b} P‘_{b} IM_{b}

color 200 200 200
drawline BP‘_{b}
color 0 0 0



% NDG: lines BP‘_{b} and h_{b} are not parallel% DET: lines BP‘_{b} and h_{b} are not the same
% Constructing a point B which belongs to line BP‘_{b} and line h_{b}
intersec B BP‘_{b} h_{b}
cmark_b B


% DET: points I and B are not the same
% Constructing a line s_{b} which passes through point I and point B
line s_{b} I B

color 200 200 200
drawline s_{b}
color 0 0 0



% NDG: lines m_{b} and s_{b} are not parallel% DET: lines m_{b} and s_{b} are not the same
% Constructing a point N_{b} which belongs to line m_{b} and line s_{b}
intersec N_{b} m_{b} s_{b}
cmark_rb N_{b}


% NDG: points I and N_{b} are not the same
% Constructing a circle k(N_{b},A) whose center is at point N_{b} and which passes through point I
```

```
circle k(N_{b},A) N_{b} I

color 200 200 200
drawcircle k(N_{b},A)
color 0 0 0



% NDG: line b and circle k(N_{b},A) intersect
% Constructing points A and C which are in intersection of k(N_{b},A) and b
intersec2 A C k(N_{b},A) b
cmark_t A
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(N_{b},A) intersect; points I and N_{b} are not the
     same; lines m_{b} and s_{b} are not parallel; lines BP'_{b} and h_{b} are not parallel; line b
     and circle k(N,M_{a}) intersect; point M_{b} is outside the circle k(I,P_{a}); circles k(I,P_{
    a}) and k_over(I,M_{b}) intersect; point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points E_{b} and N are not the same; lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are
    not parallel; points I and M_{b} are not the same
% Determination conditions: lines m_{b} and s_{b} are not the same; points I and B are not the same
    ; lines BP'_{b} and h_{b} are not the same; points H_{b} and E_{b} are not the same; points M_{
    b} and H_{b} must be different; circles k(I,P_{a}) and k_over(I,M_{b}) are not the same; lines
    m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the same; points E_{b} and M_{b} are not the same;
    points I and M_{b} are not the same; points E_{b} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving I=_I

Proving failed

4.1.3 Proving M_b=_M_b

Proving failed

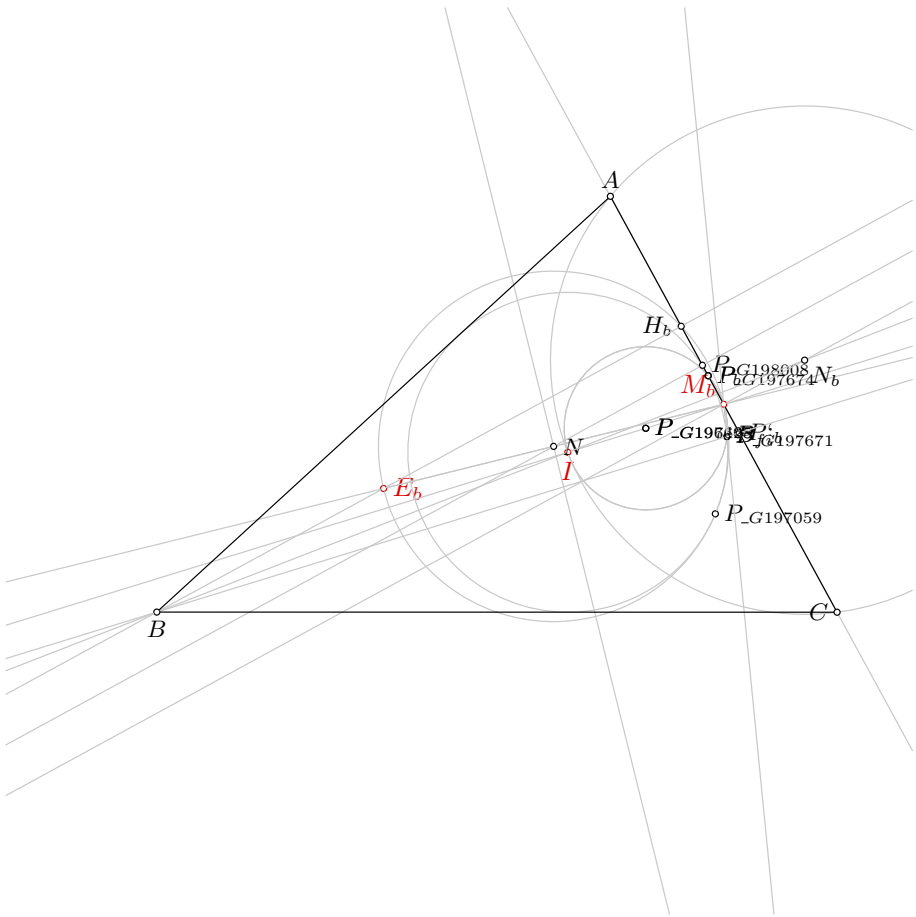

Figure 1: Illustration of the problem 0937

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving I=_I

Proving failed

4.2.3 Proving M_b=_M_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving I=_I

Proving failed

4.3.3 Proving M_b=_M_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving I=_I

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 938

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 938: Given a point E_b, a point I and a point M_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 939

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 939: Given a point E_b, a point I and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;

2. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;

3. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;

4. Using the point M_b and the point I, construct a line IM_b (rule W02); % DET: points M_b and I are not the same;

5. Using the point I and the point M_b, construct a circle $k_over(I, M_b)$ (rule W09); % NDG: points I and M_b are not the same;

6. Using the point I, the circle $k(N, M_a)$, the point N and the point E_b, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

7. Using the circle $k(I, P_a)$ and the circle $k_over(I, M_b)$, construct a point B_{fi} and a point P_b (rule W07); % NDG: circles $k(I, P_a)$ and $k_over(I, M_b)$ intersect % DET: circles $k(I, P_a)$ and $k_over(I, M_b)$ are not the same;

8. Using the point P_b and the point M_b, construct a point $P`_b$ (rule W01); ;

9. Using the circle $k(I, P_a)$, the point M_b and the point I, construct a line $x2$ and a line b (rule W12); % NDG: point M_b is outside the circle $k(I, P_a)$;

10. Using the circle $k(N, M_a)$, the line b, the point N and the point M_b, construct a point H_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points M_b and H_b must be different;

11. Using the point H_b and the point E_b, construct a line h_b (rule W02); % DET: points H_b and E_b are not the same;

12. Using the point M_b and the line b, construct a line m_b (rule W10b); ;

13. Using the point $P`_b$ and the line $IM_b$, construct a line $BP`_b$ (rule W16); ;

14. Using the line $BP`_b$ and the line $h_b$, construct a point $B$ (rule W03); % NDG: lines $BP`_b$ and h_b are not parallel % DET: lines $BP`_b$ and h_b are not the same;

15. Using the point I and the point B, construct a line s_b (rule W02); % DET: points I and B are not the same;

16. Using the line m_b and the line s_b, construct a point N_b (rule W03); % NDG: lines m_b and s_b are not parallel % DET: lines m_b and s_b are not the same;

17. Using the point I and the point N_b, construct a circle $k(N_b, A)$ (rule W06); % NDG: points I and N_b are not the same;

18. Using the circle $k(N_b, A)$ and the line b, construct a point A and a point C (rule W04); % NDG: line b and circle $k(N_b, A)$ intersect.

Non-degenerate conditions: line b and circle $k(N_b, A)$ intersect; points I and N_b are not the same; lines m_b and s_b are not parallel; lines $BP`_b$ and h_b are not parallel; line b and circle $k(N, M_a)$ intersect; point M_b is outside the circle $k(I, P_a)$; circles $k(I, P_a)$ and $k_over(I, M_b)$ intersect; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points I and M_b are not the same; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: lines m_b and s_b are not the same; points I and B are not the same; lines $BP`_b$ and h_b are not the same; points H_b and E_b are not the same; points M_b and H_b must be different; circles $k(I, P_a)$ and $k_over(I, M_b)$ are not the same; points M_b and I are not the same; points E_b and M_b must be different; points E_b and N are not the same.

Rules used: [W01,W02,W03,W04,W05,W05a,W06,W07,W09,W10b,W12,W16,W22]

Lemmas used: [D12,D2,D22,D27,D29,D3,D32,D48,D6,D66,D86,D9,GD01,GD02,GL01,GL03,GL09,L119,L13,L

Solving time: 53.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point I 74.37 61.15
point N 72.5 61.93

color 220 0 0
fontsize 9
```

```
cmark_r E_{b}
cmark_b I
cmark_r N
color 0 0 0
fontsize 8

% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}


% DET: points M_{b} and I are not the same
% Constructing a line IM_{b} which passes through point M_{b} and point I
line IM_{b} M_{b} I

color 200 200 200
drawline IM_{b}
color 0 0 0



% NDG: points I and M_{b} are not the same
% Constructing midpoint P_{\_G62020} of the segment IM_{b}
midpoint P_{\_G62020} I M_{b}
cmark_r P_{\_G62020}

% Constructing a circle k_over(I,M_{b}) whose center is at point P_{\_G62020} and which passes
    through point I
circle k_over(I,M_{b}) P_{\_G62020} I

color 200 200 200
drawcircle k_over(I,M_{b})
color 0 0 0
```

```
% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G62206] from point N to point E_{b}
distance V[_G62206] N E_{b}


% Calculating distance V[_G62230] from point N to point I
distance V[_G62230] N I


% Calculating value V[_G62251] using formula V[_G62206]/V[_G62230]
expression V[_G62251] { V[_G62206]/V[_G62230] }


% Constructing a point P_{\_G62282} such that NP_{\_G62282}/NI=V[_G62206]/V[_G62230]
towards P_{\_G62282} N I V[_G62251]
cmark_r P_{\_G62282}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    62282}
circle k(I,P_{a}) I P_{\_G62282}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: circles k(I,P_{a}) and k_over(I,M_{b}) intersect% DET: circles k(I,P_{a}) and k_over(I,M_{b
    }) are not the same
% Constructing points B_{fi} and P_{b} which are in intersection of k(I,P_{a}) and k_over(I,M_{b})
intersec2 B_{fi} P_{b} k(I,P_{a}) k_over(I,M_{b})
cmark_r B_{fi}
cmark_r P_{b}



% Constructing a point P‘_{b} such that P_{b}P‘_{b}/P_{b}M_{b}=2
towards P‘_{b} P_{b} M_{b} 2
cmark_r P‘_{b}
color 200 200 200
drawsegment P_{b} P‘_{b}
color 0 0 0


% NDG: point M_{b} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G62887} of the segment M_{b}I
midpoint P_{\_G62887} M_{b} I
cmark_r P_{\_G62887}

% Constructing a circle C_{\_G62890} whose center is at point P_{\_G62887} and which passes through
     point M_{b}
circle C_{\_G62890} P_{\_G62887} M_{b}

color 200 200 200
```

```
drawcircle C_{\_G62890}
color 0 0 0


% Constructing points P_{\_G62893} and P_{\_G62896} which are in intersection of C_{\_G62890} and k
    (I,P_{a})
intersec2 P_{\_G62893} P_{\_G62896} C_{\_G62890} k(I,P_{a})
cmark_r P_{\_G62893}
cmark_r P_{\_G62896}

% Constructing a line x2 which passes through point M_{b} and point P_{\_G62893}
line x2 M_{b} P_{\_G62893}

color 200 200 200
drawline x2
color 0 0 0


% Constructing a line b which passes through point M_{b} and point P_{\_G62896}
line b M_{b} P_{\_G62896}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(N,M_{a}) intersect% DET: points M_{b} and H_{b} must be different
% Constructing a point P_{\_G63230} which is a foot of the point N on the line b
foot P_{\_G63230} N b
cmark_r P_{\_G63230}
color 200 200 200
drawline N P_{\_G63230}
color 0 0 0

% Constructing a point H_{b} which is an image of the point M_{b} in the symmetry to point/line P
    _{\_G63230}
sim H_{b} P_{\_G63230} M_{b}
cmark_l H_{b}


% DET: points H_{b} and E_{b} are not the same
% Constructing a line h_{b} which passes through point H_{b} and point E_{b}
line h_{b} H_{b} E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0




% Constructing a line m_{b} which is perpendicular to line b and which passes through point M_{b}
perp m_{b} M_{b} b

color 200 200 200
```

```
drawline m_{b}
color 0 0 0



% Constructing a line BP‘_{b} which contains the point P‘_{b} and is parallel to the line IM_{b}
parallel BP‘_{b} P‘_{b} IM_{b}

color 200 200 200
drawline BP‘_{b}
color 0 0 0



% NDG: lines BP‘_{b} and h_{b} are not parallel% DET: lines BP‘_{b} and h_{b} are not the same
% Constructing a point B which belongs to line BP‘_{b} and line h_{b}
intersec B BP‘_{b} h_{b}
cmark_b B


% DET: points I and B are not the same
% Constructing a line s_{b} which passes through point I and point B
line s_{b} I B

color 200 200 200
drawline s_{b}
color 0 0 0



% NDG: lines m_{b} and s_{b} are not parallel% DET: lines m_{b} and s_{b} are not the same
% Constructing a point N_{b} which belongs to line m_{b} and line s_{b}
intersec N_{b} m_{b} s_{b}
cmark_rb N_{b}


% NDG: points I and N_{b} are not the same
% Constructing a circle k(N_{b},A) whose center is at point N_{b} and which passes through point I
circle k(N_{b},A) N_{b} I

color 200 200 200
drawcircle k(N_{b},A)
color 0 0 0



% NDG: line b and circle k(N_{b},A) intersect
% Constructing points A and C which are in intersection of k(N_{b},A) and b
intersec2 A C k(N_{b},A) b
cmark_t A
cmark_l C



drawsegment A B
```

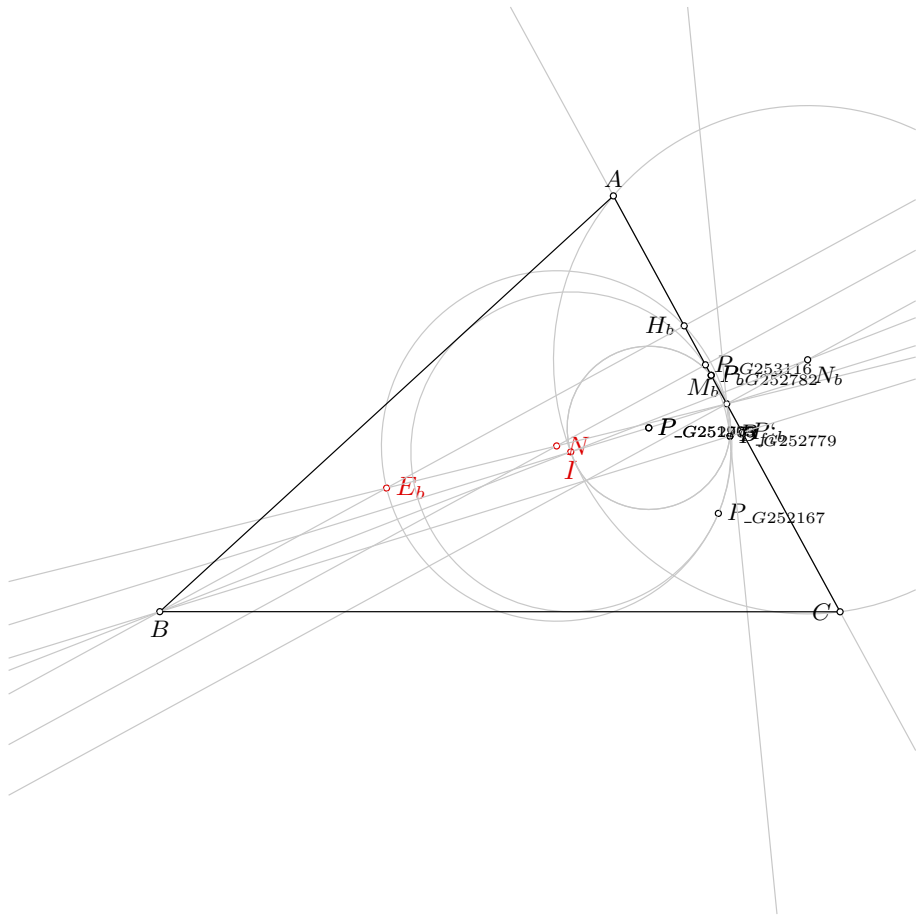

Figure 1: Illustration of the problem 0939

```
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(N_{b},A) intersect; points I and N_{b} are not the
     same; lines m_{b} and s_{b} are not parallel; lines BP'_{b} and h_{b} are not parallel; line b
     and circle k(N,M_{a}) intersect; point M_{b} is outside the circle k(I,P_{a}); circles k(I,P_{
    a}) and k_over(I,M_{b}) intersect; point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points I and M_{b} are not the same; line m(H_{a}H_{c}) and circle k(N,M_{a})
    intersect; points E_{b} and N are not the same
% Determination conditions: lines m_{b} and s_{b} are not the same; points I and B are not the same
    ; lines BP'_{b} and h_{b} are not the same; points H_{b} and E_{b} are not the same; points M_{
    b} and H_{b} must be different; circles k(I,P_{a}) and k_over(I,M_{b}) are not the same; points
     M_{b} and I are not the same; points E_{b} and M_{b} must be different; points E_{b} and N are
     not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving I=_I

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving I=_I

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving I=_I

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving I=_I

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 940

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 940: Given a point E_b, a point I and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 941

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 941: Given a point E_b, a point I and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 942

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 942: Given a point E_b, a point I and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 943

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 943: Given a point E_b, a point I and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 944

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 944: Given a point E_b, a point M_b and a point M_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
2. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;
3. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;
4. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
5. Choose freely a point M_a on the circle $k(N, M_a)$ (rule WOncircle);
6. Choose freely a point A (rule free);
7. Using the point A and the point M_b, construct a point C (rule W01); ;
8. Using the point M_a and the point C, construct a point B (rule W01); .

Non-degenerate conditions: points E_b and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel.

Determination conditions: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points E_b and M_b are not the same.

Rules used: [W01,W02,W03,W06,W14,WOncircle1,free]

Lemmas used: [D21,D22,D32,GD02,GL01,GL03,GL04,L17,L19,L21,L23,L44,L45,L50,L51]

Solving time: 200.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point M_{b} 95 67.5
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_lt M_{b}
cmark_r M_{a}
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0


% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% Choosing randomly a point M_{a} on the circle with center N through point E_{b}
oncircle M_{a} N E_{b}
cmark_r M_{a}
color 200 200 200
drawcircle N E_{b}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points E_{b} and N are not the same; lines m(E_{b}M_{b}) and m(H_{a}H
    _{c}) are not parallel
% Determination conditions: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the same; points E_{b}
    and M_{b} are not the same; points E_{b} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

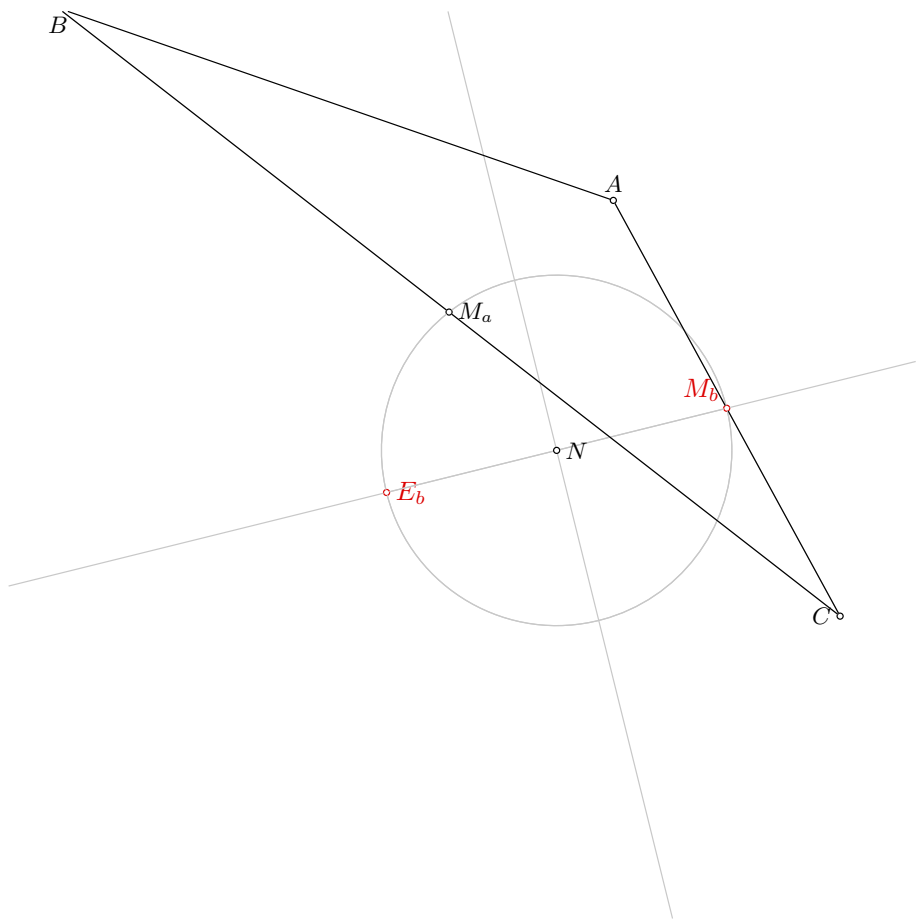

Figure 1: Illustration of the problem 0944

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.087 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving M_a=_M_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving M_b=_M_b

NDG conditions are:

$S_{M^0_{m(E_bM_b)}E_bM_b} \neq S_{T^1_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^0_{m(E_bM_b)}T^1_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 42

Time spent by the prover: 0.000 seconds

4.2.3 Proving M_a=_M_a

NDG conditions are:

$S_{M^0_{m(E_bM_b)}E_bM_b} \neq S_{T^1_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^0_{m(E_bM_b)}T^1_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.3.3 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 28 terms.

Time Complexity: Time spent by the prover is 0.060 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 945

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 945: Given a point E_b, a point M_a and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_a, construct a line $m(E_bM_a)$ (rule W14); % DET: points E_b and M_a are not the same;

2. Using the point E_b and the point M_c, construct a line $m(E_bM_c)$ (rule W14); % DET: points E_b and M_c are not the same;

3. Using the line $m(E_bM_c)$ and the line $m(E_bM_a)$, construct a point N (rule W03); % NDG: lines $m(E_bM_c)$ and $m(E_bM_a)$ are not parallel % DET: lines $m(E_bM_c)$ and $m(E_bM_a)$ are not the same;

4. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;

5. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;

6. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;

7. Using the point M_c and the point E_a, construct a line $m(AH_b)$ (rule W02); % DET: points M_c and E_a are not the same;

8. Using the point E_b and the line $m(AH_b)$, construct a line h_b (rule W16); ;

9. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;

10. Using the point H_b and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points H_b and M_a are not the same;

11. Using the circle $k(M_a, B)$, the line h_b, the point M_a and the point H_b, construct a point B (rule W05); % NDG: line h_b and circle $k(M_a, B)$ intersect % DET: points H_b and B must be different;

12. Using the point M_a and the point B, construct a point C (rule W01); ;

13. Using the point M_c and the point B, construct a point A (rule W01); .

Non-degenerate conditions: line h_b and circle $k(M_a, B)$ intersect; points H_b and M_a are not the same; line h_b and circle $k(N, M_a)$ intersect; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points E_b and N are not the same; lines $m(E_bM_c)$ and $m(E_bM_a)$ are not parallel.

Determination conditions: points H_b and B must be different; points E_b and H_b must be different; points M_c and E_a are not the same; points M_a and E_a must be different; points M_a and N are not the same; lines $m(E_bM_c)$ and $m(E_bM_a)$ are not the same; points E_b and M_c are not the same; points E_b and M_a are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W14,W16]

Lemmas used: [D20,D21,D29,D3,D32,D6,D9,GD02,GL01,GL03,GL04,GL09,L18,L20,L21,L22,L23,L38,L39,L41

Solving time: 25.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point M_{a} 65 40
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r M_{a}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{a} are not the same
% Constructing bisector m(E_{b}M_{a}) of the segment E_{b}M_{a}
med m(E_{b}M_{a}) E_{b} M_{a}

color 200 200 200
drawline m(E_{b}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{a}
color 0 0 0
```

```
% DET: points E_{b} and M_{c} are not the same
% Constructing bisector m(E_{b}M_{c}) of the segment E_{b}M_{c}
med m(E_{b}M_{c}) E_{b} M_{c}

color 200 200 200
drawline m(E_{b}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{c}
color 0 0 0


% NDG: lines m(E_{b}M_{c}) and m(E_{b}M_{a}) are not parallel% DET: lines m(E_{b}M_{c}) and m(E_{b}
    M_{a}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{c}) and line m(E_{b}M_{a})
intersec N m(E_{b}M_{c}) m(E_{b}M_{a})
cmark_r N


% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% DET: points M_{c} and E_{a} are not the same
% Constructing a line m(AH_{b}) which passes through point M_{c} and point E_{a}
line m(AH_{b}) M_{c} E_{a}

color 200 200 200
drawline m(AH_{b})
color 0 0 0
```

```
% Constructing a line h_{b} which contains the point E_{b} and is parallel to the line m(AH_{b})
parallel h_{b} E_{b} m(AH_{b})

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G141182} which is a foot of the point N on the line h_{b}
foot P_{\_G141182} N h_{b}
cmark_r P_{\_G141182}
color 200 200 200
drawline N P_{\_G141182}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G141182}
sim H_{b} P_{\_G141182} E_{b}
cmark_l H_{b}


% NDG: points H_{b} and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point H
    _{b}
circle k(M_{a},B) M_{a} H_{b}

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: line h_{b} and circle k(M_{a},B) intersect% DET: points H_{b} and B must be different
% Constructing a point P_{\_G141486} which is a foot of the point M_{a} on the line h_{b}
foot P_{\_G141486} M_{a} h_{b}
cmark_r P_{\_G141486}
color 200 200 200
drawline M_{a} P_{\_G141486}
color 0 0 0

% Constructing a point B which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    141486}
sim B P_{\_G141486} H_{b}
cmark_b B



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
```

```
color 0 0 0



% Constructing a point A such that M_{c}A/M_{c}B=-1
towards A M_{c} B -1
cmark_t A
color 200 200 200
drawsegment B A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line h_{b} and circle k(M_{a},B) intersect; points H_{b} and M_{a} are
     not the same; line h_{b} and circle k(N,M_{a}) intersect; line m(H_{b}H_{c}) and circle k(N,M
    _{a}) intersect; points E_{b} and N are not the same; lines m(E_{b}M_{c}) and m(E_{b}M_{a}) are
     not parallel
% Determination conditions: points H_{b} and B must be different; points E_{b} and H_{b} must be
    different; points M_{c} and E_{a} are not the same; points M_{a} and E_{a} must be different;
    points M_{a} and N are not the same; lines m(E_{b}M_{c}) and m(E_{b}M_{a}) are not the same;
    points E_{b} and M_{c} are not the same; points E_{b} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 9 terms.

Time Complexity: Time spent by the prover is 0.275 seconds.

NDG conditions Points M_c and E_b are not identical

Points M_c and E_b are not identical

Line through points M_c and E_a is not parallel with line through points E_b and M_a

Points tempPoint-815h_b and E_b are not identical

Points tempPoint-815h_b and E_b are not identical

Points E_b and P_$G136203$ are not identical

Points E_b, M_a and P_$G136203$ are not collinear

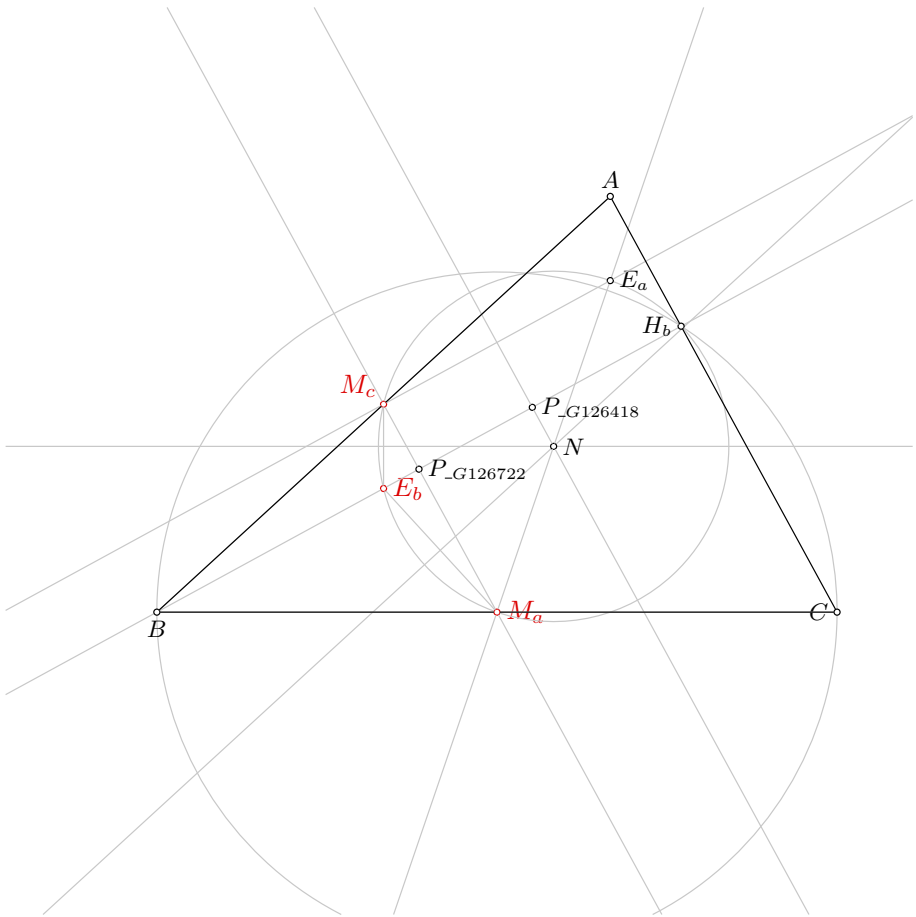

Figure 1: Illustration of the problem 0945

4.1.3 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.261 seconds.

NDG conditions Points M_c and E_b are not identical

Points M_c and E_b are not identical

Line through points M_c and E_a is not parallel with line through points E_b and M_a

Points E_b and tempPoint-518h_b are not identical

Points tempPoint-518h_b and M_a are not identical

Points E_b and $P_{\_G137539}$ are not identical

Points E_b and $P_{\_G137539}$ are not identical

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving M_a=_M_a

NDG conditions are:

$S_{M^2_{m(E_bM_c)}M^0_{m(E_bM_a)}T^1_{m(E_bM_a)}} \neq S_{T^3_{m(E_bM_c)}M^0_{m(E_bM_a)}T^1_{m(E_bM_a)}}$ i.e., lines $M^2_{m(E_bM_c)}T^3_{m(E_bM_c)}$ and $M^0_{m(E_bM_a)}T^1_{m(E_bM_a)}$ are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving M_c=_M_c

NDG conditions are:

$S_{M^2_{m(E_bM_c)}M^0_{m(E_bM_a)}T^1_{m(E_bM_a)}} \neq S_{T^3_{m(E_bM_c)}M^0_{m(E_bM_a)}T^1_{m(E_bM_a)}}$ i.e., lines $M^2_{m(E_bM_c)}T^3_{m(E_bM_c)}$ and $M^0_{m(E_bM_a)}T^1_{m(E_bM_a)}$ are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving M_a=_M_a

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 946

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 946: Given a point M_a, a point N and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;
2. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
3. Choose freely a point E_b on the circle $k(N, M_a)$ (rule WOncircle);
4. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
5. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;
6. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
7. Choose freely a point A (rule free);
8. Using the point A and the point E_a, construct a point H (rule W01); ;
9. Using the point A and the point M_b, construct a point C (rule W01); ;
10. Using the point E_b and the point H, construct a point B (rule W01); .

Non-degenerate conditions: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points M_a and N are not the same.

Determination conditions: points E_b and M_b must be different; points M_a and E_a must be different; points E_b and N are not the same; points M_a and N are not the same.

Rules used: [W01,W02,W05a,W06,WOncircle1,free]

Lemmas used: [D22,D28,D29,D32,GD02,GL01,GL03,GL04,L17,L19,L20,L21,L22,L23,L38,L39,L44,L45,L47,L48

Solving time: 150.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{a} 65 40
point N 72.5 61.93
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_r M_{a}
cmark_r N
cmark_r E_{b}
color 0 0 0
fontsize 8

% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% Choosing randomly a point E_{b} on the circle with center N through point M_{a}
oncircle E_{b} N M_{a}
cmark_r E_{b}
color 200 200 200
drawcircle N M_{a}
color 0 0 0
```

```
% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0
```

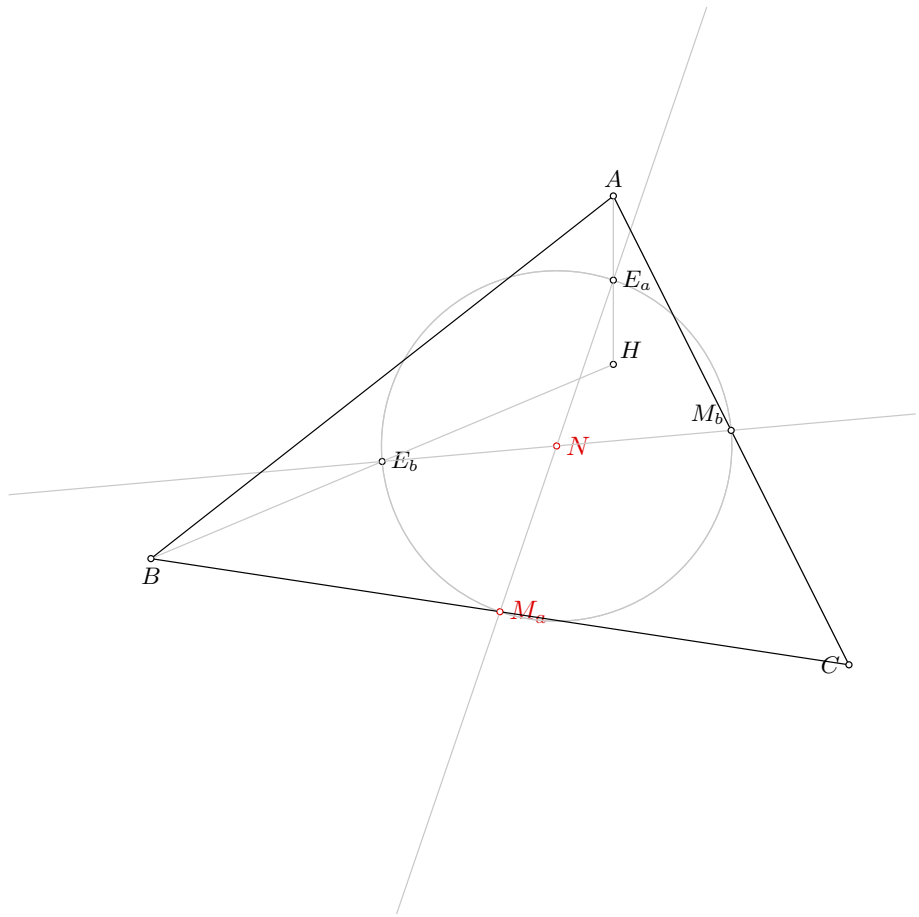

Figure 1: Illustration of the problem 0946

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; line m(H_{b}H_{c})
     and circle k(N,M_{a}) intersect; points M_{a} and N are not the same
% Determination conditions: points E_{b} and M_{b} must be different; points M_{a} and E_{a} must
    be different; points E_{b} and N are not the same; points M_{a} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 15 terms.

Time Complexity: Time spent by the prover is 0.302 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_a=_M_a

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_a=_M_a

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_a=_M_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 947

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 947: Given a point E_b, a point M_a and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_a, construct a line $m(BH_c)$ (rule W02); % DET: points E_b and M_a are not the same;
2. Using the point M_a and the point O, construct a line m_a (rule W02); % DET: points M_a and O are not the same;
3. Using the point M_a and the line m_a, construct a line a (rule W10a); ;
4. Using the point E_b and the line m_a, construct a line $m(BH_a)$ (rule W16); ;
5. Using the point O and the line $m(BH_c)$, construct a line m_c (rule W16); ;
6. Using the line m_c and the line $m(BH_a)$, construct a point M_c (rule W03); % NDG: lines m_c and $m(BH_a)$ are not parallel % DET: lines m_c and $m(BH_a)$ are not the same;
7. Using the point M_c and the line m_c, construct a line c (rule W10a); ;
8. Using the line c and the line a, construct a point B (rule W03); % NDG: lines c and a are not parallel % DET: lines c and a are not the same;
9. Using the point B and the point E_b, construct a point H (rule W01); ;
10. Using the point M_a and the point B, construct a point C (rule W01); ;
11. Using the point O and the point H, construct a point G (rule W01); ;
12. Using the point M_a and the point G, construct a point A (rule W01); .

Non-degenerate conditions: lines c and a are not parallel; lines m_c and $m(BH_a)$ are not parallel.

Determination conditions: lines c and a are not the same; lines m_c and $m(BH_a)$ are not the same; points M_a and O are not the same; points E_b and M_a are not the same.

Rules used: [W01,W02,W03,W10a,W16]

Lemmas used: [D1,D11,D13,D20,D21,D29,GD01,GD02,GL01,GL03,GL04,GL09,L1,L39,L40,L42,L50,L51,L55,I

Solving time: 3.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point M_{a} 65 40
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r M_{a}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{a} are not the same
% Constructing a line m(BH_{c}) which passes through point E_{b} and point M_{a}
line m(BH_{c}) E_{b} M_{a}

color 200 200 200
drawline m(BH_{c})
color 0 0 0



% DET: points M_{a} and O are not the same
% Constructing a line m_{a} which passes through point M_{a} and point O
line m_{a} M_{a} O

color 200 200 200
drawline m_{a}
color 0 0 0



% Constructing a line a which is perpendicular to line m_{a} and which passes through point M_{a}
perp a M_{a} m_{a}

color 200 200 200
drawline a
color 0 0 0
```

```
% Constructing a line m(BH_{a}) which contains the point E_{b} and is parallel to the line m_{a}
parallel m(BH_{a}) E_{b} m_{a}

color 200 200 200
drawline m(BH_{a})
color 0 0 0



% Constructing a line m_{c} which contains the point O and is parallel to the line m(BH_{c})
parallel m_{c} O m(BH_{c})

color 200 200 200
drawline m_{c}
color 0 0 0



% NDG: lines m_{c} and m(BH_{a}) are not parallel% DET: lines m_{c} and m(BH_{a}) are not the same
% Constructing a point M_{c} which belongs to line m_{c} and line m(BH_{a})
intersec M_{c} m_{c} m(BH_{a})
cmark_lt M_{c}



% Constructing a line c which is perpendicular to line m_{c} and which passes through point M_{c}
perp c M_{c} m_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines c and a are not parallel% DET: lines c and a are not the same
% Constructing a point B which belongs to line c and line a
intersec B c a
cmark_b B



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
```

```
drawsegment B C
color 0 0 0



% Constructing a line L_{\_G205340} which passes through point O and point H
line L_{\_G205340} O H

color 200 200 200
drawline L_{\_G205340}
color 0 0 0


% Constructing a point P_{\_G205441} with coordinates (0,0)
point P_{\_G205441} 0 0
cmark_r P_{\_G205441}

% Constructing a point P_{\_G205365} such that OP_{\_G205365}/OP_{\_G205441}=1
towards P_{\_G205365} O P_{\_G205441} 1
cmark_r P_{\_G205365}
color 200 200 200
drawsegment O P_{\_G205365}
color 0 0 0

% Constructing a point P_{\_G205410} such that OP_{\_G205410}/OP_{\_G205441}=3
towards P_{\_G205410} O P_{\_G205441} 3
cmark_r P_{\_G205410}
color 200 200 200
drawsegment O P_{\_G205410}
color 0 0 0

% Constructing a line L_{\_G205371} which passes through point H and point P_{\_G205410}
line L_{\_G205371} H P_{\_G205410}

color 200 200 200
drawline L_{\_G205371}
color 0 0 0


% Constructing a line L_{\_G205334} which contains the point P_{\_G205365} and is parallel to the
    line L_{\_G205371}
parallel L_{\_G205334} P_{\_G205365} L_{\_G205371}

color 200 200 200
drawline L_{\_G205334}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G205334} and line L_{\_G205340}
intersec G L_{\_G205334} L_{\_G205340}
cmark_t G



% Constructing a point A such that M_{a}A/M_{a}G=3
towards A M_{a} G 3
```

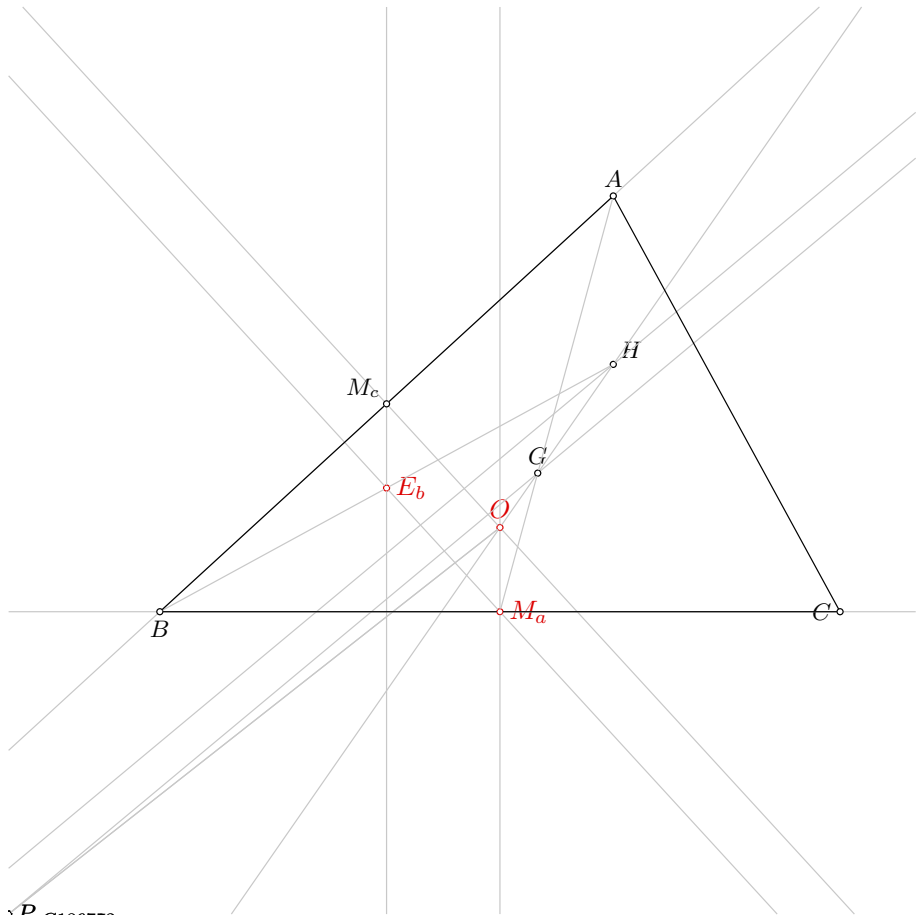

Figure 1: Illustration of the problem 0947

```
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and a are not parallel; lines m_{c} and m(BH_{a}) are not
    parallel
% Determination conditions: lines c and a are not the same; lines m_{c} and m(BH_{a}) are not the
    same; points M_{a} and O are not the same; points E_{b} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=$\_E_b$

Proving failed

4.1.2 Proving M_a=$\_M_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 9 terms.

Time Complexity: Time spent by the prover is 0.191 seconds.

NDG conditions Points M_c and M_a are not identical

Line through points M_c and E_b is not perpendicular to line through points E_b and O

4.1.3 Proving O=$\_O$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=$\_E_b$

Proving failed

4.2.2 Proving M_a=$\_M_a$

NDG conditions are:

$S_{OE_bP^1_{m(BH_a)}} \neq S_{P^2_{m_c}E_bP^1_{m(BH_a)}}$ i.e., lines $OP^2_{m_c}$ and $E_bP^1_{m(BH_a)}$ are not parallel (construction based assumption)

$S_{M_cOP^2_{m_c}} \neq 0$ i.e., points M_c, O and $P^2_{m_c}$ are not collinear (foot is not the point itself; construction based assumption)

$S_{M_cM_aT^0_a} \neq S_{F^3_cM_aT^0_a}$ i.e., lines $M_cF^3_c$ and $M_aT^0_a$ are not parallel (construction based assumption)

$S_{P\_G191476OH} \neq S_{P^4_{L\_G191445}OH}$ i.e., lines $P\_G191476P^4_{L\_G191445}$ and OH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^8_{\_m_b}} \neq S_{F^7_{\_m_a}\_M_bF^8_{\_m_b}}$ i.e., lines $\_M_aF^7_{\_m_a}$ and $\_M_bF^8_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.080 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 948

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 948: Given a point E_b, a point M_a and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 949

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 949: Given a point E_b, a point M_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 950

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 950: Given a point E_b, a point M_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 951

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 951: Given a point E_b, a point M_b and a point M_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
2. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;
3. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;
4. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
5. Choose freely a point M_c on the circle $k(N, M_a)$ (rule WOncircle);
6. Choose freely a point A (rule free);
7. Using the point A and the point M_c, construct a point B (rule W01); ;
8. Using the point A and the point M_b, construct a point C (rule W01); .

Non-degenerate conditions: points E_b and N are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel.

Determination conditions: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points E_b and M_b are not the same.

Rules used: [W01,W02,W03,W06,W14,WOncircle1,free]

Lemmas used: [D20,D22,D32,GD02,GL01,GL03,GL04,L17,L19,L21,L23,L44,L45,L50,L51]

Solving time: 203.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point M_{b} 95 67.5
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_lt M_{b}
cmark_lt M_{c}
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0


% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N


% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% Choosing randomly a point M_{c} on the circle with center N through point E_{b}
oncircle M_{c} N E_{b}
cmark_lt M_{c}
color 200 200 200
drawcircle N E_{b}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points E_{b} and N are not the same; lines m(E_{b}M_{b}) and m(H_{a}H
    _{c}) are not parallel
% Determination conditions: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the same; points E_{b}
    and M_{b} are not the same; points E_{b} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

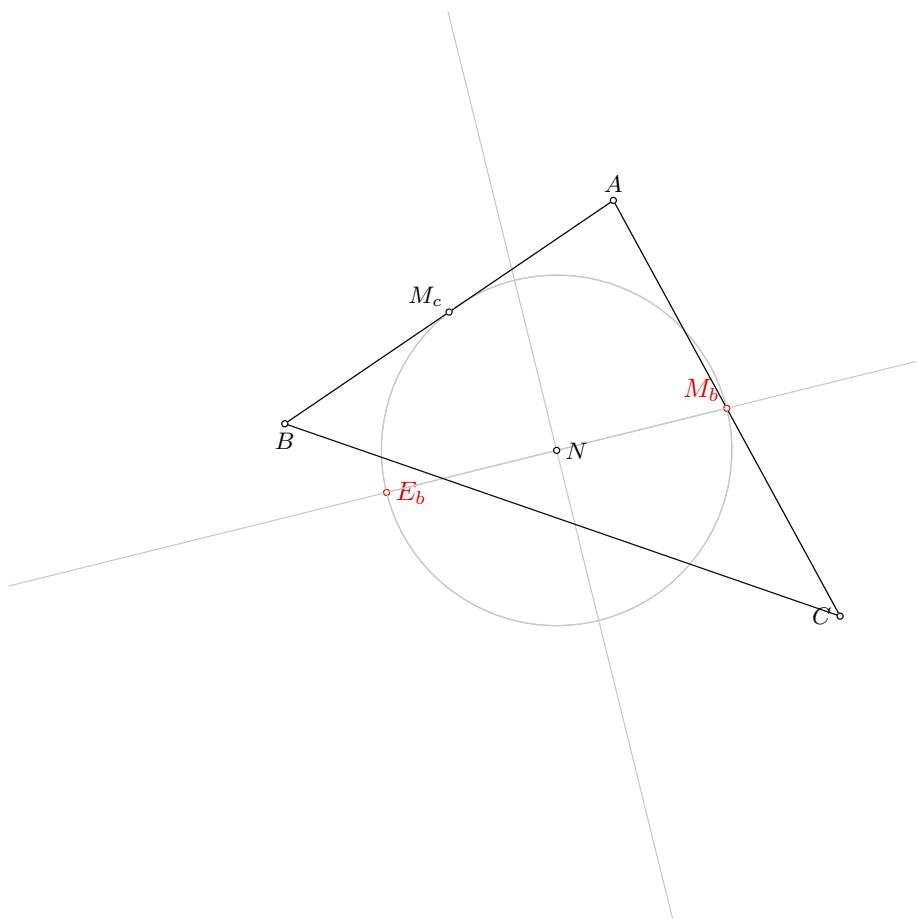

Figure 1: Illustration of the problem 0951

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.077 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving M_c=_M_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving M_b=_M_b

NDG conditions are:

$S_{M^0_{m(E_bM_b)}E_bM_b} \neq S_{T^1_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^0_{m(E_bM_b)}T^1_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 42

Time spent by the prover: 0.000 seconds

4.2.3 Proving M_c=_M_c

NDG conditions are:

$S_{M^0_{m(E_bM_b)}E_bM_b} \neq S_{T^1_{m(E_bM_b)}E_bM_b}$ i.e., lines $M^0_{m(E_bM_b)}T^1_{m(E_bM_b)}$ and E_bM_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 11284 terms.

Time Complexity: Time spent by the prover is 47.170 seconds.There are no ndg conditions.

4.3.2 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 28 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 952

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 952: Given a point M_b, a point N and a point E_b, construct the triangle ABC.

2 Status

Problem is redundant.

3 Solution

3.1 Construction in natural language form

1. Using the point M_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points M_b and N are not the same;
2. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
3. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point M_b, construct a point E_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_b and E_b must be different;
4. Choose freely a point A (rule free);
5. Using the point A and the point M_b, construct a point C (rule W01); ;
6. Using the point A and the point M_b, construct a line b (rule W02); % DET: points A and M_b are not the same;
7. Using the circle $k(N, M_a)$, the line b, the point N and the point M_b, construct a point H_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points M_b and H_b must be different;
8. Using the point H_b and the point E_b, construct a line h_b (rule W02); % DET: points H_b and E_b are not the same;
9. Using the point A and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points A and M_b are not the same;

10. Using the circle $k(N, M_a)$ and the circle $k(M_b, C)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_b, C)$ intersect % DET: circles $k(N, M_a)$ and $k(M_b, C)$ are not the same;

11. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

12. Using the line h_b and the line h_a, construct a point H (rule W03); % NDG: lines h_b and h_a are not parallel % DET: lines h_b and h_a are not the same;

13. Using the point N and the point H, construct a point G (rule W01); ;

14. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: lines h_b and h_a are not parallel; circles $k(N, M_a)$ and $k(M_b, C)$ intersect; points A and M_b are not the same; line b and circle $k(N, M_a)$ intersect; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points M_b and N are not the same.

Determination conditions: lines h_b and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points H_b and E_b are not the same; points M_b and H_b must be different; points A and M_b are not the same; points M_b and E_b must be different; points M_b and N are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07,free]

Lemmas used: [D22,D29,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L16,L17,L19,L20,L21,L23

Solving time: 5.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{b} 95 67.5
point N 72.5 61.93
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_lt M_{b}
cmark_r N
cmark_r E_{b}
color 0 0 0
fontsize 8

% DET: points M_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point M_{b} and point N
line m(H_{a}H_{c}) M_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0
```

```
% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{b} and E_{b} must be
    different
% Constructing a point E_{b} which is an image of the point M_{b} in the symmetry to point/line N
sim E_{b} N M_{b}
cmark_r E_{b}



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and M_{b} are not the same
% Constructing a line b which passes through point A and point M_{b}
line b A M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(N,M_{a}) intersect% DET: points M_{b} and H_{b} must be different
% Constructing a point P_{\_G54608} which is a foot of the point N on the line b
foot P_{\_G54608} N b
cmark_r P_{\_G54608}
color 200 200 200
drawline N P_{\_G54608}
color 0 0 0

% Constructing a point H_{b} which is an image of the point M_{b} in the symmetry to point/line P
    _{\_G54608}
sim H_{b} P_{\_G54608} M_{b}
cmark_l H_{b}
```

```
% DET: points H_{b} and E_{b} are not the same
% Constructing a line h_{b} which passes through point H_{b} and point E_{b}
line h_{b} H_{b} E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points A and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point A
circle k(M_{b},C) M_{b} A

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{b},C) intersect% DET: circles k(N,M_{a}) and k(M_{b},C) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{b},C)
intersec2 H_{a} H_{c} k(N,M_{a}) k(M_{b},C)
cmark_r H_{a}
cmark_rt H_{c}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{b} and h_{a} are not parallel% DET: lines h_{b} and h_{a} are not the same
% Constructing a point H which belongs to line h_{b} and line h_{a}
intersec H h_{b} h_{a}
cmark_rt H



% Constructing a line L_{\_G55152} which passes through point N and point H
line L_{\_G55152} N H

color 200 200 200
drawline L_{\_G55152}
color 0 0 0


% Constructing a point P_{\_G55253} with coordinates (0,0)
point P_{\_G55253} 0 0
```

```
cmark_r P_{\_G55253}

% Constructing a point P_{\_G55177} such that NP_{\_G55177}/NP_{\_G55253}=-1
towards P_{\_G55177} N P_{\_G55253} -1
cmark_r P_{\_G55177}
color 200 200 200
drawsegment P_{\_G55253} P_{\_G55177}
color 0 0 0

% Constructing a point P_{\_G55222} such that NP_{\_G55222}/NP_{\_G55253}=3
towards P_{\_G55222} N P_{\_G55253} 3
cmark_r P_{\_G55222}
color 200 200 200
drawsegment N P_{\_G55222}
color 0 0 0

% Constructing a line L_{\_G55183} which passes through point H and point P_{\_G55222}
line L_{\_G55183} H P_{\_G55222}

color 200 200 200
drawline L_{\_G55183}
color 0 0 0


% Constructing a line L_{\_G55146} which contains the point P_{\_G55177} and is parallel to the
    line L_{\_G55183}
parallel L_{\_G55146} P_{\_G55177} L_{\_G55183}

color 200 200 200
drawline L_{\_G55146}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G55146} and line L_{\_G55152}
intersec G L_{\_G55146} L_{\_G55152}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{b
    },C) intersect; points A and M_{b} are not the same; line b and circle k(N,M_{a}) intersect;
    line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; points M_{b} and N are not the same
```

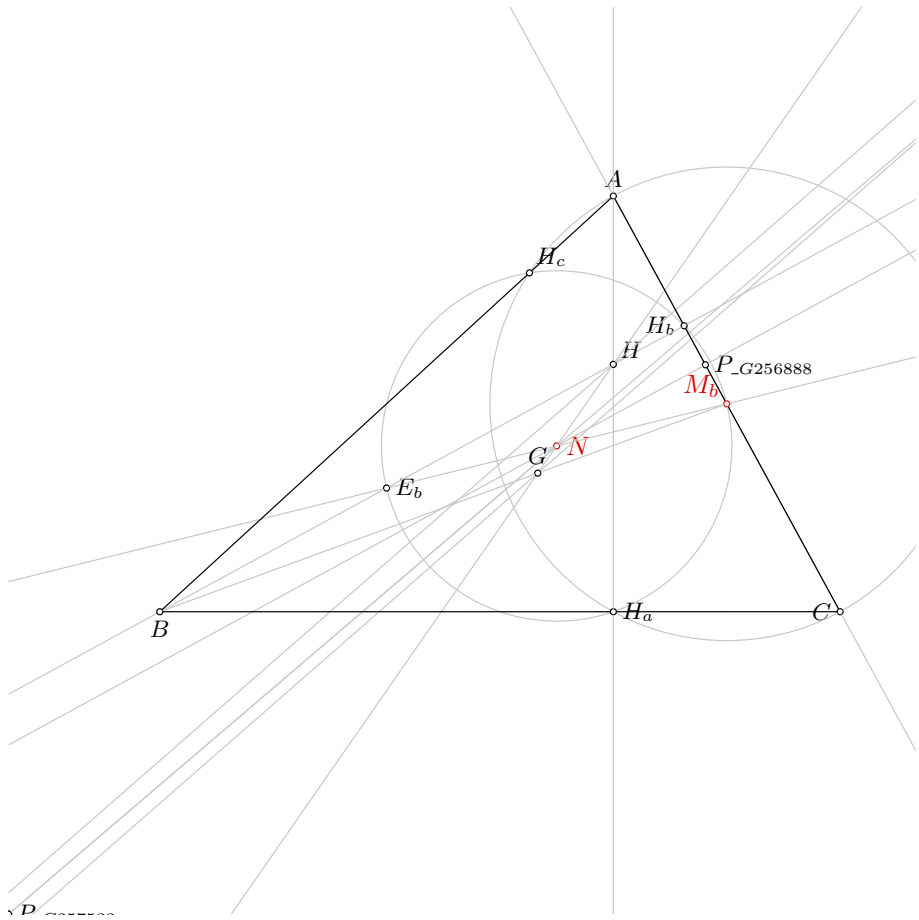

Figure 1: Illustration of the problem 0952

```
% Determination conditions: lines h_{b} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{b},C) are not the same; points H_{b} and E_{b} are not the
    same; points M_{b} and H_{b} must be different; points A and M_{b} are not the same; points M_{
    b} and E_{b} must be different; points M_{b} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.036 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_b=_M_b

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_b=_E_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.060 seconds.There are no ndg conditions.

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_b=_E_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_b=_M_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_b=_E_b

Proving failed

Problem 953

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 953: Given a point E_b, a point M_b and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and M_b are not the same;
2. Using the point M_b and the point O, construct a line m_b (rule W02); % DET: points M_b and O are not the same;
3. Using the point M_b and the line m_b, construct a line b (rule W10a); ;
4. Using the point E_b and the point M_b, construct a line $m(E_bM_b)$ (rule W14); % DET: points E_b and M_b are not the same;
5. Using the line $m(E_bM_b)$ and the line $m(H_aH_c)$, construct a point N (rule W03); % NDG: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel % DET: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same;
6. Using the point N and the point O, construct a point G (rule W01); ;
7. Using the point M_b and the point G, construct a point B (rule W01); ;
8. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
9. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; lines $m(E_bM_b)$ and $m(H_aH_c)$ are not parallel.

Determination conditions: lines $m(E_bM_b)$ and $m(H_aH_c)$ are not the same; points E_b and M_b are not the same; points M_b and O are not the same; points E_b and M_b are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W14]

Lemmas used: [D1,D12,D22,D26,D32,GD01,GD02,GL01,GL03,GL04,GL09,L11,L12,L15,L17,L19,L21,L23,L44,

Solving time: 6.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point M_{b} 95 67.5
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_lt M_{b}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point M_{b}
line m(H_{a}H_{c}) E_{b} M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% DET: points M_{b} and O are not the same
% Constructing a line m_{b} which passes through point M_{b} and point O
line m_{b} M_{b} O

color 200 200 200
drawline m_{b}
color 0 0 0




% Constructing a line b which is perpendicular to line m_{b} and which passes through point M_{b}
perp b M_{b} m_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points E_{b} and M_{b} are not the same
```

```
% Constructing bisector m(E_{b}M_{b}) of the segment E_{b}M_{b}
med m(E_{b}M_{b}) E_{b} M_{b}

color 200 200 200
drawline m(E_{b}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{b} M_{b}
color 0 0 0


% NDG: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel% DET: lines m(E_{b}M_{b}) and m(H_{a}
    H_{c}) are not the same
% Constructing a point N which belongs to line m(E_{b}M_{b}) and line m(H_{a}H_{c})
intersec N m(E_{b}M_{b}) m(H_{a}H_{c})
cmark_r N



% Constructing a line L_{\_G86741} which passes through point N and point O
line L_{\_G86741} N O

color 200 200 200
drawline L_{\_G86741}
color 0 0 0


% Constructing a point P_{\_G86842} with coordinates (0,0)
point P_{\_G86842} 0 0
cmark_r P_{\_G86842}

% Constructing a point P_{\_G86766} such that NP_{\_G86766}/NP_{\_G86842}=1
towards P_{\_G86766} N P_{\_G86842} 1
cmark_r P_{\_G86766}
color 200 200 200
drawsegment N P_{\_G86766}
color 0 0 0

% Constructing a point P_{\_G86811} such that NP_{\_G86811}/NP_{\_G86842}=3
towards P_{\_G86811} N P_{\_G86842} 3
cmark_r P_{\_G86811}
color 200 200 200
drawsegment N P_{\_G86811}
color 0 0 0

% Constructing a line L_{\_G86772} which passes through point O and point P_{\_G86811}
line L_{\_G86772} O P_{\_G86811}

color 200 200 200
drawline L_{\_G86772}
color 0 0 0


% Constructing a line L_{\_G86735} which contains the point P_{\_G86766} and is parallel to the
    line L_{\_G86772}
```

```
parallel L_{\_G86735} P_{\_G86766} L_{\_G86772}

color 200 200 200
drawline L_{\_G86735}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G86735} and line L_{\_G86741}
intersec G L_{\_G86735} L_{\_G86741}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0


% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not parallel
% Determination conditions: lines m(E_{b}M_{b}) and m(H_{a}H_{c}) are not the same; points E_{b}
    and M_{b} are not the same; points M_{b} and O are not the same; points E_{b} and M_{b} are not
     the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

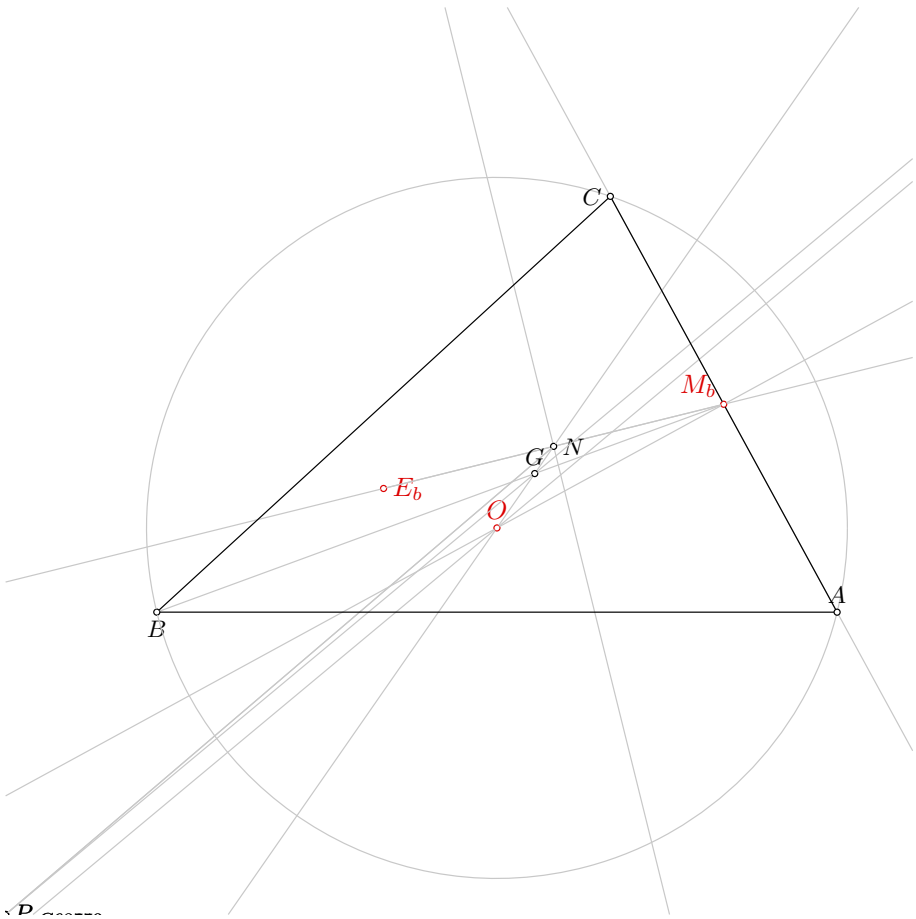

Figure 1: Illustration of the problem 0953

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving M_b=_M_b

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving M_b=_M_b

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 923 terms.

Time Complexity: Time spent by the prover is 2.050 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving $O{=}\_O$

Proving failed

Problem 954

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 954: Given a point E_b, a point M_b and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 955

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 955: Given a point E_b, a point M_b and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 956

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 956: Given a point E_b, a point M_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 957

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 957: Given a point M_c, a point N and a point E_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
2. Choose freely a point E_b on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points E_b and N are not the same;
4. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point E_b, construct a point M_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points E_b and M_b must be different;
5. Choose freely a point A (rule free);
6. Using the point A and the point M_c, construct a point B (rule W01); ;
7. Using the point A and the point M_b, construct a point C (rule W01); .

Non-degenerate conditions: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points M_c and N are not the same.

Determination conditions: points E_b and M_b must be different; points E_b and N are not the same.

Rules used: [W01,W02,W05a,W06,WOncircle1,free]

Lemmas used: [D20,D22,D32,GD02,GL01,GL03,GL04,L17,L18,L19,L21,L23,L44,L45,L50,L51]

Solving time: 150.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{c} 50 67.5
point N 72.5 61.93
point E_{b} 50 56.36

color 220 0 0
fontsize 9

cmark_lt M_{c}
cmark_r N
cmark_r E_{b}
color 0 0 0
fontsize 8

% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{b} on the circle with center N through point M_{c}
oncircle E_{b} N M_{c}
cmark_r E_{b}
color 200 200 200
drawcircle N M_{c}
color 0 0 0


% DET: points E_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point E_{b} and point N
line m(H_{a}H_{c}) E_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points E_{b} and M_{b} must be
    different
% Constructing a point M_{b} which is an image of the point E_{b} in the symmetry to point/line N
sim M_{b} N E_{b}
cmark_lt M_{b}



% Constructing a free point A
point A 80 95
```

```
cmark_t A



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect; points M_{c} and N
     are not the same
% Determination conditions: points E_{b} and M_{b} must be different; points E_{b} and N are not
    the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.029 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_b=_E_b

Proving failed

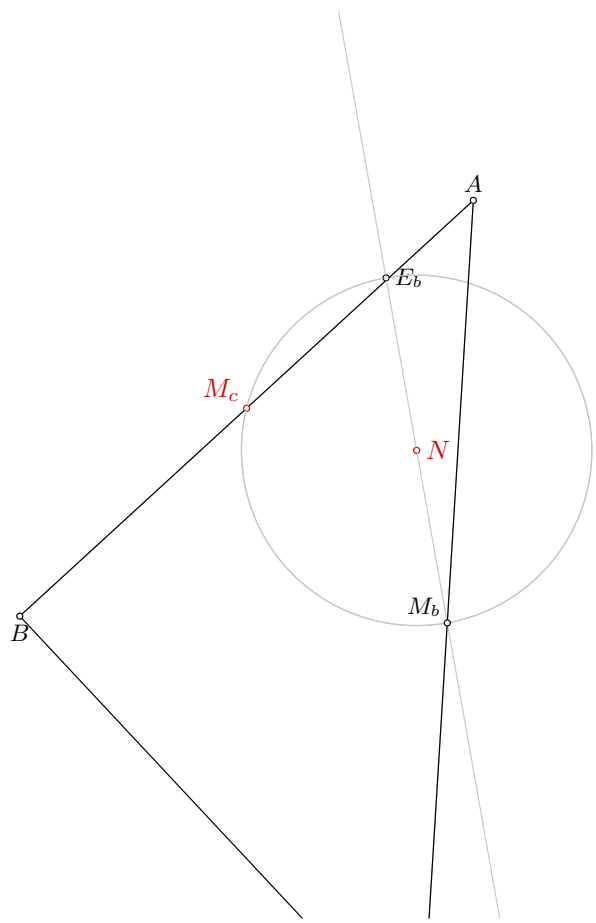

Figure 1: Illustration of the problem 0957

4.2 GCLC - Area method

4.2.1 Proving M_c=$\_M_c$

NDG conditions are:

$S_{\_M_a BC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_b AC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a} BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a \_M_b F^1_{\_m_b}} \neq S_{F^0_{\_m_a} \_M_b F^1_{\_m_b}}$ i.e., lines $\_M_a F^0_{\_m_a}$ and $\_M_b F^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving E_b=$\_E_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_c=$\_M_c$

Proving failed

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving E_b=$\_E_b$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_c=$\_M_c$

Proving failed

4.4.2 Proving N=$\_N$

Proving failed

4.4.3 Proving E_b=$\_E_b$

Proving failed

Problem 958

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 958: Given a point E_b, a point M_c and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_b and the point M_c, construct a line $m(BH_a)$ (rule W02); % DET: points E_b and M_c are not the same;
2. Using the point M_c and the point O, construct a line m_c (rule W02); % DET: points M_c and O are not the same;
3. Using the point M_c and the line m_c, construct a line c (rule W10a); ;
4. Using the point E_b and the line m_c, construct a line $m(BH_c)$ (rule W16); ;
5. Using the point O and the line $m(BH_a)$, construct a line m_a (rule W16); ;
6. Using the line m_a and the line $m(BH_c)$, construct a point M_a (rule W03); % NDG: lines m_a and $m(BH_c)$ are not parallel % DET: lines m_a and $m(BH_c)$ are not the same;
7. Using the point M_a and the line m_a, construct a line a (rule W10a); ;
8. Using the line a and the line c, construct a point B (rule W03); % NDG: lines a and c are not parallel % DET: lines a and c are not the same;
9. Using the point B and the point E_b, construct a point H (rule W01); ;
10. Using the point M_c and the point B, construct a point A (rule W01); ;
11. Using the point O and the point H, construct a point G (rule W01); ;
12. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: lines a and c are not parallel; lines m_a and $m(BH_c)$ are not parallel.

Determination conditions: lines a and c are not the same; lines m_a and $m(BH_c)$ are not the same; points M_c and O are not the same; points E_b and M_c are not the same.

Rules used: [W01,W02,W03,W10a,W16]

Lemmas used: [D1,D11,D13,D20,D21,D29,GD01,GD02,GL01,GL03,GL04,GL09,L1,L39,L40,L42,L50,L51,L57,I

Solving time: 3.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point M_{c} 50 67.5
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_lt M_{c}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{b} and M_{c} are not the same
% Constructing a line m(BH_{a}) which passes through point E_{b} and point M_{c}
line m(BH_{a}) E_{b} M_{c}

color 200 200 200
drawline m(BH_{a})
color 0 0 0



% DET: points M_{c} and O are not the same
% Constructing a line m_{c} which passes through point M_{c} and point O
line m_{c} M_{c} O

color 200 200 200
drawline m_{c}
color 0 0 0



% Constructing a line c which is perpendicular to line m_{c} and which passes through point M_{c}
perp c M_{c} m_{c}

color 200 200 200
drawline c
color 0 0 0
```

```
% Constructing a line m(BH_{c}) which contains the point E_{b} and is parallel to the line m_{c}
parallel m(BH_{c}) E_{b} m_{c}

color 200 200 200
drawline m(BH_{c})
color 0 0 0



% Constructing a line m_{a} which contains the point O and is parallel to the line m(BH_{a})
parallel m_{a} O m(BH_{a})

color 200 200 200
drawline m_{a}
color 0 0 0



% NDG: lines m_{a} and m(BH_{c}) are not parallel% DET: lines m_{a} and m(BH_{c}) are not the same
% Constructing a point M_{a} which belongs to line m_{a} and line m(BH_{c})
intersec M_{a} m_{a} m(BH_{c})
cmark_r M_{a}



% Constructing a line a which is perpendicular to line m_{a} and which passes through point M_{a}
perp a M_{a} m_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines a and c are not parallel% DET: lines a and c are not the same
% Constructing a point B which belongs to line a and line c
intersec B a c
cmark_b B



% Constructing a point H such that BH/BE_{b}=2
towards H B E_{b} 2
cmark_rt H
color 200 200 200
drawsegment B H
color 0 0 0



% Constructing a point A such that M_{c}A/M_{c}B=-1
towards A M_{c} B -1
cmark_t A
color 200 200 200
```

```
drawsegment B A
color 0 0 0


% Constructing a line L_{\_G165768} which passes through point O and point H
line L_{\_G165768} O H

color 200 200 200
drawline L_{\_G165768}
color 0 0 0


% Constructing a point P_{\_G165869} with coordinates (0,0)
point P_{\_G165869} 0 0
cmark_r P_{\_G165869}

% Constructing a point P_{\_G165793} such that OP_{\_G165793}/OP_{\_G165869}=1
towards P_{\_G165793} O P_{\_G165869} 1
cmark_r P_{\_G165793}
color 200 200 200
drawsegment O P_{\_G165793}
color 0 0 0

% Constructing a point P_{\_G165838} such that OP_{\_G165838}/OP_{\_G165869}=3
towards P_{\_G165838} O P_{\_G165869} 3
cmark_r P_{\_G165838}
color 200 200 200
drawsegment O P_{\_G165838}
color 0 0 0

% Constructing a line L_{\_G165799} which passes through point H and point P_{\_G165838}
line L_{\_G165799} H P_{\_G165838}

color 200 200 200
drawline L_{\_G165799}
color 0 0 0


% Constructing a line L_{\_G165762} which contains the point P_{\_G165793} and is parallel to the
    line L_{\_G165799}
parallel L_{\_G165762} P_{\_G165793} L_{\_G165799}

color 200 200 200
drawline L_{\_G165762}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G165762} and line L_{\_G165768}
intersec G L_{\_G165762} L_{\_G165768}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
```

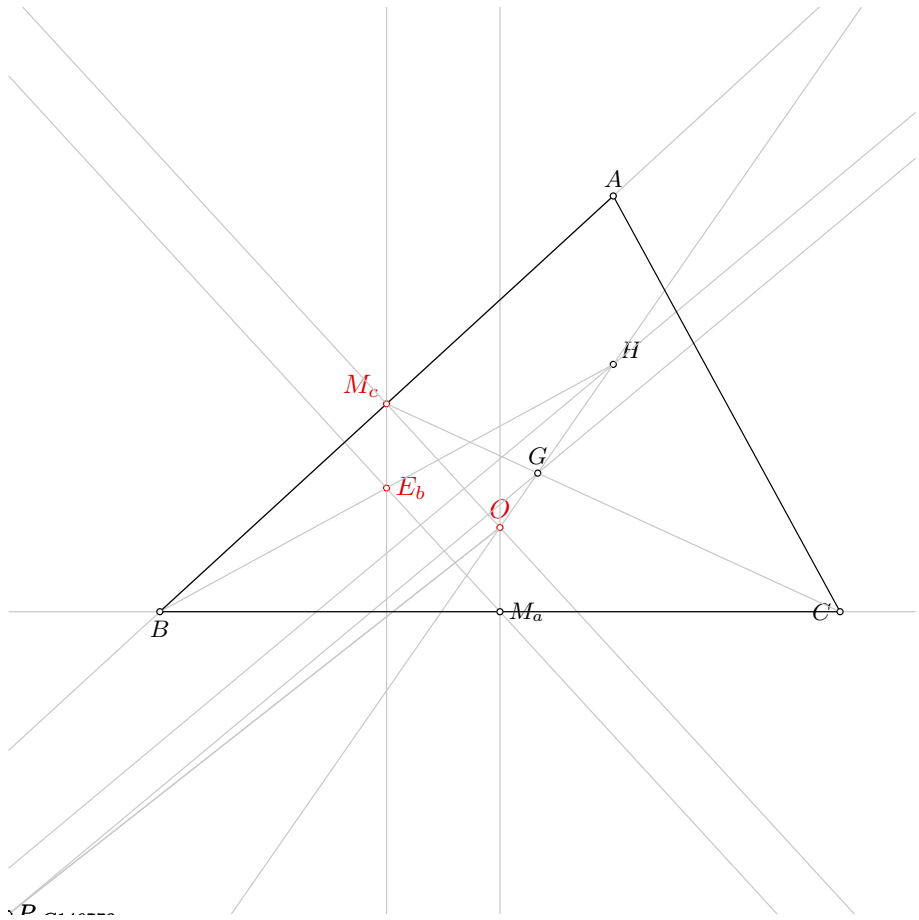

Figure 1: Illustration of the problem 0958

```
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and c are not parallel; lines m_{a} and m(BH_{c}) are not
    parallel
% Determination conditions: lines a and c are not the same; lines m_{a} and m(BH_{c}) are not the
    same; points M_{c} and O are not the same; points E_{b} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=$\_E_b$

Proving failed

4.1.2 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 9 terms.

Time Complexity: Time spent by the prover is 0.194 seconds.

NDG conditions Points M_c and M_a are not identical

Line through points M_c and M_a is not perpendicular to line through points M_a and E_b

4.1.3 Proving O=$\_O$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=$\_E_b$

Proving failed

4.2.2 Proving M_c=$\_M_c$

NDG conditions are:

$S_{OE_bP^1_{m(BH_c)}} \neq S_{P^2_{m_a}E_bP^1_{m(BH_c)}}$ i.e., lines $OP^2_{m_a}$ and $E_bP^1_{m(BH_c)}$ are not parallel (construction based assumption)

$S_{M_aOP^2_{m_a}} \neq 0$ i.e., points M_a, O and $P^2_{m_a}$ are not collinear (foot is not the point itself; construction based assumption)

$S_{M_aM_cT^0_c} \neq S_{F^3_aM_cT^0_c}$ i.e., lines $M_aF^3_a$ and $M_cT^0_c$ are not parallel (construction based assumption)

$S_{P\_G151613OH} \neq S_{P^4_{L\_G151582}OH}$ i.e., lines $P\_G151613P^4_{L\_G151582}$ and OH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^8_{\_m_b}} \neq S_{F^7_{\_m_a}\_M_bF^8_{\_m_b}}$ i.e., lines $\_M_aF^7_{\_m_a}$ and $\_M_bF^8_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.100 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 959

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 959: Given a point E_b, a point M_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 960

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 960: Given a point E_b, a point M_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 961

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 961: Given a point E_b, a point M_c and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 962

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 962: Given a point E_b, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point N and the point O, construct a point H (rule W01); ;
3. Using the point E_b and the point H, construct a point B (rule W01); ;
4. Using the point G and the point B, construct a point M_b (rule W01); ;
5. Using the point E_b and the point H, construct a line h_b (rule W02); % DET: points E_b and H are not the same;
6. Using the point E_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points E_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points E_b and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L15,L20,L23,L56]

Solving time: 7.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{b} 50 56.36
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{b}
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G225344} which passes through point N and point O
line L_{\_G225344} N O

color 200 200 200
drawline L_{\_G225344}
color 0 0 0


% Constructing a point P_{\_G225445} with coordinates (0,0)
point P_{\_G225445} 0 0
cmark_r P_{\_G225445}

% Constructing a point P_{\_G225369} such that NP_{\_G225369}/NP_{\_G225445}=1
towards P_{\_G225369} N P_{\_G225445} 1
cmark_r P_{\_G225369}
color 200 200 200
drawsegment N P_{\_G225369}
color 0 0 0

% Constructing a point P_{\_G225414} such that NP_{\_G225414}/NP_{\_G225445}=3
towards P_{\_G225414} N P_{\_G225445} 3
cmark_r P_{\_G225414}
color 200 200 200
drawsegment N P_{\_G225414}
color 0 0 0

% Constructing a line L_{\_G225375} which passes through point O and point P_{\_G225414}
line L_{\_G225375} O P_{\_G225414}
```

```
color 200 200 200
drawline L_{\_G225375}
color 0 0 0


% Constructing a line L_{\_G225338} which contains the point P_{\_G225369} and is parallel to the
    line L_{\_G225375}
parallel L_{\_G225338} P_{\_G225369} L_{\_G225375}

color 200 200 200
drawline L_{\_G225338}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G225338} and line L_{\_G225344}
intersec G L_{\_G225338} L_{\_G225344}
cmark_t G



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point M_{b} such that GM_{b}/GB=-0.5
towards M_{b} G B -0.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points E_{b} and H are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H
line h_{b} E_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points E_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{b}
circle k(N,M_{a}) N E_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G226429} which is a foot of the point N on the line h_{b}
foot P_{\_G226429} N h_{b}
cmark_r P_{\_G226429}
color 200 200 200
drawline N P_{\_G226429}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G226429}
sim H_{b} P_{\_G226429} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

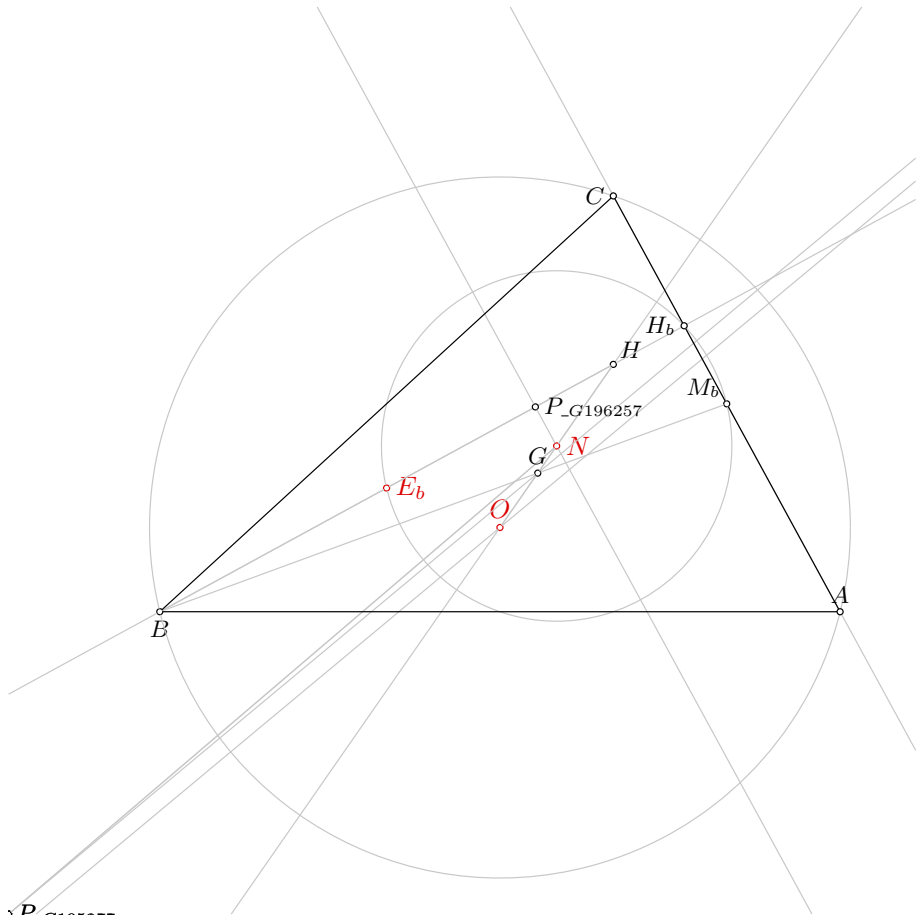

Figure 1: Illustration of the problem 0962

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points E_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points E_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_b=_E_b

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_b=_E_b

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_b=_E_b

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_b=_E_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 963

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 963: Given a point E_b, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 964

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 964: Given a point E_b, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 965

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 965: Given a point E_b, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 966

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 966: Given a point E_b, a point O and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 967

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 967: Given a point E_b, a point O and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 968

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 968: Given a point E_b, a point O and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 969

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 969: Given a point E_b, a point T_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 970

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 970: Given a point E_b, a point T_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 971

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 971: Given a point E_b, a point T_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 972

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 972: Given a point E_c, a point G and a point H, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H, construct a point C (rule W01); ;
2. Using the point G and the point H, construct a point N (rule W01); ;
3. Using the point G and the point H, construct a point O (rule W01); ;
4. Using the point G and the point C, construct a point M_c (rule W01); ;
5. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
6. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points E_c and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L16,L21,L24,L3,L57,L58]

Solving time: 7.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point G 70 58.33
point H 80 72.73

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_t G
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point N such that GN/GH=0.25
towards N G H 0.25
cmark_r N
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a point M_{c} such that GM_{c}/GC=-0.5
```

```
towards M_{c} G C -0.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G76401} which is a foot of the point N on the line h_{c}
foot P_{\_G76401} N h_{c}
cmark_r P_{\_G76401}
color 200 200 200
drawline N P_{\_G76401}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G76401}
sim H_{c} P_{\_G76401} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points E_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving H=_H

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving H=_H

Proving failed

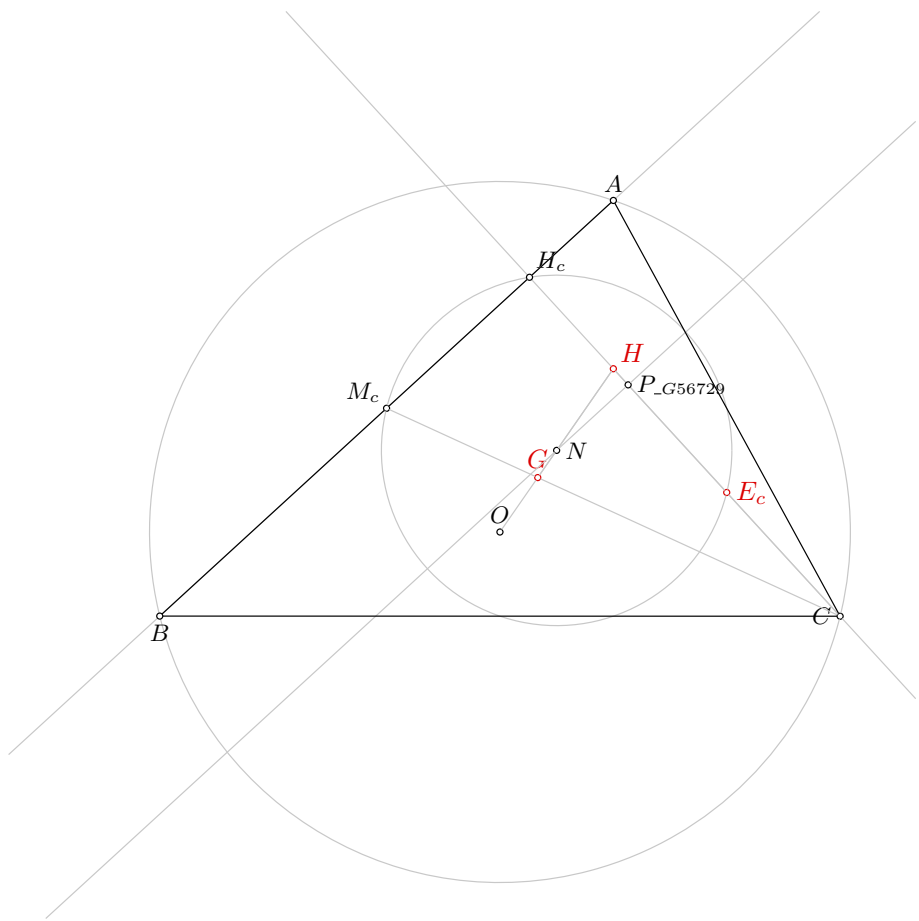

Figure 1: Illustration of the problem 0972

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving H=_H

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving H=_H

Proving failed

Problem 973

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 973: Given a point E_c, a point G and a point H_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 974

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 974: Given a point E_c, a point G and a point H_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 975

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 975: Given a point E_c, a point G and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Using the point H_c and the line h_c, construct a line c (rule W10a); ;
3. Using the point G, the line h_c and the point E_c, construct a line $h_{G,-1/2}(h_c)$ (rule W15); ;
4. Using the line $h_{G,-1/2}(h_c)$ and the line c, construct a point M_c (rule W03); % NDG: lines $h_{G,-1/2}(h_c)$ and c are not parallel % DET: lines $h_{G,-1/2}(h_c)$ and c are not the same;
5. Using the point M_c and the point G, construct a point C (rule W01); ;
6. Using the point E_c and the point C, construct a point H (rule W01); ;
7. Using the point G and the point H, construct a point O (rule W01); ;
8. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
9. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; lines $h_{G,-1/2}(h_c)$ and c are not parallel.

Determination conditions: lines $h_{G,-1/2}(h_c)$ and c are not the same; points E_c and H_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W15]

Lemmas used: [D10,D20,D26,D30,D7,GD01,GL02,GL03,GL04,GL09,L11,L12,L3,L57,L58]

Solving time: 4.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point G 70 58.33
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_t G
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0




% Constructing a line c which is perpendicular to line h_{c} and which passes through point H_{c}
perp c H_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0




% Constructing a point P_{\_G120124} such that GP_{\_G120124}/GE_{c}=-0.5
towards P_{\_G120124} G E_{c} -0.5
cmark_r P_{\_G120124}
color 200 200 200
drawsegment E_{c} P_{\_G120124}
color 0 0 0

% Constructing a line h_{G,-1/2}(h_{c}) which contains the point P_{\_G120124} and is parallel to
    the line h_{c}
parallel h_{G,-1/2}(h_{c}) P_{\_G120124} h_{c}

color 200 200 200
drawline h_{G,-1/2}(h_{c})
color 0 0 0
```

```
% NDG: lines h_{G,-1/2}(h_{c}) and c are not parallel% DET: lines h_{G,-1/2}(h_{c}) and c are not
    the same
% Constructing a point M_{c} which belongs to line h_{G,-1/2}(h_{c}) and line c
intersec M_{c} h_{G,-1/2}(h_{c}) c
cmark_lt M_{c}



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



% Constructing a point H such that E_{c}H/E_{c}C=-1
towards H E_{c} C -1
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

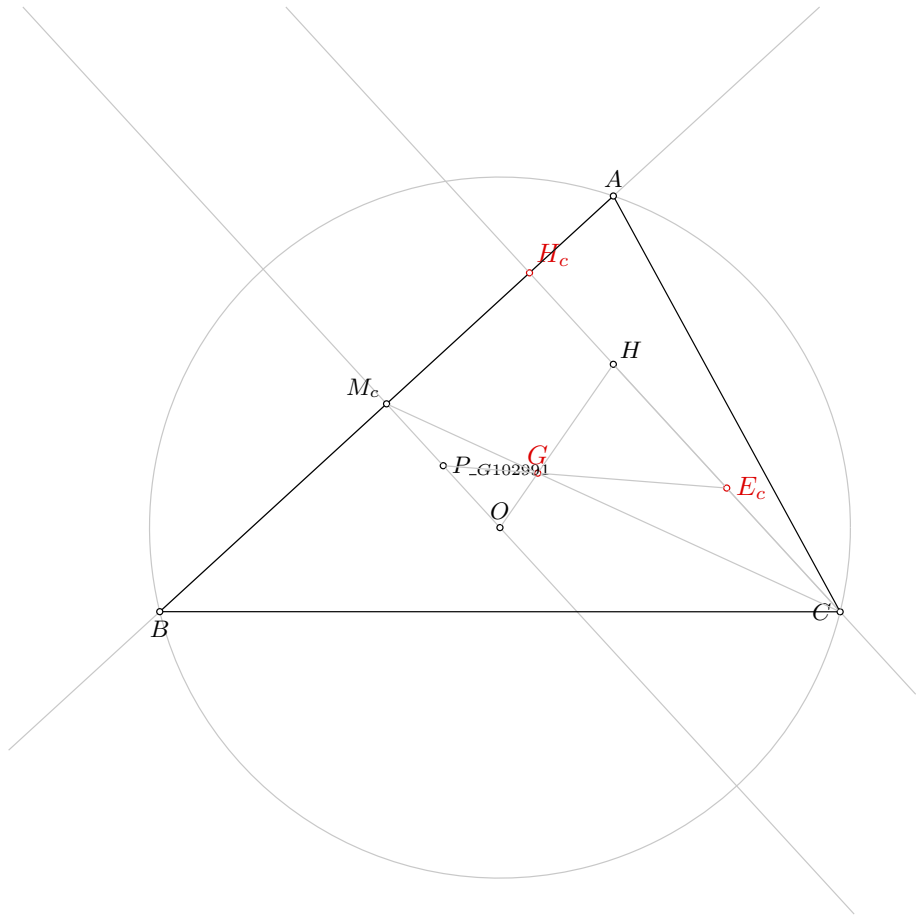

Figure 1: Illustration of the problem 0975

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    lines h_{G,-1/2}(h_{c}) and c are not parallel
% Determination conditions: lines h_{G,-1/2}(h_{c}) and c are not the same; points E_{c} and H_{c}
    are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving H_c=_H_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 976

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 976: Given a point E_c, a point G and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 977

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 977: Given a point E_c, a point G and a point M_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 978

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 978: Given a point E_c, a point G and a point M_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 979

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 979: Given a point E_c, a point G and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point M_c, construct a point C (rule W01); ;
2. Using the point E_c and the point C, construct a point H (rule W01); ;
3. Using the point G and the point H, construct a point N (rule W01); ;
4. Using the point G and the point H, construct a point O (rule W01); ;
5. Using the point E_c and the point C, construct a line h_c (rule W02); % DET: points E_c and C are not the same;
6. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points E_c and C are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L16,L21,L24,L3,L57,L58]

Solving time: 7.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point G 70 58.33
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_t G
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point C such that GC/GM_{c}=-2
towards C G M_{c} -2
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



% Constructing a point H such that E_{c}H/E_{c}C=-1
towards H E_{c} C -1
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point N such that GN/GH=0.25
towards N G H 0.25
cmark_r N
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GH=-0.5
```

```
towards O G H -0.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points E_{c} and C are not the same
% Constructing a line h_{c} which passes through point E_{c} and point C
line h_{c} E_{c} C

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G170291} which is a foot of the point N on the line h_{c}
foot P_{\_G170291} N h_{c}
cmark_r P_{\_G170291}
color 200 200 200
drawline N P_{\_G170291}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G170291}
sim H_{c} P_{\_G170291} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points E_{c} and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving M_c=_M_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving M_c=_M_c

Proving failed

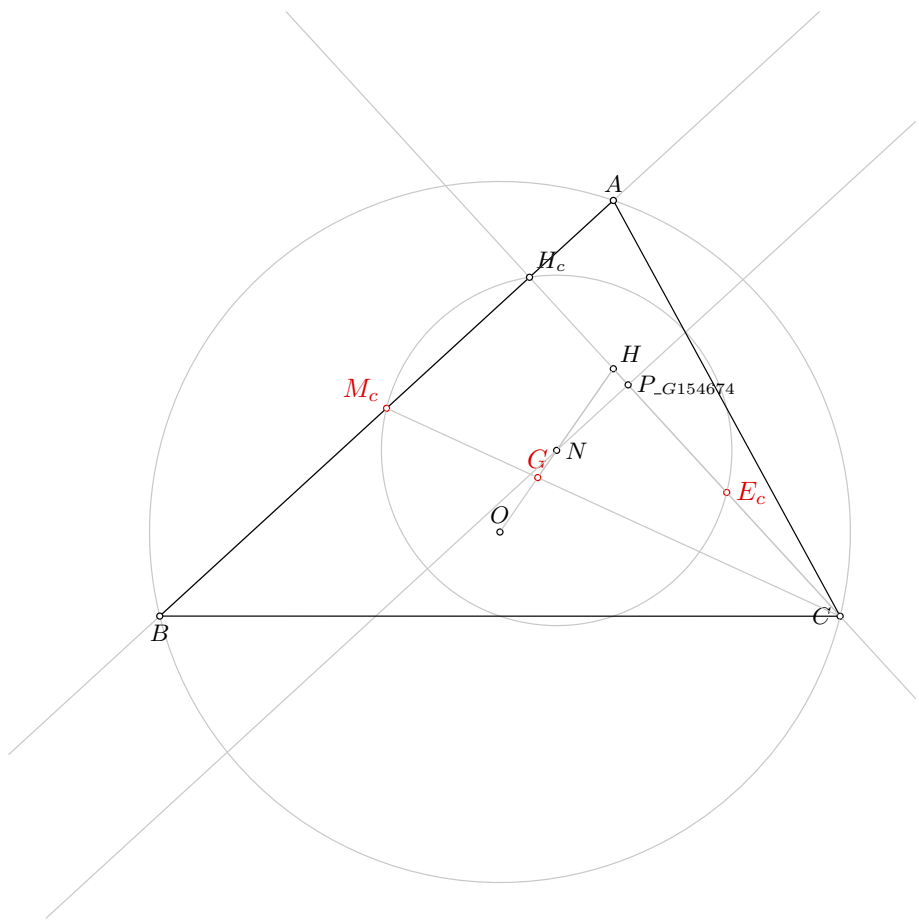

Figure 1: Illustration of the problem 0979

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 980

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 980: Given a point E_c, a point G and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point N, construct a point H (rule W01); ;
2. Using the point E_c and the point H, construct a point C (rule W01); ;
3. Using the point G and the point N, construct a point O (rule W01); ;
4. Using the point G and the point C, construct a point M_c (rule W01); ;
5. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
6. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points E_c and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L21,L24,L3,L57]

Solving time: 7.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point G 70 58.33
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_t G
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point O such that GO/GN=-2
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0



% Constructing a point M_{c} such that GM_{c}/GC=-0.5
```

```
towards M_{c} G C -0.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G212889} which is a foot of the point N on the line h_{c}
foot P_{\_G212889} N h_{c}
cmark_r P_{\_G212889}
color 200 200 200
drawline N P_{\_G212889}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G212889}
sim H_{c} P_{\_G212889} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points E_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving N=_N

Proving failed

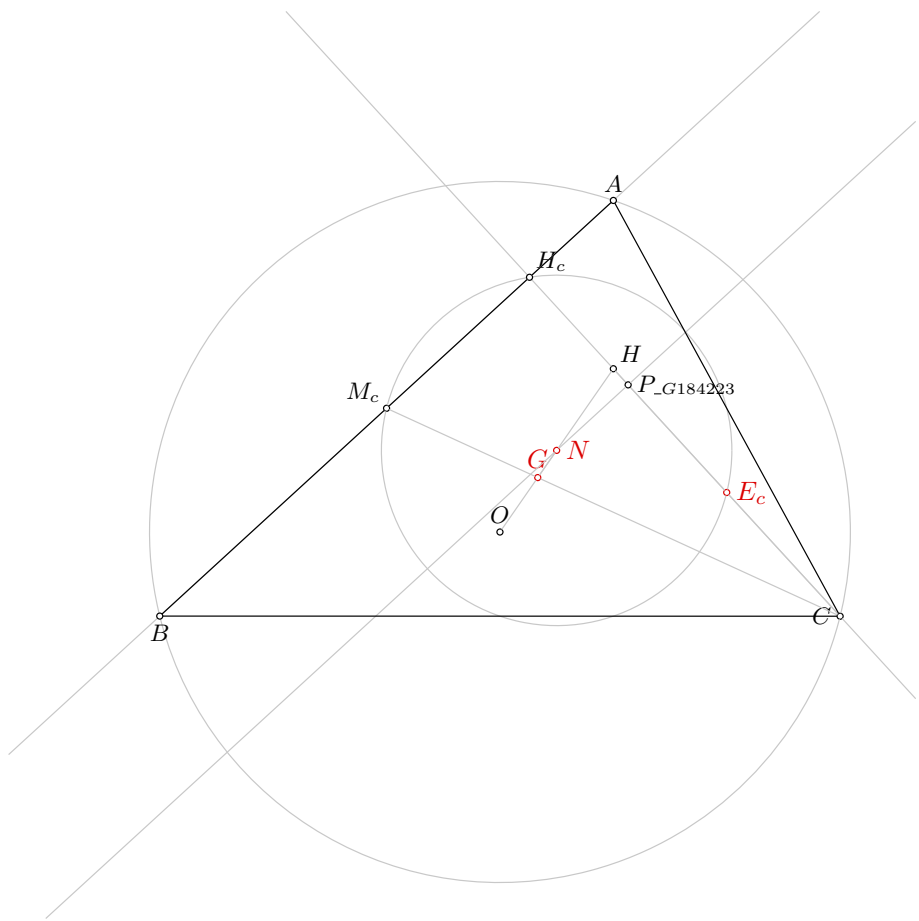

Figure 1: Illustration of the problem 0980

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 981

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 981: Given a point E_c, a point G and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point O, construct a point N (rule W01); ;
2. Using the point G and the point O, construct a point H (rule W01); ;
3. Using the point E_c and the point H, construct a point C (rule W01); ;
4. Using the point G and the point C, construct a point M_c (rule W01); ;
5. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
6. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points E_c and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L15,L21,L24,L3,L57,L58]

Solving time: 7.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point G 70 58.33
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_t G
cmark_t O
color 0 0 0
fontsize 8


% Constructing a point N such that GN/GO=-0.5
towards N G O -0.5
cmark_r N
color 200 200 200
drawsegment O N
color 0 0 0



% Constructing a point H such that GH/GO=-2
towards H G O -2
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point M_{c} such that GM_{c}/GC=-0.5
```

```
towards M_{c} G C -0.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G247204} which is a foot of the point N on the line h_{c}
foot P_{\_G247204} N h_{c}
cmark_r P_{\_G247204}
color 200 200 200
drawline N P_{\_G247204}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G247204}
sim H_{c} P_{\_G247204} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points E_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving G=_G

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving G=_G

Proving failed

4.2.3 Proving O=_O

Proving failed

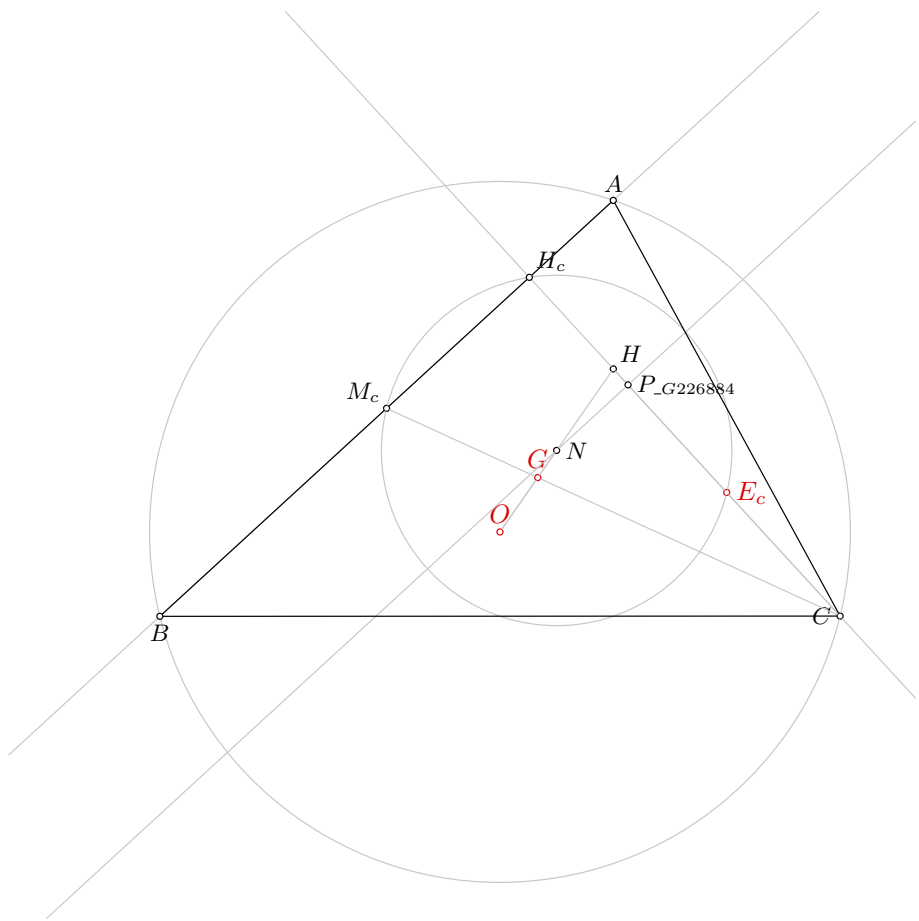

Figure 1: Illustration of the problem 0981

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving G=_G

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving G=_G

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 982

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 982: Given a point E_c, a point G and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 983

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 983: Given a point E_c, a point G and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 984

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 984: Given a point E_c, a point G and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 985

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 985: Given a point H, a point H_a and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point H_a, construct a line h_a (rule W02); % DET: points H and H_a are not the same;
2. Using the point H_a and the line h_a, construct a line a (rule W10a); ;
3. Using the point H, the line a and the point H_a, construct a line $h_{H,1/2}(a)$ (rule W15); ;
4. Choose freely a point E_c on the line $h_{H,1/2}(a)$ (rule WOnline4);
5. Using the point E_c and the point H, construct a point C (rule W01); ;
6. Using the point H and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H and E_c are not the same;
7. Choose freely a point A on the line h_a (rule WOnline1) ;
8. Using the point A and the point C, construct a line b (rule W02); % DET: points A and C are not the same;
9. Using the circle $k(E_c, C)$, the line b, the point E_c and the point C, construct a point H_b (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points C and H_b must be different;
10. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
11. Using the line a and the line h_b, construct a point B (rule W03); % NDG: lines a and h_b are not parallel % DET: lines a and h_b are not the same.

Non-degenerate conditions: lines a and h_b are not parallel; line b and circle $k(E_c, C)$ intersect; points H and E_c are not the same.

Determination conditions: lines a and h_b are not the same; points H_b and H are not the same; points C and H_b must be different; points A and C are not the same; points H and H_a are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,W15,WOnline1,WOnline4]

Lemmas used: [D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,L52,L53]

Solving time: 691.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{a} 80 40
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_rt H
cmark_r H_{a}
cmark_r E_{c}
color 0 0 0
fontsize 8

% DET: points H and H_{a} are not the same
% Constructing a line h_{a} which passes through point H and point H_{a}
line h_{a} H H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Constructing a line a which is perpendicular to line h_{a} and which passes through point H_{a}
perp a H_{a} h_{a}

color 200 200 200
drawline a
color 0 0 0




% Constructing a point P_{\_G66145} such that HP_{\_G66145}/HH_{a}=0.5
towards P_{\_G66145} H H_{a} 0.5
cmark_r P_{\_G66145}
color 200 200 200
drawsegment H H_{a}
color 0 0 0
```

```
% Constructing a line h_{H,1/2}(a) which contains the point P_{\_G66145} and is parallel to the
    line a
parallel h_{H,1/2}(a) P_{\_G66145} a

color 200 200 200
drawline h_{H,1/2}(a)
color 0 0 0




% Constructing a point P_{\_G66452} such that HP_{\_G66452}/HH_{a}=0.5
towards P_{\_G66452} H H_{a} 0.5
cmark_r P_{\_G66452}
color 200 200 200
drawsegment H H_{a}
color 0 0 0

% Generating random value V[_G66391]
random V[_G66391]


% Calculating value V[_G66412] using formula V[_G66391]*20
expression V[_G66412] { V[_G66391]*20 }


% Constructing a point E_{c} which is a point for which holds P_{\_G66452}E_{c} = V[_G66412] and
    angle HP_{\_G66452}E_{c} = 90
turtle E_{c} H P_{\_G66452} 90 V[_G66412]
cmark_r E_{c}



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% NDG: points H and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
circle k(E_{c},C) E_{c} H

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0




% Choosing randomly a point A on the line HH_{a}
online A H H_{a}
cmark_t A
color 200 200 200
```

```
drawline H H_{a}
color 0 0 0


% DET: points A and C are not the same
% Constructing a line b which passes through point A and point C
line b A C

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points C and H_{b} must be different
% Constructing a point P_{\_G67017} which is a foot of the point E_{c} on the line b
foot P_{\_G67017} E_{c} b
cmark_r P_{\_G67017}
color 200 200 200
drawline E_{c} P_{\_G67017}
color 0 0 0

% Constructing a point H_{b} which is an image of the point C in the symmetry to point/line P_{\_G
    67017}
sim H_{b} P_{\_G67017} C
cmark_l H_{b}


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines a and h_{b} are not parallel% DET: lines a and h_{b} are not the same
% Constructing a point B which belongs to line a and line h_{b}
intersec B a h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{b} are not parallel; line b and circle k(E_{c},C)
    intersect; points H and E_{c} are not the same
% Determination conditions: lines a and h_{b} are not the same; points H_{b} and H are not the same
    ; points C and H_{b} must be different; points A and C are not the same; points H and H_{a} are
     not the same
```

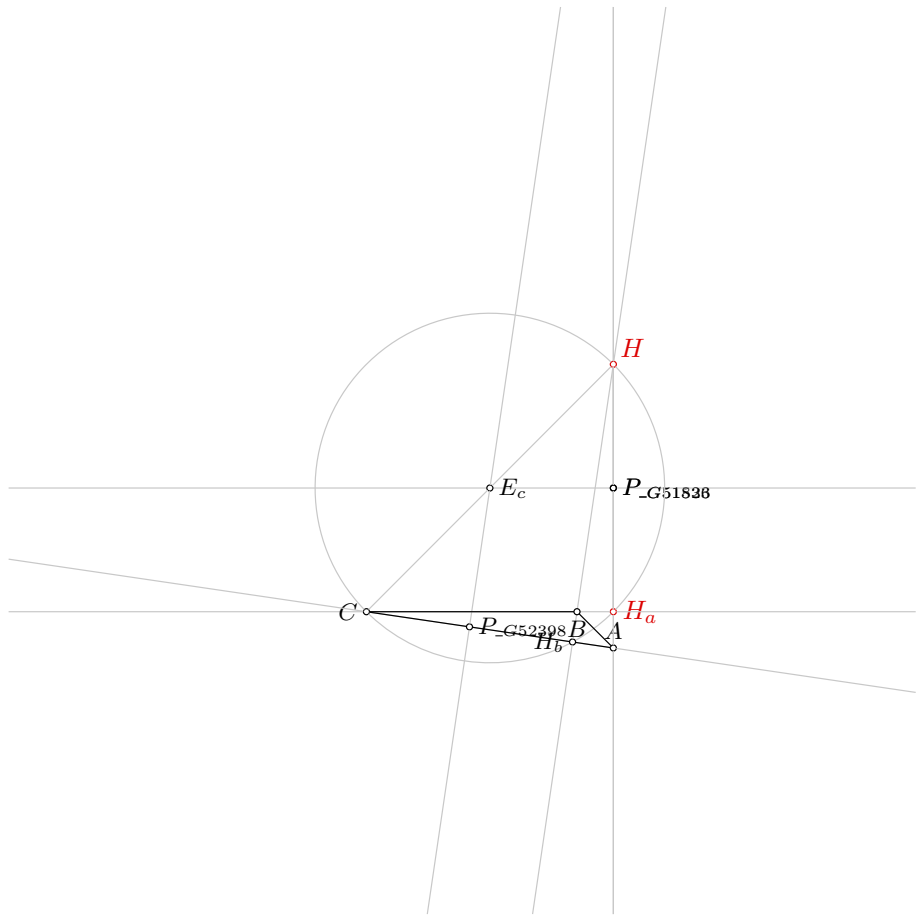

Figure 1: Illustration of the problem 0985

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 986

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 986: Given a point H, a point H_b and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
2. Using the point H_b and the line h_b, construct a line b (rule W10a); ;
3. Using the point H, the line b and the point H_b, construct a line $h_{H,1/2}(b)$ (rule W15); ;
4. Choose freely a point E_c on the line $h_{H,1/2}(b)$ (rule WOnline4);
5. Using the point E_c and the point H, construct a point C (rule W01); ;
6. Using the point H and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H and E_c are not the same;
7. Choose freely a point A on the line b (rule WOnline1) ;
8. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
9. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H and H_a must be different;
10. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;
11. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; line h_a and circle $k(E_c, C)$ intersect; points H and E_c are not the same.

Determination conditions: lines h_b and a are not the same; points C and H_a are not the same; points H and H_a must be different; points A and H are not the same; points H and H_b are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,W15,WOnline1,WOnline4]

Lemmas used: [D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,L52,L54]

Solving time: 697.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{b} 89.36 77.83
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_rt H
cmark_l H_{b}
cmark_r E_{c}
color 0 0 0
fontsize 8

% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0




% Constructing a line b which is perpendicular to line h_{b} and which passes through point H_{b}
perp b H_{b} h_{b}

color 200 200 200
drawline b
color 0 0 0




% Constructing a point P_{\_G98364} such that HP_{\_G98364}/HH_{b}=0.5
towards P_{\_G98364} H H_{b} 0.5
cmark_r P_{\_G98364}
color 200 200 200
drawsegment H H_{b}
color 0 0 0
```

```
% Constructing a line h_{H,1/2}(b) which contains the point P_{\_G98364} and is parallel to the
    line b
parallel h_{H,1/2}(b) P_{\_G98364} b

color 200 200 200
drawline h_{H,1/2}(b)
color 0 0 0




% Constructing a point P_{\_G98671} such that HP_{\_G98671}/HH_{b}=0.5
towards P_{\_G98671} H H_{b} 0.5
cmark_r P_{\_G98671}
color 200 200 200
drawsegment H H_{b}
color 0 0 0

% Generating random value V[_G98610]
random V[_G98610]


% Calculating value V[_G98631] using formula V[_G98610]*20
expression V[_G98631] { V[_G98610]*20 }


% Constructing a point E_{c} which is a point for which holds P_{\_G98671}E_{c} = V[_G98631] and
    angle HP_{\_G98671}E_{c} = 90
turtle E_{c} H P_{\_G98671} 90 V[_G98631]
cmark_r E_{c}



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% NDG: points H and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
circle k(E_{c},C) E_{c} H

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0




% Choosing randomly a point A on the line H_{b}C
online A H_{b} C
cmark_t A
color 200 200 200
```

```
drawline H_{b} C
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G99236} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G99236} E_{c} h_{a}
cmark_r P_{\_G99236}
color 200 200 200
drawline E_{c} P_{\_G99236}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    99236}
sim H_{a} P_{\_G99236} H
cmark_r H_{a}


% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; line h_{a} and circle k(E_{c},C)
    intersect; points H and E_{c} are not the same
% Determination conditions: lines h_{b} and a are not the same; points C and H_{a} are not the same
    ; points H and H_{a} must be different; points A and H are not the same; points H and H_{b} are
     not the same
```

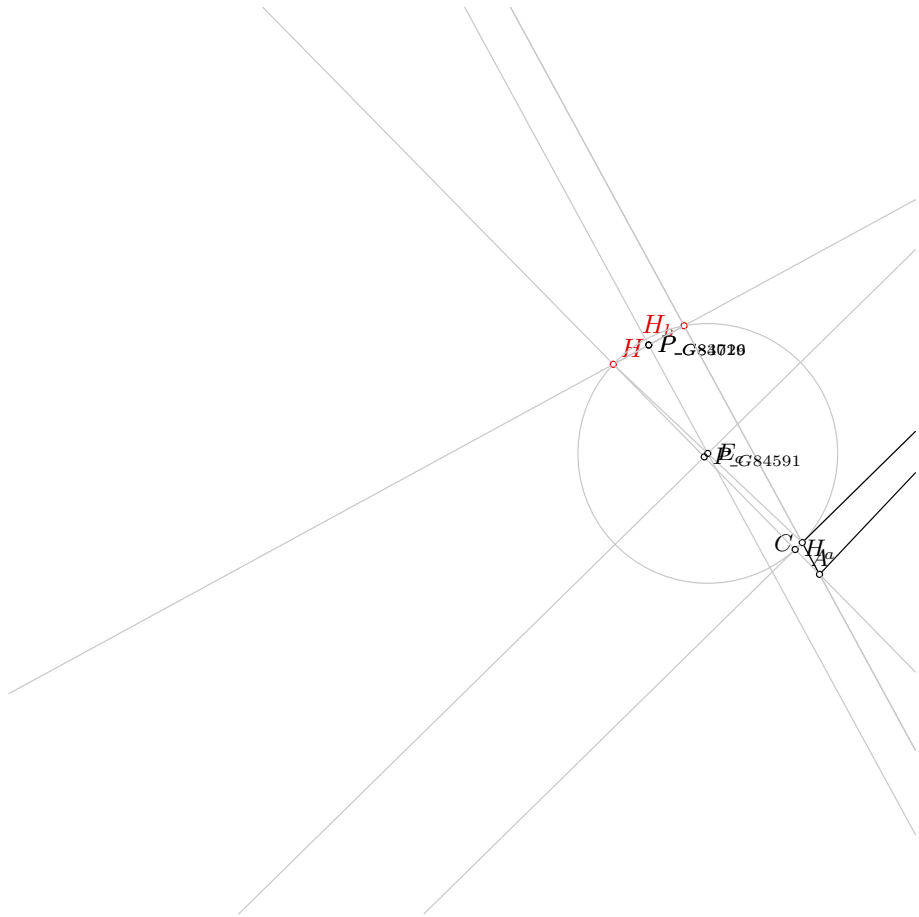

Figure 1: Illustration of the problem 0986

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Construction steps:

- Free point H
- Free point H_b
- Line h_b through two points H and H_b
- Line b through point H_b perpendicular to line h_b
- Segment division point $P_{\_G93517}$ of segment HH_b with division coefficient 1.0

- Line $h_{H,1/2}(b)$ through point $P_{\_G93517}$ parallel with line b
- Segment division point $P_{\_G93649}$ of segment HH_b with division coefficient -0.5
- Line $L_{\_G93652}$ through point $P_{\_G93649}$ parallel with line $h_{H,1/2}(b)$
- Random point E_c from line $L_{\_G93652}$
- Segment division point C of segment E_cH with division coefficient -0.5
- Circle $k(E_c, C)$ with center E_c and one point H
- Random point A from line b
- Line h_a through two points A and H
- Line footPointPerpLine586 through point E_c perpendicular to line h_a
- Intersection point $P_{\_G93911}$ of point sets footPointPerpLine586 and h_a
- Cental symmetric point H_a of point H with respect to center of symmetry $P_{\_G93911}$
- Line a through two points C and H_a
- Intersection point B of point sets h_b and a
- Line $\_b$ through two points A and C
- Line $\_a$ through two points B and C
- Line $\_h_a$ through point A perpendicular to line $\_a$
- Line $\_h_b$ through point B perpendicular to line $\_b$
- Intersection point $\_H$ of point sets $\_h_a$ and $\_h_b$
- Intersection point $\_H_b$ of point sets $\_b$ and $\_h_b$

Theorem statement:

- Points H and $\_H$ are identical

Info: Attempting to add the construction of new random point tempPoint-368$h_{H,1/2}(b)$ necessary for completion of construction of line $L_{\_G93652}$

Warrning: Generated new random point tempPoint-368$h_{H,1/2}(b)$ on line $h_{H,1/2}(b)$ in order to complete the construction of parallel line $L_{\_G93652}$

Validation result: Theorem protocol is valid.

NDG conditions Point H has been assigned following coordinates: (0, 0)

4.1.2 Proving H_b=$\_H_b$

Construction steps:

- Free point H
- Free point H_b
- Line h_b through two points H and H_b
- Line b through point H_b perpendicular to line h_b
- Segment division point $P_{\_G94773}$ of segment HH_b with division coefficient 1.0
- Line $h_{H,1/2}(b)$ through point $P_{\_G94773}$ parallel with line b
- Segment division point $P_{\_G94905}$ of segment HH_b with division coefficient -0.5
- Line $L_{\_G94908}$ through point $P_{\_G94905}$ parallel with line $h_{H,1/2}(b)$
- Random point E_c from line $L_{\_G94908}$
- Segment division point C of segment E_cH with division coefficient -0.5
- Circle $k(E_c, C)$ with center E_c and one point H

- Random point A from line b
- Line h_a through two points A and H
- Line footPointPerpLine359 through point E_c perpendicular to line h_a
- Intersection point $P_{\_G95167}$ of point sets footPointPerpLine359 and h_a
- Cental symmetric point H_a of point H with respect to center of symmetry $P_{\_G95167}$
- Line a through two points C and H_a
- Intersection point B of point sets h_b and a
- Line $\_b$ through two points A and C
- Line $\_a$ through two points B and C
- Line $\_h_a$ through point A perpendicular to line $\_a$
- Line $\_h_b$ through point B perpendicular to line $\_b$
- Intersection point $\_H$ of point sets $\_h_a$ and $\_h_b$
- Intersection point $\_H_b$ of point sets $\_b$ and $\_h_b$

Theorem statement:

- Points H_b and $\_H_b$ are identical

Info: Attempting to add the construction of new random point tempPoint-206$h_{H,1/2}(b)$ necessary for completion of construction of line $L_{\_G94908}$

Warrning: Generated new random point tempPoint-206$h_{H,1/2}(b)$ on line $h_{H,1/2}(b)$ in order to complete the construction of parallel line $L_{\_G94908}$

Validation result: Theorem protocol is valid.

NDG conditions Point H has been assigned following coordinates: (0, 0)

4.1.3 Proving E_c=$\_E_c$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=$\_H$

Proving failed

4.2.2 Proving H_b=$\_H_b$

Proving failed

4.2.3 Proving E_c=$\_E_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=$\_H$

Proving failed

4.3.2 Proving H_b=$\_H_b$

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 987

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 987: Given a point H, a point H_c and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
2. Choose freely a point E_c on the line h_c (rule WOnline1) ;
3. Using the point E_c and the point H, construct a point C (rule W01); ;
4. Using the point H and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H and E_c are not the same;
5. Using the point H_c and the line h_c, construct a line c (rule W10a); ;
6. Choose freely a point A on the line c (rule WOnline2);
7. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
8. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H and H_a must be different;
9. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;
10. Using the line c and the line a, construct a point B (rule W03); % NDG: lines c and a are not parallel % DET: lines c and a are not the same.

Non-degenerate conditions: lines c and a are not parallel; line h_a and circle $k(E_c, C)$ intersect; points H and E_c are not the same.

Determination conditions: lines c and a are not the same; points C and H_a are not the same; points H and H_a must be different; points A and H are not the same; points H and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06,W10a,WOnline1,WOnline2]

Lemmas used: [D10,D3,D30,D5,D7,D8,GD01,GD02,GL03,GL04,L3,L52,L54]

Solving time: 170.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{c} 68.91 84.83
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_rt H
cmark_rt H_{c}
cmark_r E_{c}
color 0 0 0
fontsize 8

% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0




% Choosing randomly a point E_{c} on the line HH_{c}
online E_{c} H H_{c}
cmark_r E_{c}
color 200 200 200
drawline H H_{c}
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0
```

```
% NDG: points H and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
circle k(E_{c},C) E_{c} H

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0




% Constructing a line c which is perpendicular to line h_{c} and which passes through point H_{c}
perp c H_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0




% Generating random value V[_G127647]
random V[_G127647]


% Calculating value V[_G127668] using formula V[_G127647]*20
expression V[_G127668] { V[_G127647]*20 }


% Constructing a point A which is a point for which holds H_{c}A = V[_G127668] and angle E_{c}H_{c}
    A = 90
turtle A E_{c} H_{c} 90 V[_G127668]
cmark_t A


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G127940} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G127940} E_{c} h_{a}
cmark_r P_{\_G127940}
color 200 200 200
drawline E_{c} P_{\_G127940}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    127940}
sim H_{a} P_{\_G127940} H
```

```
cmark_r H_{a}


% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines c and a are not parallel% DET: lines c and a are not the same
% Constructing a point B which belongs to line c and line a
intersec B c a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and a are not parallel; line h_{a} and circle k(E_{c},C)
    intersect; points H and E_{c} are not the same
% Determination conditions: lines c and a are not the same; points C and H_{a} are not the same;
    points H and H_{a} must be different; points A and H are not the same; points H and H_{c} are
    not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 91 terms.

Time Complexity: Time spent by the prover is 0.736 seconds.

NDG conditions Points A and H are not identical

Points B and H are not identical

Line through points H_c and C is not perpendicular to line through points C and H

Points A, B and C are not collinear

Line through points E_c and A is not perpendicular to line through points A and H

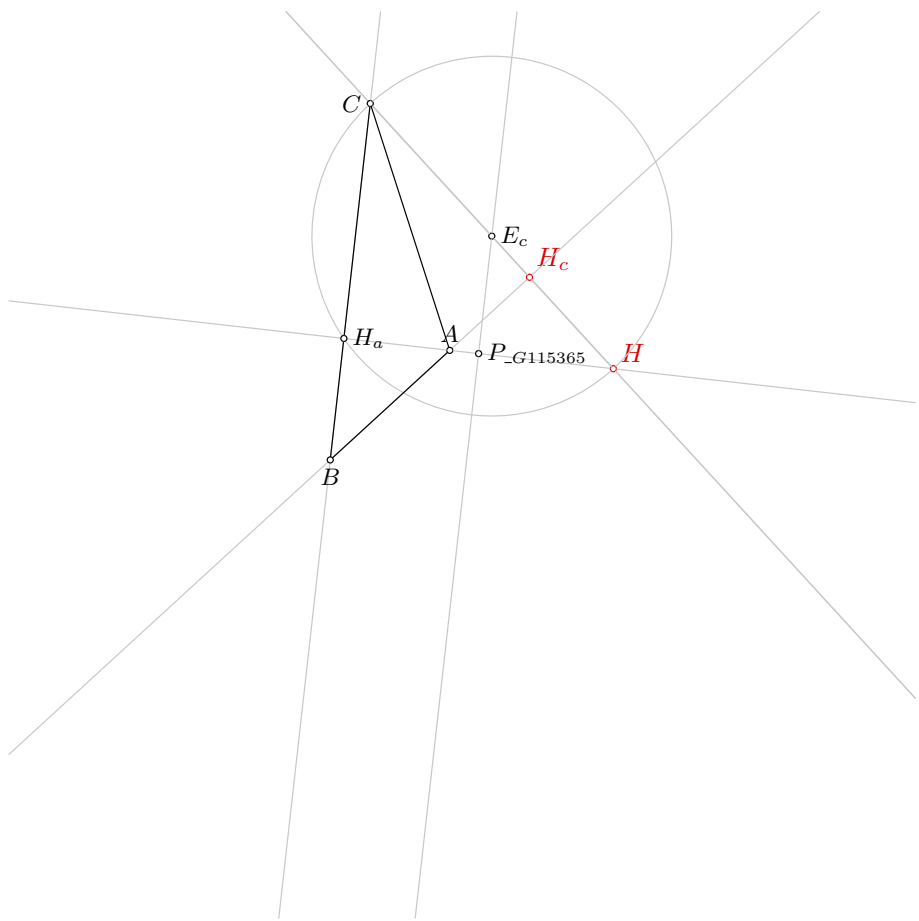

Figure 1: Illustration of the problem 0987

4.1.2 Proving H_c=_H_c

Status: Theorem has been proved.
Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.
Time Complexity: Time spent by the prover is 0.159 seconds.
NDG conditions Points A and H are not identical
Points B and H are not identical
Line through points H_c and C is not perpendicular to line through points C and H
Points A, B and H are not collinear

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Status: The conjecture has not been proved nor disproved.
Space Complexity: The biggest polynomial obtained during proof process contained 6 terms.
Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.2 Proving H_c=_H_c

Status: The conjecture has not been proved nor disproved.
Space Complexity: The biggest polynomial obtained during proof process contained 6 terms.
Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.3.3 Proving E_c=_E_c

Status: The conjecture has not been proved nor disproved.
Space Complexity: The biggest polynomial obtained during proof process contained 13 terms.
Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Status: The conjecture has not been proved nor disproved.
Space Complexity: The biggest polynomial obtained during proof process contained 4 terms.
Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

4.4.2 Proving H_c=_H_c

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 5 terms.

Time Complexity: Time spent by the prover is 0.000 seconds.There are no ndg conditions.

4.4.3 Proving E_c=_E_c

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 6 terms.

Time Complexity: Time spent by the prover is 0.010 seconds.There are no ndg conditions.

Problem 988

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 988: Given a point E_c, a point H and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 989

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 989: Given a point E_c, a point H and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H, construct a point C (rule W01); ;
2. Using the point M_a and the point C, construct a point B (rule W01); ;
3. Using the point H and the point B, construct a line h_b (rule W02); % DET: points H and B are not the same;
4. Using the point M_a and the point C, construct a line a (rule W02); % DET: points M_a and C are not the same;
5. Using the point H and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H and E_c are not the same;
6. Using the circle $k(E_c, C)$, the line h_b, the point E_c and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_c, C)$ intersect % DET: points H and H_b must be different;
7. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
8. Using the circle $k(E_c, C)$, the line a, the point E_c and the point C, construct a point H_a (rule W05); % NDG: line a and circle $k(E_c, C)$ intersect % DET: points C and H_a must be different;
9. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
10. Using the line b and the line h_a, construct a point A (rule W03); % NDG: lines b and h_a are not parallel % DET: lines b and h_a are not the same.

Non-degenerate conditions: lines b and h_a are not parallel; line a and circle $k(E_c, C)$ intersect; line h_b and circle $k(E_c, C)$ intersect; points H and E_c are not the same.

Determination conditions: lines b and h_a are not the same; points H_a and H are not the same; points C and H_a must be different; points H_b and C are not the same; points H and H_b must be different; points M_a and C are not the same; points H and B are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D21,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 12.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H 80 72.73
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H
cmark_r M_{a}
color 0 0 0
fontsize 8


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0


% DET: points H and B are not the same
% Constructing a line h_{b} which passes through point H and point B
line h_{b} H B

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% DET: points M_{a} and C are not the same
% Constructing a line a which passes through point M_{a} and point C
line a M_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: points H and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
circle k(E_{c},C) E_{c} H

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line h_{b} and circle k(E_{c},C) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G163950} which is a foot of the point E_{c} on the line h_{b}
foot P_{\_G163950} E_{c} h_{b}
cmark_r P_{\_G163950}
color 200 200 200
drawline E_{c} P_{\_G163950}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    163950}
sim H_{b} P_{\_G163950} H
cmark_l H_{b}


% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% NDG: line a and circle k(E_{c},C) intersect% DET: points C and H_{a} must be different
% Constructing a point P_{\_G164188} which is a foot of the point E_{c} on the line a
foot P_{\_G164188} E_{c} a
cmark_r P_{\_G164188}
color 200 200 200
drawline E_{c} P_{\_G164188}
color 0 0 0

% Constructing a point H_{a} which is an image of the point C in the symmetry to point/line P_{\_G
    164188}
sim H_{a} P_{\_G164188} C
cmark_r H_{a}
```

```
% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines b and h_{a} are not parallel% DET: lines b and h_{a} are not the same
% Constructing a point A which belongs to line b and line h_{a}
intersec A b h_{a}
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{a} are not parallel; line a and circle k(E_{c},C)
    intersect; line h_{b} and circle k(E_{c},C) intersect; points H and E_{c} are not the same
% Determination conditions: lines b and h_{a} are not the same; points H_{a} and H are not the same
    ; points C and H_{a} must be different; points H_{b} and C are not the same; points H and H_{b}
     must be different; points M_{a} and C are not the same; points H and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.109 seconds.

NDG conditions There are no NDG conditions for this theorem

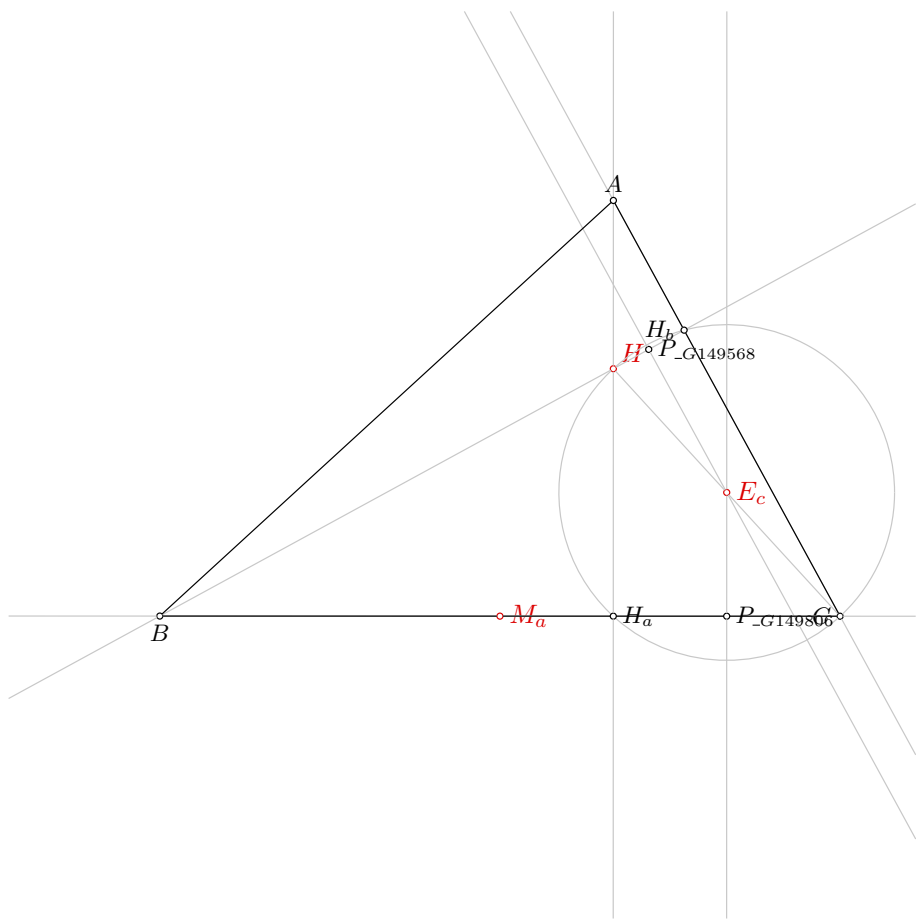

Figure 1: Illustration of the problem 0989

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving M_a=_M_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 2602 terms.

Time Complexity: Time spent by the prover is 14.230 seconds.There are no ndg conditions.

4.3.2 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 494 terms.

Time Complexity: Time spent by the prover is 0.420 seconds.There are no ndg conditions.

4.3.3 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 990

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 990: Given a point E_c, a point H and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H, construct a point C (rule W01); ;
2. Using the point M_b and the point C, construct a point A (rule W01); ;
3. Using the point H and the point A, construct a line h_a (rule W02); % DET: points H and A are not the same;
4. Using the point M_b and the point C, construct a line b (rule W02); % DET: points M_b and C are not the same;
5. Using the point H and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H and E_c are not the same;
6. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H and H_a must be different;
7. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
8. Using the circle $k(E_c, C)$, the line b, the point E_c and the point C, construct a point H_b (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points C and H_b must be different;
9. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
10. Using the line a and the line h_b, construct a point B (rule W03); % NDG: lines a and h_b are not parallel % DET: lines a and h_b are not the same.

Non-degenerate conditions: lines a and h_b are not parallel; line b and circle $k(E_c, C)$ intersect; line h_a and circle $k(E_c, C)$ intersect; points H and E_c are not the same.

Determination conditions: lines a and h_b are not the same; points H_b and H are not the same; points C and H_b must be different; points H_a and C are not the same; points H and H_a must be different; points M_b and C are not the same; points H and A are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D22,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 12.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H 80 72.73
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H
cmark_lt M_{b}
color 0 0 0
fontsize 8


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point A such that M_{b}A/M_{b}C=-1
towards A M_{b} C -1
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0


% DET: points H and A are not the same
% Constructing a line h_{a} which passes through point H and point A
line h_{a} H A

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% DET: points M_{b} and C are not the same
% Constructing a line b which passes through point M_{b} and point C
line b M_{b} C

color 200 200 200
drawline b
color 0 0 0



% NDG: points H and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
circle k(E_{c},C) E_{c} H

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G193955} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G193955} E_{c} h_{a}
cmark_r P_{\_G193955}
color 200 200 200
drawline E_{c} P_{\_G193955}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    193955}
sim H_{a} P_{\_G193955} H
cmark_r H_{a}


% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points C and H_{b} must be different
% Constructing a point P_{\_G194193} which is a foot of the point E_{c} on the line b
foot P_{\_G194193} E_{c} b
cmark_r P_{\_G194193}
color 200 200 200
drawline E_{c} P_{\_G194193}
color 0 0 0

% Constructing a point H_{b} which is an image of the point C in the symmetry to point/line P_{\_G
    194193}
sim H_{b} P_{\_G194193} C
cmark_l H_{b}
```

```
% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines a and h_{b} are not parallel% DET: lines a and h_{b} are not the same
% Constructing a point B which belongs to line a and line h_{b}
intersec B a h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{b} are not parallel; line b and circle k(E_{c},C)
    intersect; line h_{a} and circle k(E_{c},C) intersect; points H and E_{c} are not the same
% Determination conditions: lines a and h_{b} are not the same; points H_{b} and H are not the same
    ; points C and H_{b} must be different; points H_{a} and C are not the same; points H and H_{a}
     must be different; points M_{b} and C are not the same; points H and A are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.117 seconds.

NDG conditions There are no NDG conditions for this theorem

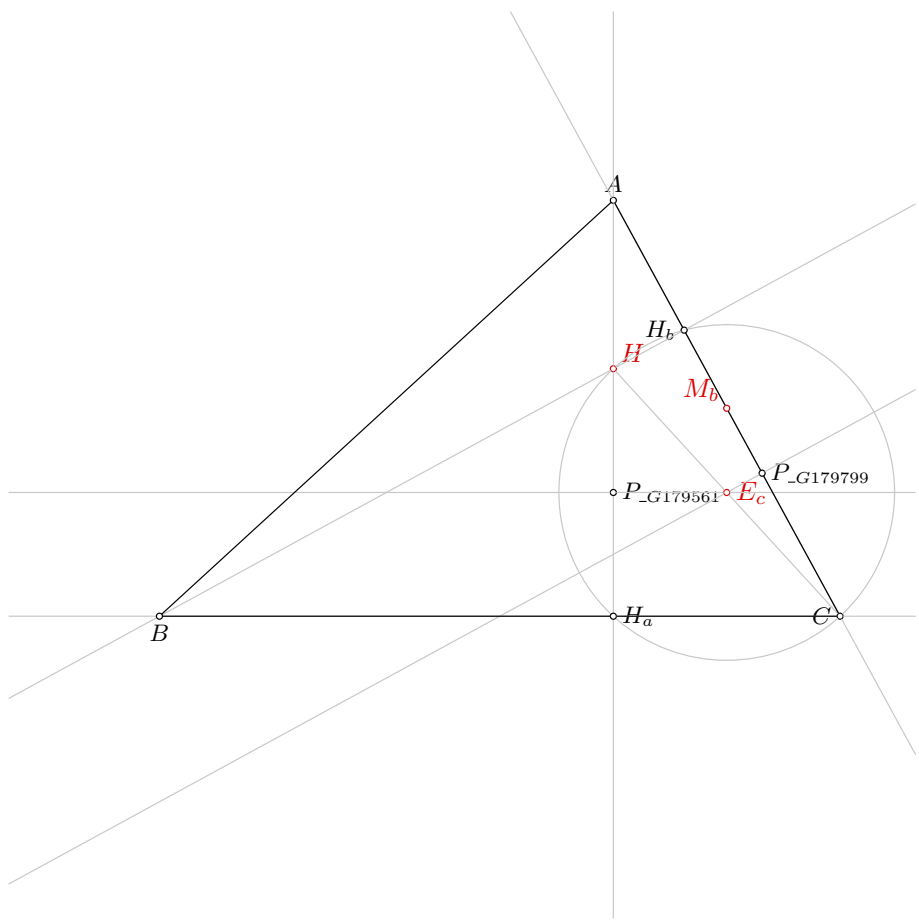

Figure 1: Illustration of the problem 0990

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving M_b=_M_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 1656 terms.

Time Complexity: Time spent by the prover is 10.840 seconds.There are no ndg conditions.

4.3.2 Proving H=_H

Status: The conjecture has been disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 333 terms.

Time Complexity: Time spent by the prover is 0.630 seconds.There are no ndg conditions.

4.3.3 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.030 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 991

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 991: Given a point E_c, a point H and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H, construct a point C (rule W01); ;
2. Using the point M_c and the point C, construct a point G (rule W01); ;
3. Using the point H and the point G, construct a point N (rule W01); ;
4. Using the point H and the point G, construct a point O (rule W01); ;
5. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
6. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points E_c and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L16,L21,L24,L3,L57,L58]

Solving time: 7.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H 80 72.73
point M_{c} 50 67.5

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H
cmark_lt M_{c}
color 0 0 0
fontsize 8


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a line L_{\_G224262} which passes through point M_{c} and point C
line L_{\_G224262} M_{c} C

color 200 200 200
drawline L_{\_G224262}
color 0 0 0


% Constructing a point P_{\_G224363} with coordinates (0,0)
point P_{\_G224363} 0 0
cmark_r P_{\_G224363}

% Constructing a point P_{\_G224287} such that M_{c}P_{\_G224287}/M_{c}P_{\_G224363}=1
towards P_{\_G224287} M_{c} P_{\_G224363} 1
cmark_r P_{\_G224287}
color 200 200 200
drawsegment M_{c} P_{\_G224287}
color 0 0 0
```

```
% Constructing a point P_{\_G224332} such that M_{c}P_{\_G224332}/M_{c}P_{\_G224363}=3
towards P_{\_G224332} M_{c} P_{\_G224363} 3
cmark_r P_{\_G224332}
color 200 200 200
drawsegment M_{c} P_{\_G224332}
color 0 0 0

% Constructing a line L_{\_G224293} which passes through point C and point P_{\_G224332}
line L_{\_G224293} C P_{\_G224332}

color 200 200 200
drawline L_{\_G224293}
color 0 0 0


% Constructing a line L_{\_G224256} which contains the point P_{\_G224287} and is parallel to the
    line L_{\_G224293}
parallel L_{\_G224256} P_{\_G224287} L_{\_G224293}

color 200 200 200
drawline L_{\_G224256}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G224256} and line L_{\_G224262}
intersec G L_{\_G224256} L_{\_G224262}
cmark_t G



% Constructing a point N such that HN/HG=0.75
towards N H G 0.75
cmark_r N
color 200 200 200
drawsegment H G
color 0 0 0



% Constructing a point O such that HO/HG=1.5
towards O H G 1.5
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G225282} which is a foot of the point N on the line h_{c}
foot P_{\_G225282} N h_{c}
cmark_r P_{\_G225282}
color 200 200 200
drawline N P_{\_G225282}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G225282}
sim H_{c} P_{\_G225282} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

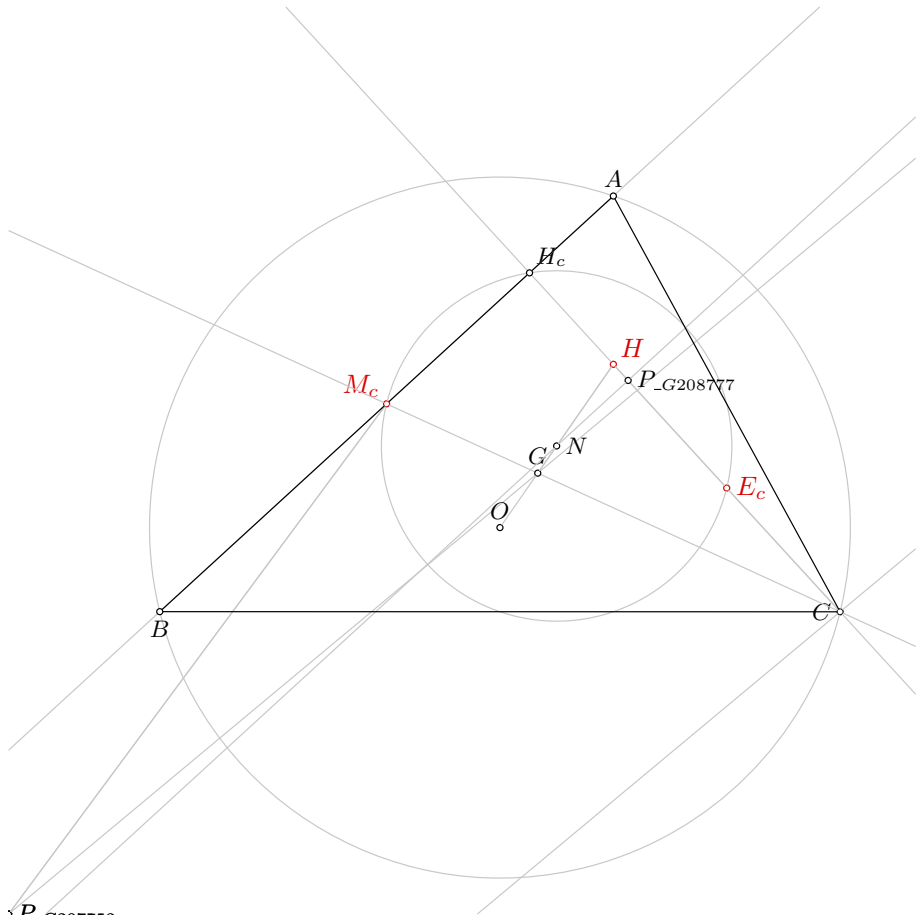

Figure 1: Illustration of the problem 0991

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points E_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving M_c=_M_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving M_c=_M_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 992

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 992: Given a point E_c, a point H and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H, construct a point C (rule W01); ;
2. Using the point H and the point N, construct a point O (rule W01); ;
3. Using the point H and the point N, construct a point G (rule W01); ;
4. Using the point C and the point G, construct a point M_c (rule W01); ;
5. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
6. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points E_c and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L16,L21,L24,L3,L57]

Solving time: 7.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H 80 72.73
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G41772} which passes through point H and point N
line L_{\_G41772} H N

color 200 200 200
drawline L_{\_G41772}
color 0 0 0


% Constructing a point P_{\_G41873} with coordinates (0,0)
point P_{\_G41873} 0 0
```

```
cmark_r P_{\_G41873}

% Constructing a point P_{\_G41797} such that HP_{\_G41797}/HP_{\_G41873}=4
towards P_{\_G41797} H P_{\_G41873} 4
cmark_r P_{\_G41797}
color 200 200 200
drawsegment H P_{\_G41797}
color 0 0 0

% Constructing a point P_{\_G41842} such that HP_{\_G41842}/HP_{\_G41873}=3
towards P_{\_G41842} H P_{\_G41873} 3
cmark_r P_{\_G41842}
color 200 200 200
drawsegment H P_{\_G41842}
color 0 0 0

% Constructing a line L_{\_G41803} which passes through point N and point P_{\_G41842}
line L_{\_G41803} N P_{\_G41842}

color 200 200 200
drawline L_{\_G41803}
color 0 0 0


% Constructing a line L_{\_G41766} which contains the point P_{\_G41797} and is parallel to the
    line L_{\_G41803}
parallel L_{\_G41766} P_{\_G41797} L_{\_G41803}

color 200 200 200
drawline L_{\_G41766}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G41766} and line L_{\_G41772}
intersec G L_{\_G41766} L_{\_G41772}
cmark_t G



% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G42709} which is a foot of the point N on the line h_{c}
foot P_{\_G42709} N h_{c}
cmark_r P_{\_G42709}
color 200 200 200
drawline N P_{\_G42709}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G42709}
sim H_{c} P_{\_G42709} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

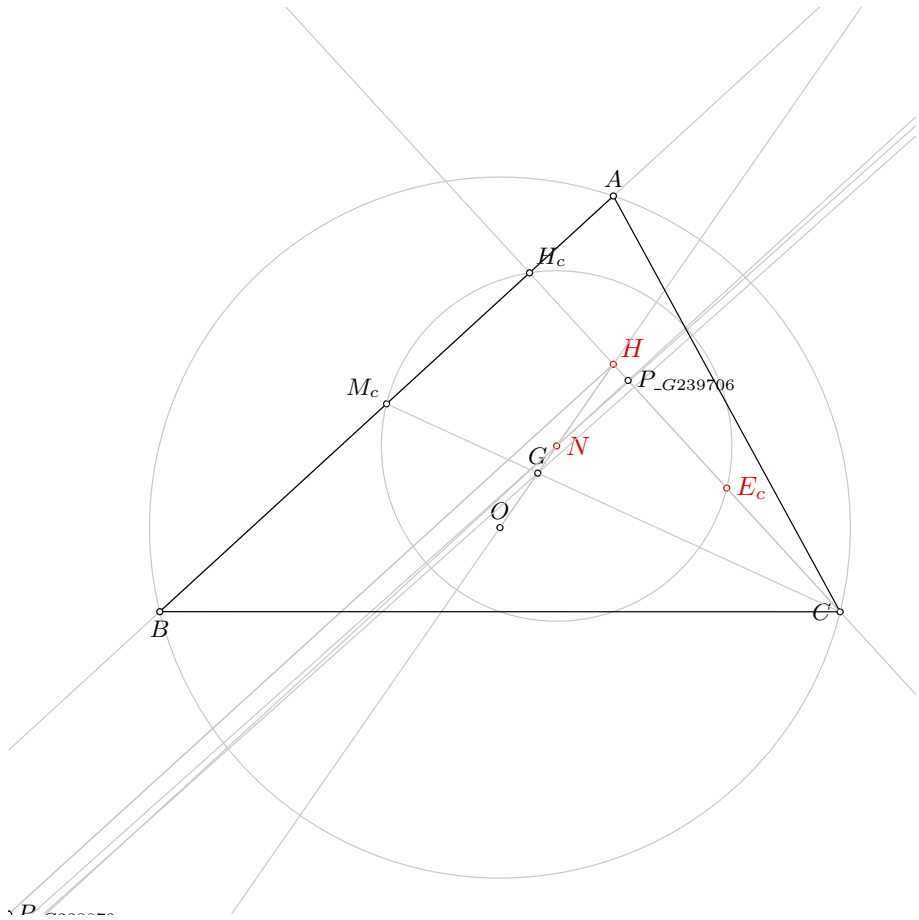

Figure 1: Illustration of the problem 0992

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points E_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 993

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 993: Given a point E_c, a point H and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H, construct a point C (rule W01); ;
2. Using the point H and the point O, construct a point N (rule W01); ;
3. Using the point H and the point O, construct a point G (rule W01); ;
4. Using the point C and the point G, construct a point M_c (rule W01); ;
5. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
6. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points E_c and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L21,L24,L3,L57,L58]

Solving time: 7.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H 80 72.73
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H
cmark_t O
color 0 0 0
fontsize 8


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point N such that HN/HO=0.5
towards N H O 0.5
cmark_r N
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G77794} which passes through point H and point O
line L_{\_G77794} H O

color 200 200 200
drawline L_{\_G77794}
color 0 0 0


% Constructing a point P_{\_G77895} with coordinates (0,0)
point P_{\_G77895} 0 0
```

```
cmark_r P_{\_G77895}

% Constructing a point P_{\_G77819} such that HP_{\_G77819}/HP_{\_G77895}=2
towards P_{\_G77819} H P_{\_G77895} 2
cmark_r P_{\_G77819}
color 200 200 200
drawsegment H P_{\_G77819}
color 0 0 0

% Constructing a point P_{\_G77864} such that HP_{\_G77864}/HP_{\_G77895}=3
towards P_{\_G77864} H P_{\_G77895} 3
cmark_r P_{\_G77864}
color 200 200 200
drawsegment H P_{\_G77864}
color 0 0 0

% Constructing a line L_{\_G77825} which passes through point O and point P_{\_G77864}
line L_{\_G77825} O P_{\_G77864}

color 200 200 200
drawline L_{\_G77825}
color 0 0 0


% Constructing a line L_{\_G77788} which contains the point P_{\_G77819} and is parallel to the
    line L_{\_G77825}
parallel L_{\_G77788} P_{\_G77819} L_{\_G77825}

color 200 200 200
drawline L_{\_G77788}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G77788} and line L_{\_G77794}
intersec G L_{\_G77788} L_{\_G77794}
cmark_t G



% Constructing a point M_{c} such that CM_{c}/CG=1.5
towards M_{c} C G 1.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G78731} which is a foot of the point N on the line h_{c}
foot P_{\_G78731} N h_{c}
cmark_r P_{\_G78731}
color 200 200 200
drawline N P_{\_G78731}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G78731}
sim H_{c} P_{\_G78731} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

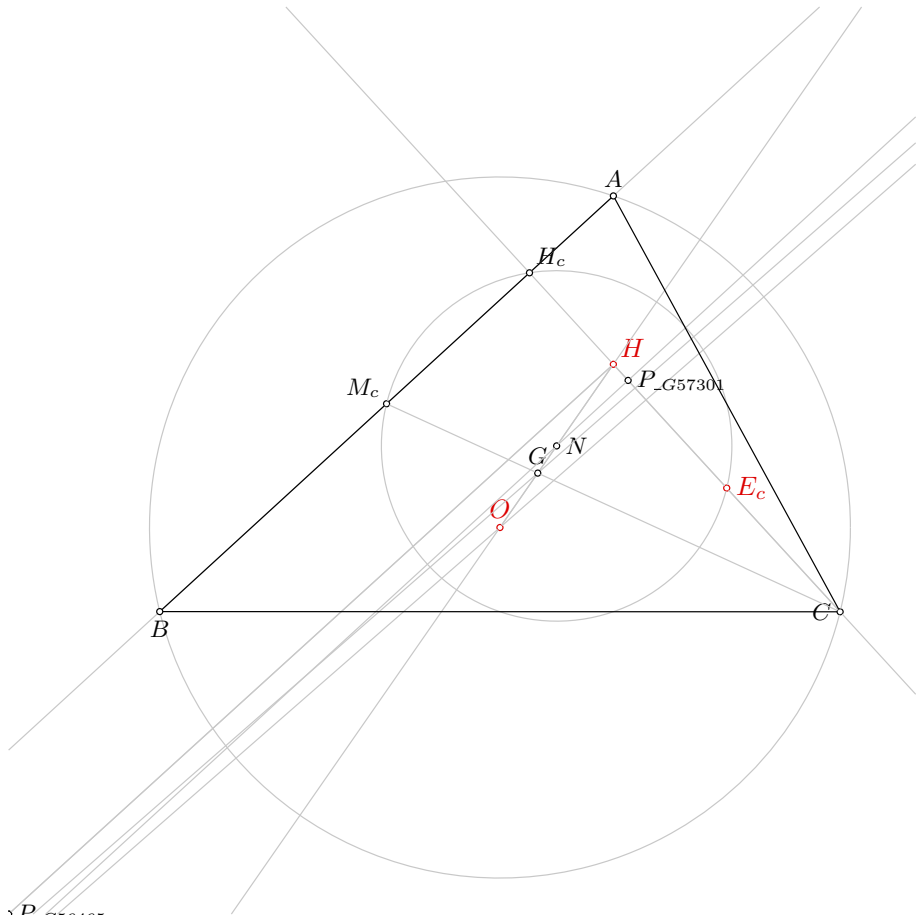

Figure 1: Illustration of the problem 0993

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points E_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 994

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 994: Given a point E_c, a point H and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 995

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 995: Given a point E_c, a point H and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 996

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 996: Given a point E_c, a point H and a point T_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H, construct a point C (rule W01); ;
2. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
3. Using the point T_c and the point C, construct a line s_c (rule W02); % DET: points T_c and C are not the same;
4. Using the point T_c and the line h_c, construct a line c (rule W10a); ;
5. Using the line c and the line h_c, construct a point H_c (rule W03); % NDG: lines c and h_c are not parallel % DET: lines c and h_c are not the same;
6. Using the point H and the point H_c, construct a line $m(HH_c)$ (rule W14); % DET: points H and H_c are not the same;
7. Using the point E_c, the point C, the point T_c, the line s_c and the line h_c, construct a line CO (rule W17); % NDG: points C and T_c are not the same; points E_c and C are not the same % DET: points C and T_c are not the same;
8. Using the point E_c and the line CO, construct a line $m(H_bH_a)$ (rule W16); ;
9. Using the line $m(H_bH_a)$ and the line c, construct a point M_c (rule W03); % NDG: lines $m(H_bH_a)$ and c are not parallel % DET: lines $m(H_bH_a)$ and c are not the same;
10. Using the point M_c and the point C, construct a point G (rule W01); ;
11. Using the point H and the point G, construct a point N (rule W01); ;

12. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;

13. Using the circle $k(N, M_a)$ and the line $m(HH_c)$, construct a point E_a and a point E_b (rule W04); % NDG: line $m(HH_c)$ and circle $k(N, M_a)$ intersect;

14. Using the point E_a and the point H, construct a point A (rule W01); ;

15. Using the point H and the point E_b, construct a point B (rule W01); .

Non-degenerate conditions: line $m(HH_c)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same; lines $m(H_bH_a)$ and c are not parallel; points C and T_c are not the same; points E_c and C are not the same; lines c and h_c are not parallel.

Determination conditions: lines $m(H_bH_a)$ and c are not the same; points C and T_c are not the same; points H and H_c are not the same; lines c and h_c are not the same; points T_c and C are not the same; points E_c and H are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W14,W16,W17]

Lemmas used: [D10,D20,D25,D28,D29,D30,D32,D7,GD01,GD02,GL01,GL03,GL04,GL09,GL17,L106,L16,L22,

Solving time: 124.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H 80 72.73
point T_{c} 55.38 72.43

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H
cmark_rt T_{c}
color 0 0 0
fontsize 8


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% DET: points T_{c} and C are not the same
% Constructing a line s_{c} which passes through point T_{c} and point C
line s_{c} T_{c} C

color 200 200 200
drawline s_{c}
color 0 0 0



% Constructing a line c which is perpendicular to line h_{c} and which passes through point T_{c}
perp c T_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines c and h_{c} are not parallel% DET: lines c and h_{c} are not the same
% Constructing a point H_{c} which belongs to line c and line h_{c}
intersec H_{c} c h_{c}
cmark_rt H_{c}


% DET: points H and H_{c} are not the same
% Constructing bisector m(HH_{c}) of the segment HH_{c}
med m(HH_{c}) H H_{c}

color 200 200 200
drawline m(HH_{c})
color 0 0 0

color 200 200 200
drawsegment H H_{c}
color 0 0 0


% NDG: points C and T_{c} are not the same; points E_{c} and C are not the same% DET: points C and
    T_{c} are not the same
% Constructing an angle V[_G133255] which is equal to the angle E_{c}CT_{c}
angle_o V[_G133255] E_{c} C T_{c}


% Calculating value angle[_G133334] using formula 1/pow(2,0)*V[_G133255]+0/pow(2,0)*180
expression angle[_G133334] { 1/pow(2,0)*V[_G133255]+0/pow(2,0)*180 }


% Constructing a point P_{\_G133331} which is an image of the point T_{c} in a rotation around the
    point C for the angle 1/pow(2,0)*V[_G133255]+0/pow(2,0)*180
rotate P_{\_G133331} C angle[_G133334] T_{c}
cmark_r P_{\_G133331}
```

```
color 200 200 200
drawarc_p C T_{c} angle[_G133334]
color 0 0 0

% Constructing a line CO which passes through point C and point P_{\_G133331}
line CO C P_{\_G133331}

color 200 200 200
drawline CO
color 0 0 0



% Constructing a line m(H_{b}H_{a}) which contains the point E_{c} and is parallel to the line CO
parallel m(H_{b}H_{a}) E_{c} CO

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: lines m(H_{b}H_{a}) and c are not parallel% DET: lines m(H_{b}H_{a}) and c are not the same
% Constructing a point M_{c} which belongs to line m(H_{b}H_{a}) and line c
intersec M_{c} m(H_{b}H_{a}) c
cmark_lt M_{c}



% Constructing a line L_{\_G133856} which passes through point M_{c} and point C
line L_{\_G133856} M_{c} C

color 200 200 200
drawline L_{\_G133856}
color 0 0 0


% Constructing a point P_{\_G133957} with coordinates (0,0)
point P_{\_G133957} 0 0
cmark_r P_{\_G133957}

% Constructing a point P_{\_G133881} such that M_{c}P_{\_G133881}/M_{c}P_{\_G133957}=1
towards P_{\_G133881} M_{c} P_{\_G133957} 1
cmark_r P_{\_G133881}
color 200 200 200
drawsegment M_{c} P_{\_G133881}
color 0 0 0

% Constructing a point P_{\_G133926} such that M_{c}P_{\_G133926}/M_{c}P_{\_G133957}=3
towards P_{\_G133926} M_{c} P_{\_G133957} 3
cmark_r P_{\_G133926}
color 200 200 200
drawsegment M_{c} P_{\_G133926}
color 0 0 0
```

```
% Constructing a line L_{\_G133887} which passes through point C and point P_{\_G133926}
line L_{\_G133887} C P_{\_G133926}

color 200 200 200
drawline L_{\_G133887}
color 0 0 0


% Constructing a line L_{\_G133850} which contains the point P_{\_G133881} and is parallel to the
    line L_{\_G133887}
parallel L_{\_G133850} P_{\_G133881} L_{\_G133887}

color 200 200 200
drawline L_{\_G133850}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G133850} and line L_{\_G133856}
intersec G L_{\_G133850} L_{\_G133856}
cmark_t G



% Constructing a point N such that HN/HG=0.75
towards N H G 0.75
cmark_r N
color 200 200 200
drawsegment H G
color 0 0 0


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(HH_{c}) and circle k(N,M_{a}) intersect
% Constructing points E_{a} and E_{b} which are in intersection of k(N,M_{a}) and m(HH_{c})
intersec2 E_{a} E_{b} k(N,M_{a}) m(HH_{c})
cmark_r E_{a}
cmark_r E_{b}



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0
```

```
% Constructing a point B such that HB/HE_{b}=2
towards B H E_{b} 2
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(HH_{c}) and circle k(N,M_{a}) intersect; points E_{c} and N are
     not the same; lines m(H_{b}H_{a}) and c are not parallel; points C and T_{c} are not the same;
     points E_{c} and C are not the same; lines c and h_{c} are not parallel
% Determination conditions: lines m(H_{b}H_{a}) and c are not the same; points C and T_{c} are not
    the same; points H and H_{c} are not the same; lines c and h_{c} are not the same; points T_{c}
     and C are not the same; points E_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H=_H

Proving failed

4.1.3 Proving T_c=_T_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H=_H

Proving failed

4.2.3 Proving T_c=_T_c

Proving failed

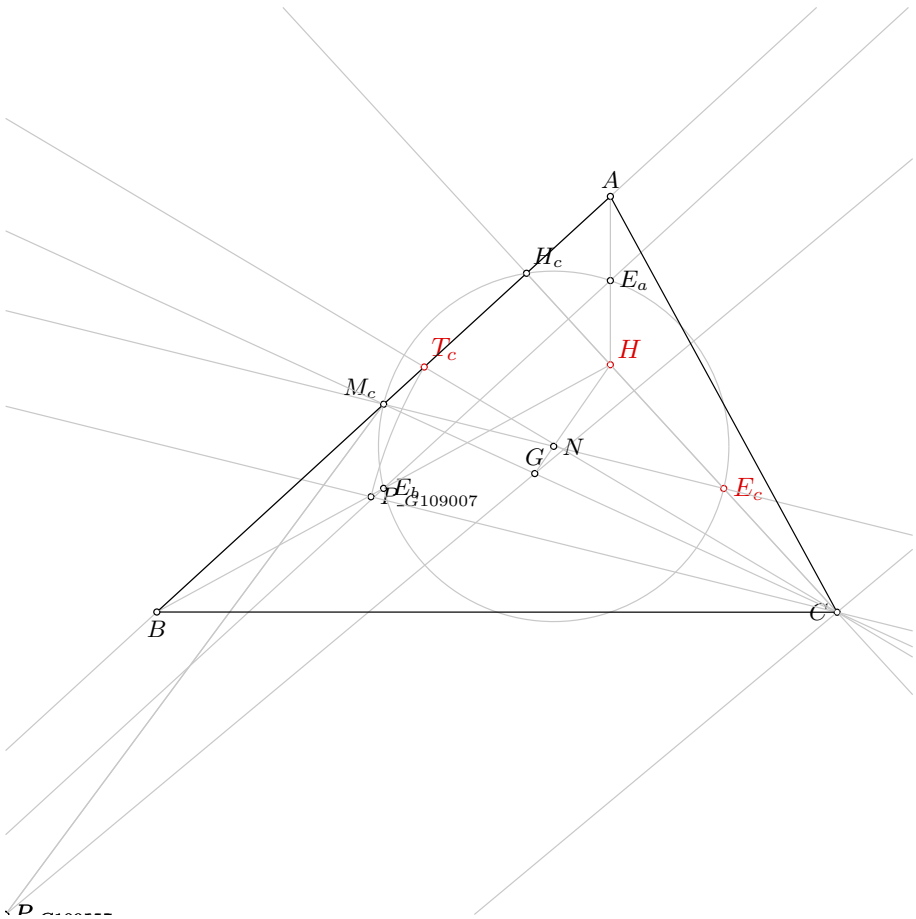

Figure 1: Illustration of the problem 0996

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H=_H

Proving failed

4.3.3 Proving T_c=_T_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H=_H

Proving failed

4.4.3 Proving T_c=_T_c

Proving failed

Problem 997

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 997: Given a point E_c, a point H_b and a point H_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
2. Choose freely a point H_a on the circle $k(E_c, C)$ (rule WOncircle);
3. Using the point H_a and the point E_c, construct a line $m(H_aE_c)$ (rule W14); % DET: points H_a and E_c are not the same;
4. Using the point H_a and the point H_b, construct a line $m(H_aH_b)$ (rule W14); % DET: points H_a and H_b are not the same;
5. Using the line $m(H_aH_b)$ and the line $m(H_aE_c)$, construct a point N (rule W03); % NDG: lines $m(H_aH_b)$ and $m(H_aE_c)$ are not parallel % DET: lines $m(H_aH_b)$ and $m(H_aE_c)$ are not the same;
6. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line $m(H_aH_b)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
8. Choose freely a point A on the circle $k(M_c, A)$ (rule WOncircle);
9. Using the point A and the point M_c, construct a point B (rule W01); ;
10. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

11. Using the point H_b and the point B, construct a line h_b (rule W02); % DET: points H_b and B are not the same;

12. Using the line h_a and the line h_b, construct a point H (rule W03); % NDG: lines h_a and h_b are not parallel % DET: lines h_a and h_b are not the same;

13. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: lines h_a and h_b are not parallel; line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect; points H_a and N are not the same; lines $m(H_aH_b)$ and $m(H_aE_c)$ are not parallel; points H_b and E_c are not the same.

Determination conditions: lines h_a and h_b are not the same; points H_b and B are not the same; points A and H_a are not the same; points E_c and M_c must be different; lines $m(H_aH_b)$ and $m(H_aE_c)$ are not the same; points H_a and H_b are not the same; points H_a and E_c are not the same.

Rules used: [W01,W02,W03,W05a,W06,W14,WOncircle1]

Lemmas used: [D20,D3,D30,D32,D5,D6,D8,D9,GD02,GL01,GL03,GL04,L18,L19,L20,L24,L41,L42,L53,L54]

Solving time: 64.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{b} 89.36 77.83
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_l H_{b}
cmark_r H_{a}
color 0 0 0
fontsize 8

% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0




% Choosing randomly a point H_{a} on the circle with center E_{c} through point H_{b}
oncircle H_{a} E_{c} H_{b}
cmark_r H_{a}
color 200 200 200
```

```
drawcircle E_{c} H_{b}
color 0 0 0


% DET: points H_{a} and E_{c} are not the same
% Constructing bisector m(H_{a}E_{c}) of the segment H_{a}E_{c}
med m(H_{a}E_{c}) H_{a} E_{c}

color 200 200 200
drawline m(H_{a}E_{c})
color 0 0 0

color 200 200 200
drawsegment H_{a} E_{c}
color 0 0 0


% DET: points H_{a} and H_{b} are not the same
% Constructing bisector m(H_{a}H_{b}) of the segment H_{a}H_{b}
med m(H_{a}H_{b}) H_{a} H_{b}

color 200 200 200
drawline m(H_{a}H_{b})
color 0 0 0

color 200 200 200
drawsegment H_{a} H_{b}
color 0 0 0


% NDG: lines m(H_{a}H_{b}) and m(H_{a}E_{c}) are not parallel% DET: lines m(H_{a}H_{b}) and m(H_{a}
    E_{c}) are not the same
% Constructing a point N which belongs to line m(H_{a}H_{b}) and line m(H_{a}E_{c})
intersec N m(H_{a}H_{b}) m(H_{a}E_{c})
cmark_r N


% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{a}H_{b}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}



% Choosing randomly a point A on the circle with center M_{c} through point H_{a}
```

```
oncircle A M_{c} H_{a}
cmark_t A
color 200 200 200
drawcircle M_{c} H_{a}
color 0 0 0


% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0


% DET: points H_{b} and B are not the same
% Constructing a line h_{b} which passes through point H_{b} and point B
line h_{b} H_{b} B

color 200 200 200
drawline h_{b}
color 0 0 0


% NDG: lines h_{a} and h_{b} are not parallel% DET: lines h_{a} and h_{b} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{b}
intersec H h_{a} h_{b}
cmark_rt H


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0


drawsegment A B
drawsegment A C
drawsegment B C
```

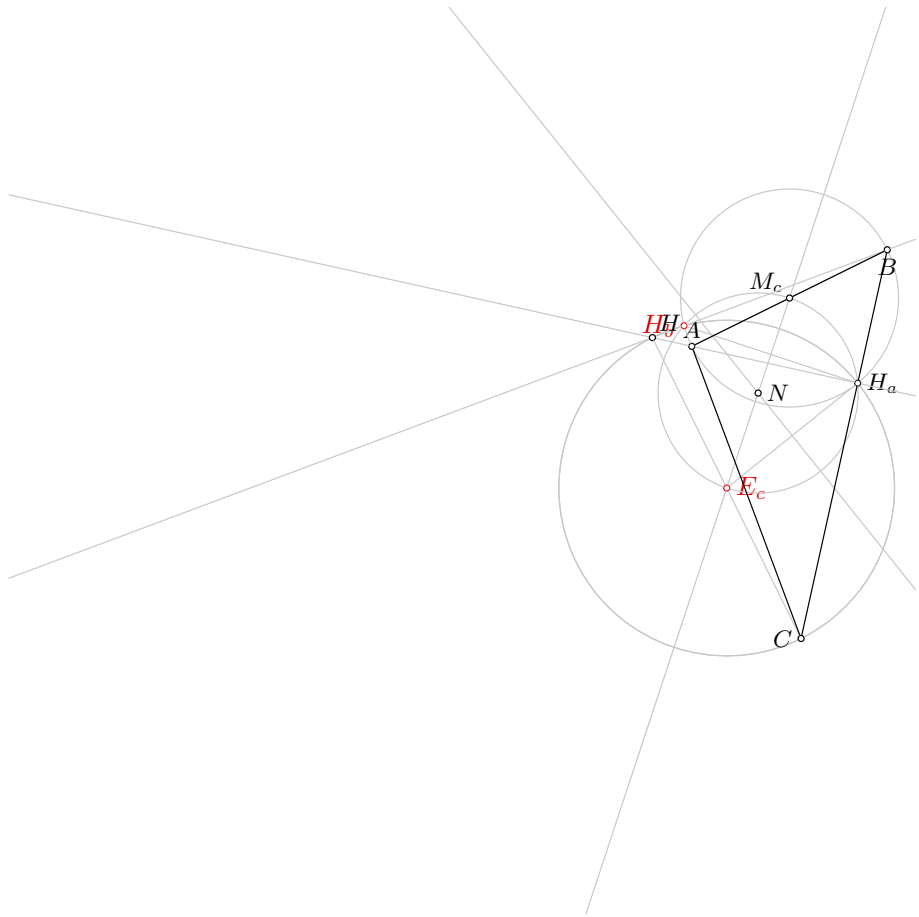

Figure 1: Illustration of the problem 0997

```
% Non-degenerate conditions: lines h_{a} and h_{b} are not parallel; line m(H_{a}H_{b}) and circle
    k(N,M_{a}) intersect; points H_{a} and N are not the same; lines m(H_{a}H_{b}) and m(H_{a}E_{c
    }) are not parallel; points H_{b} and E_{c} are not the same
% Determination conditions: lines h_{a} and h_{b} are not the same; points H_{b} and B are not the
    same; points A and H_{a} are not the same; points E_{c} and M_{c} must be different; lines m(H
    _{a}H_{b}) and m(H_{a}E_{c}) are not the same; points H_{a} and H_{b} are not the same; points
    H_{a} and E_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving H_a=_H_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 998

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 998: Given a point E_c, a point H_a and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;
3. Using the circle $k(E_c, C)$ and the line h_c, construct a point C and a point H (rule W04); % NDG: line h_c and circle $k(E_c, C)$ intersect;
4. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
5. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
6. Using the point H_c and the line h_c, construct a line c (rule W10a); ;
7. Using the line c and the line a, construct a point B (rule W03); % NDG: lines c and a are not parallel % DET: lines c and a are not the same;
8. Using the line h_a and the line c, construct a point A (rule W03); % NDG: lines h_a and c are not parallel % DET: lines h_a and c are not the same.

Non-degenerate conditions: lines h_a and c are not parallel; lines c and a are not parallel; line h_c and circle $k(E_c, C)$ intersect; points H_a and E_c are not the same.

Determination conditions: lines h_a and c are not the same; lines c and a are not the same; points H_a and H are not the same; points H_a and C are not the same; points E_c and H_c are not the same.

Rules used: [W02,W03,W04,W06,W10a]
Lemmas used: [D10,D3,D30,D5,D7,D8,GD01,GD02,GL09,L3,L52,L54]
Solving time: 6.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{a} 80 40
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_r H_{a}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line h_{c} and circle k(E_{c},C) intersect
% Constructing points C and H which are in intersection of k(E_{c},C) and h_{c}
intersec2 C H k(E_{c},C) h_{c}
cmark_l C
cmark_rt H


% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
```

```
color 0 0 0



% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0




% Constructing a line c which is perpendicular to line h_{c} and which passes through point H_{c}
perp c H_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines c and a are not parallel% DET: lines c and a are not the same
% Constructing a point B which belongs to line c and line a
intersec B c a
cmark_b B


% NDG: lines h_{a} and c are not parallel% DET: lines h_{a} and c are not the same
% Constructing a point A which belongs to line h_{a} and line c
intersec A h_{a} c
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and c are not parallel; lines c and a are not parallel;
    line h_{c} and circle k(E_{c},C) intersect; points H_{a} and E_{c} are not the same
% Determination conditions: lines h_{a} and c are not the same; lines c and a are not the same;
    points H_{a} and H are not the same; points H_{a} and C are not the same; points E_{c} and H_{c
    } are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

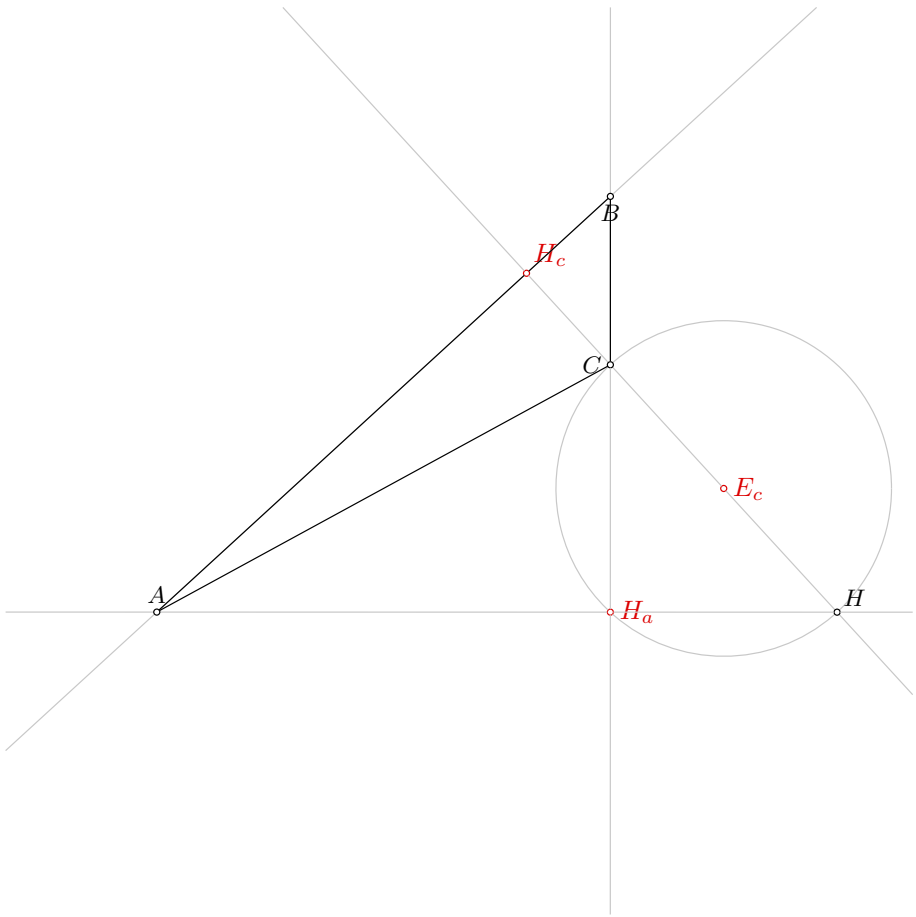

Figure 1: Illustration of the problem 0998

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving H_c=_H_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 999

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 999: Given a point E_c, a point H_a and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1000

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1000: Given a point E_c, a point H_a and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
2. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;
3. Using the circle $k(E_c, C)$, the line a, the point E_c and the point H_a, construct a point C (rule W05); % NDG: line a and circle $k(E_c, C)$ intersect % DET: points H_a and C must be different;
4. Using the point C and the point E_c, construct a point H (rule W01); ;
5. Using the point M_a and the point C, construct a point B (rule W01); ;
6. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
7. Using the point H and the point B, construct a line h_b (rule W02); % DET: points H and B are not the same;
8. Using the circle $k(E_c, C)$, the line h_b, the point E_c and the point H, construct a point H_b (rule W05); % NDG: line h_b and circle $k(E_c, C)$ intersect % DET: points H and H_b must be different;
9. Using the point C and the point H_b, construct a line b (rule W02); % DET: points C and H_b are not the same;
10. Using the line h_a and the line b, construct a point A (rule W03); % NDG: lines h_a and b are not parallel % DET: lines h_a and b are not the same.

Non-degenerate conditions: lines h_a and b are not parallel; line h_b and circle $k(E_c, C)$ intersect; line a and circle $k(E_c, C)$ intersect; points H_a and E_c are not the same.

Determination conditions: lines h_a and b are not the same; points C and H_b are not the same; points H and H_b must be different; points H and B are not the same; points H_a and H are not the same; points H_a and C must be different; points H_a and M_a are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D21,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 9.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{a} 80 40
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_r H_{a}
cmark_r M_{a}
color 0 0 0
fontsize 8

% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line a and circle k(E_{c},C) intersect% DET: points H_{a} and C must be different
% Constructing a point P_{\_G221884} which is a foot of the point E_{c} on the line a
foot P_{\_G221884} E_{c} a
cmark_r P_{\_G221884}
color 200 200 200
drawline E_{c} P_{\_G221884}
color 0 0 0
```

```
% Constructing a point C which is an image of the point H_{a} in the symmetry to point/line P_{\_G
    221884}
sim C P_{\_G221884} H_{a}
cmark_l C



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% DET: points H and B are not the same
% Constructing a line h_{b} which passes through point H and point B
line h_{b} H B

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{b} and circle k(E_{c},C) intersect% DET: points H and H_{b} must be different
% Constructing a point P_{\_G222321} which is a foot of the point E_{c} on the line h_{b}
foot P_{\_G222321} E_{c} h_{b}
cmark_r P_{\_G222321}
color 200 200 200
drawline E_{c} P_{\_G222321}
color 0 0 0

% Constructing a point H_{b} which is an image of the point H in the symmetry to point/line P_{\_G
    222321}
sim H_{b} P_{\_G222321} H
```

```
cmark_l H_{b}


% DET: points C and H_{b} are not the same
% Constructing a line b which passes through point C and point H_{b}
line b C H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines h_{a} and b are not parallel% DET: lines h_{a} and b are not the same
% Constructing a point A which belongs to line h_{a} and line b
intersec A h_{a} b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and b are not parallel; line h_{b} and circle k(E_{c},C)
    intersect; line a and circle k(E_{c},C) intersect; points H_{a} and E_{c} are not the same
% Determination conditions: lines h_{a} and b are not the same; points C and H_{b} are not the same
    ; points H and H_{b} must be different; points H and B are not the same; points H_{a} and H are
     not the same; points H_{a} and C must be different; points H_{a} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.189 seconds.

NDG conditions Points M_a and H_a are not identical

Points M_a and H_a are not identical

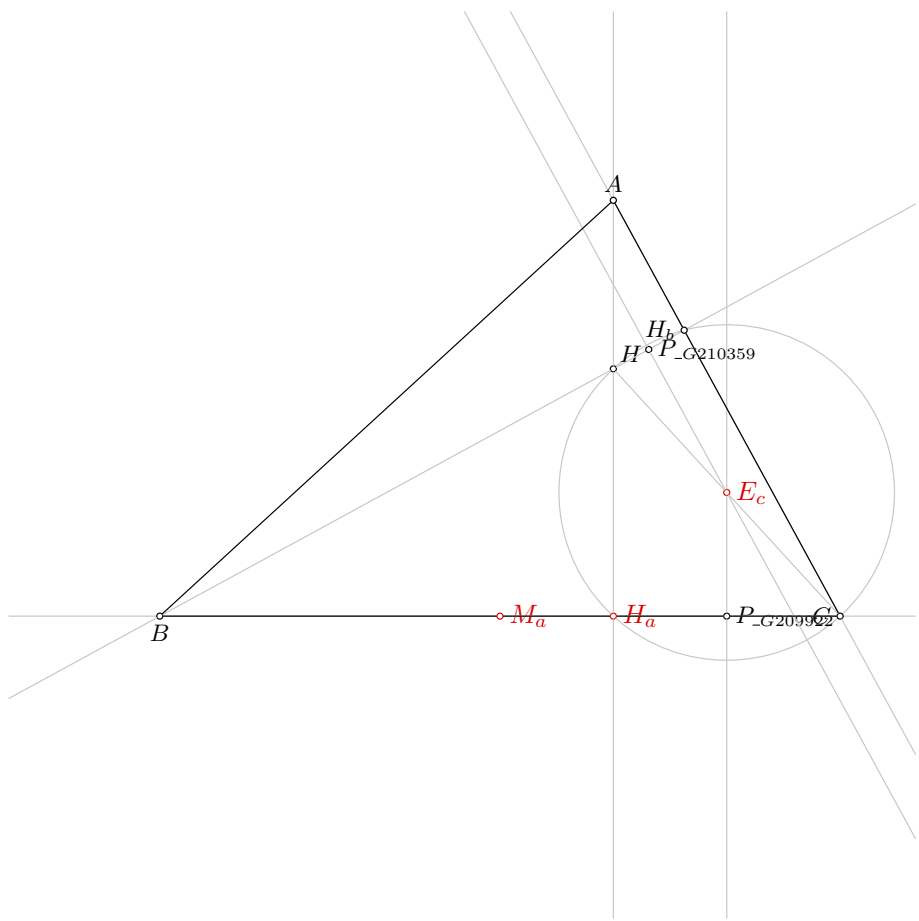

Figure 1: Illustration of the problem 1000

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving M_a=_M_a

NDG conditions are:

$S_{H_aCH_b} \neq S_{HCH_b}$ i.e., lines H_aH and CH_b are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 1001

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1001: Given a point E_c, a point H_a and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;
2. Using the point H_a and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points H_a and M_b are not the same;
3. Using the circle $k(E_c, C)$, the circle $k(M_b, C)$, the point H_a, the point E_c and the point M_b, construct a point C (rule W08); % NDG: circles $k(E_c, C)$ and $k(M_b, C)$ intersect % DET: circles $k(E_c, C)$ and $k(M_b, C)$ are not the same; points H_a and C must be different;
4. Using the point C and the point E_c, construct a point H (rule W01); ;
5. Using the point M_b and the point C, construct a point A (rule W01); ;
6. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
7. Using the point M_b and the point C, construct a line b (rule W02); % DET: points M_b and C are not the same;
8. Using the circle $k(E_c, C)$, the line b, the point E_c and the point C, construct a point H_b (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points C and H_b must be different;
9. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
10. Using the line a and the line h_b, construct a point B (rule W03); % NDG: lines a and h_b are not parallel % DET: lines a and h_b are not the same.

Non-degenerate conditions: lines a and h_b are not parallel; line b and circle $k(E_c, C)$ intersect; circles $k(E_c, C)$ and $k(M_b, C)$ intersect; points H_a and M_b are not the same; points H_a and E_c are not the same.

Determination conditions: lines a and h_b are not the same; points H and H_b are not the same; points C and H_b must be different; points M_b and C are not the same; points H_a and C are not the same; circles $k(E_c, C)$ and $k(M_b, C)$ are not the same; points H_a and C must be different.

Rules used: [W01,W02,W03,W05,W06,W08]

Lemmas used: [D22,D3,D30,D5,D6,D9,GD01,GD02,GL03,GL04,GL09,L44,L53,L54]

Solving time: 9.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{a} 80 40
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_r H_{a}
cmark_lt M_{b}
color 0 0 0
fontsize 8

% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: points H_{a} and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point H
    _{a}
circle k(M_{b},C) M_{b} H_{a}

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: circles k(E_{c},C) and k(M_{b},C) intersect% DET: circles k(E_{c},C) and k(M_{b},C) are not
    the same; points H_{a} and C must be different
% Constructing a line L_{\_G249791} which passes through point E_{c} and point M_{b}
line L_{\_G249791} E_{c} M_{b}
```

```
color 200 200 200
drawline L_{\_G249791}
color 0 0 0


% Constructing a point C which is an image of the point H_{a} in the symmetry to point/line L_{\_G
    249791}
sim C L_{\_G249791} H_{a}
cmark_l C



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point A such that M_{b}A/M_{b}C=-1
towards A M_{b} C -1
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0


% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% DET: points M_{b} and C are not the same
% Constructing a line b which passes through point M_{b} and point C
line b M_{b} C

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points C and H_{b} must be different
% Constructing a point P_{\_G250208} which is a foot of the point E_{c} on the line b
foot P_{\_G250208} E_{c} b
cmark_r P_{\_G250208}
color 200 200 200
drawline E_{c} P_{\_G250208}
```

```
color 0 0 0

% Constructing a point H_{b} which is an image of the point C in the symmetry to point/line P_{\_G
    250208}
sim H_{b} P_{\_G250208} C
cmark_l H_{b}


% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines a and h_{b} are not parallel% DET: lines a and h_{b} are not the same
% Constructing a point B which belongs to line a and line h_{b}
intersec B a h_{b}
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and h_{b} are not parallel; line b and circle k(E_{c},C)
    intersect; circles k(E_{c},C) and k(M_{b},C) intersect; points H_{a} and M_{b} are not the same
    ; points H_{a} and E_{c} are not the same
% Determination conditions: lines a and h_{b} are not the same; points H and H_{b} are not the same
    ; points C and H_{b} must be different; points M_{b} and C are not the same; points H_{a} and C
     are not the same; circles k(E_{c},C) and k(M_{b},C) are not the same; points H_{a} and C must
    be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

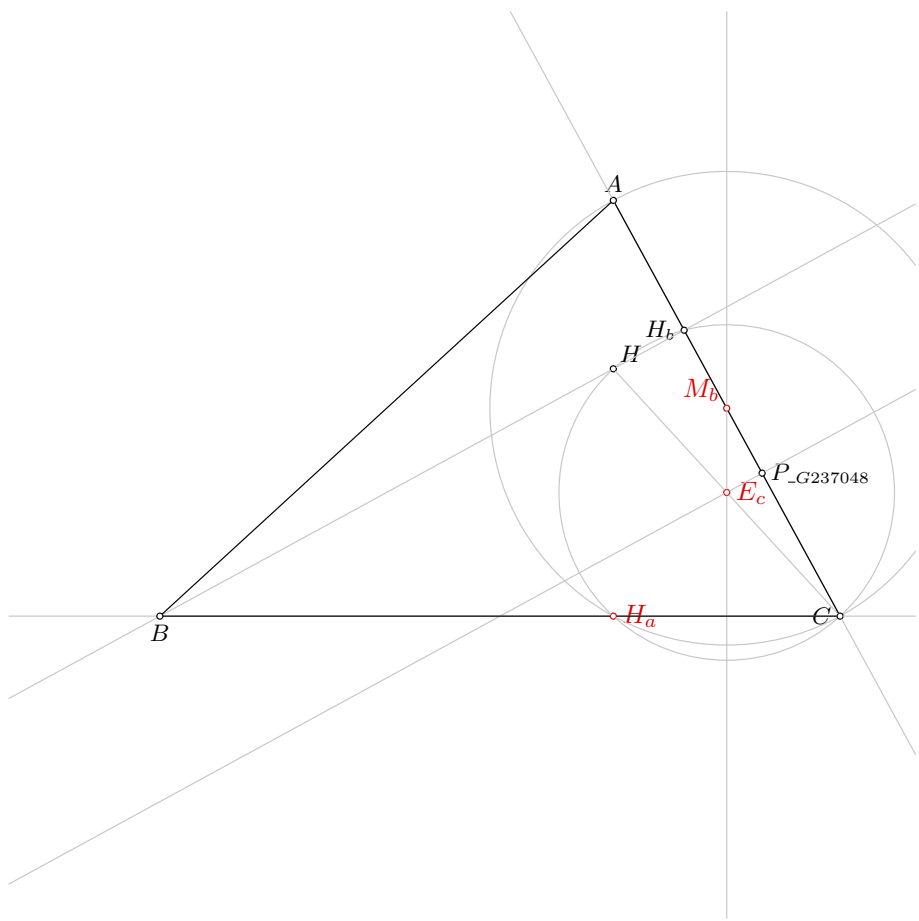

Figure 1: Illustration of the problem 1001

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.186 seconds.

NDG conditions Points M_b and H_a are not identical

Points M_b and H_a are not identical

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving M_b=_M_b

NDG conditions are:

$S_{H_aHH_b} \neq S_{CHH_b}$ i.e., lines H_aC and HH_b are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{BAF^0_{\_h_a}} \neq S_{CAF^0_{\_h_a}}$ i.e., lines BC and $AF^0_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving M_b=_M_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 1002

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1002: Given a point E_c, a point M_c and a point H_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
2. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;
3. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;
4. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
5. Choose freely a point H_a on the circle $k(N, M_a)$ (rule WOncircle);
6. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;
7. Using the circle $k(N, M_a)$, the circle $k(E_c, C)$, the point H_a, the point N and the point E_c, construct a point H_b (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_c, C)$ intersect % DET: circles $k(N, M_a)$ and $k(E_c, C)$ are not the same; points H_a and H_b must be different;
8. Choose freely a point A on the circle $k(M_c, A)$ (rule WOncircle);
9. Using the point A and the point M_c, construct a point B (rule W01); ;
10. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

11. Using the point H_b and the point B, construct a line h_b (rule W02); % DET: points H_b and B are not the same;

12. Using the line h_a and the line h_b, construct a point H (rule W03); % NDG: lines h_a and h_b are not parallel % DET: lines h_a and h_b are not the same;

13. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: lines h_a and h_b are not parallel; circles $k(N, M_a)$ and $k(E_c, C)$ intersect; points H_a and E_c are not the same; points E_c and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: lines h_a and h_b are not the same; points H_b and B are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(E_c, C)$ are not the same; points H_a and H_b must be different; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points E_c and M_c are not the same.

Rules used: [W01,W02,W03,W06,W08,W14,WOncircle1]

Lemmas used: [D20,D3,D30,D32,D5,D6,D8,D9,GD02,GL01,GL03,GL04,L18,L19,L20,L24,L41,L42,L53,L54]

Solving time: 65.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point M_{c} 50 67.5
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_lt M_{c}
cmark_r H_{a}
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
```

```
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0


% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{a} on the circle with center N through point E_{c}
oncircle H_{a} N E_{c}
cmark_r H_{a}
color 200 200 200
drawcircle N E_{c}
color 0 0 0


% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(E_{c},C) intersect% DET: circles k(N,M_{a}) and k(E_{c},C) are not
    the same; points H_{a} and H_{b} must be different
% Constructing a line L_{\_G53141} which passes through point N and point E_{c}
line L_{\_G53141} N E_{c}

color 200 200 200
drawline L_{\_G53141}
color 0 0 0


% Constructing a point H_{b} which is an image of the point H_{a} in the symmetry to point/line L
    _{\_G53141}
```

```
sim H_{b} L_{\_G53141} H_{a}
cmark_l H_{b}


% Choosing randomly a point A on the circle with center M_{c} through point H_{a}
oncircle A M_{c} H_{a}
cmark_t A
color 200 200 200
drawcircle M_{c} H_{a}
color 0 0 0


% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0


% DET: points H_{b} and B are not the same
% Constructing a line h_{b} which passes through point H_{b} and point B
line h_{b} H_{b} B

color 200 200 200
drawline h_{b}
color 0 0 0


% NDG: lines h_{a} and h_{b} are not parallel% DET: lines h_{a} and h_{b} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{b}
intersec H h_{a} h_{b}
cmark_rt H


% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0
```

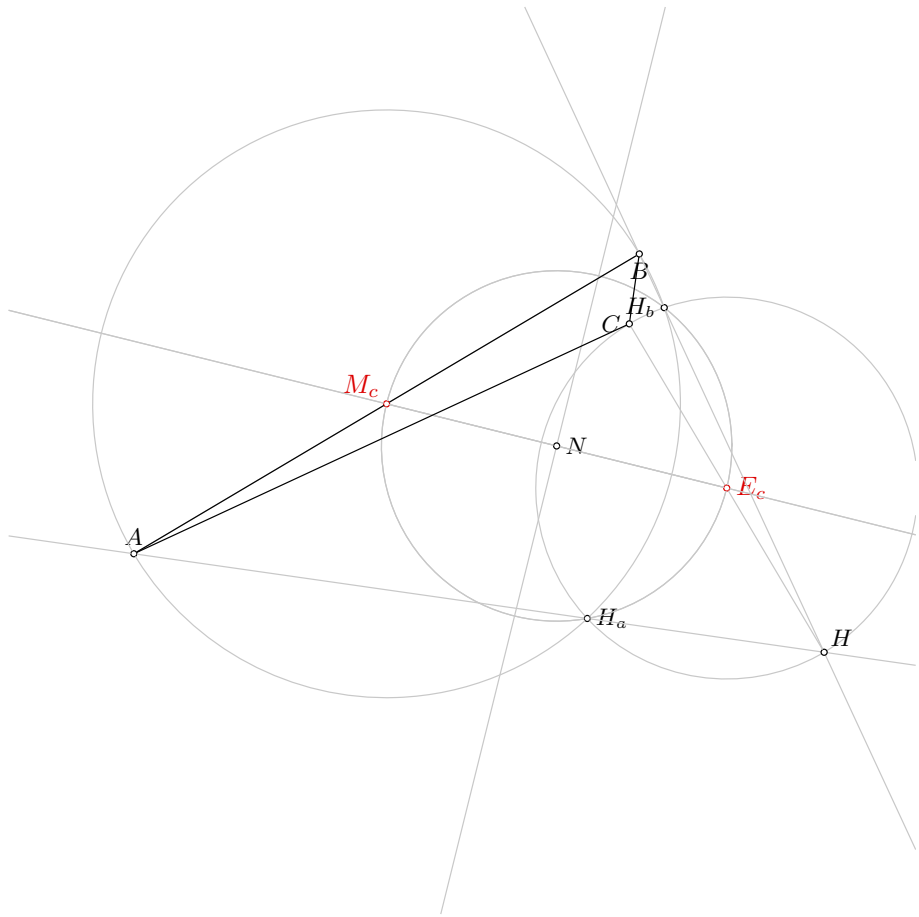

Figure 1: Illustration of the problem 1002

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{b} are not parallel; circles k(N,M_{a}) and k(E_{c
    },C) intersect; points H_{a} and E_{c} are not the same; points E_{c} and N are not the same;
    lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel
% Determination conditions: lines h_{a} and h_{b} are not the same; points H_{b} and B are not the
    same; points A and H_{a} are not the same; circles k(N,M_{a}) and k(E_{c},C) are not the same;
    points H_{a} and H_{b} must be different; lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the
    same; points E_{c} and M_{c} are not the same; points E_{c} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=$\_E_c$

Proving failed

4.1.2 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.14 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving H_a=$\_H_a$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=$\_E_c$

Proving failed

4.2.2 Proving M_c=$\_M_c$

NDG conditions are:

$S_{M^0_{m(E_cM_c)}E_cM_c} \neq S_{T^1_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^0_{m(E_cM_c)}T^1_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{AH_bB} \neq S_{H_aH_bB}$ i.e., lines AH_a and H_bB are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

$S_{BAF^2_{\_h_a}} \neq S_{CAF^2_{\_h_a}}$ i.e., lines BC and $AF^2_{\_h_a}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving H_a=$\_H_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=$\_E_c$

Proving failed

4.3.2 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 1003

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1003: Given a point H_a, a point N and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;
2. Choose freely a point E_c on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
4. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
5. Using the point H_a and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_a and E_c are not the same;
6. Using the circle $k(N, M_a)$, the circle $k(E_c, C)$, the point H_a, the point N and the point E_c, construct a point H_b (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_c, C)$ intersect % DET: circles $k(N, M_a)$ and $k(E_c, C)$ are not the same; points H_a and H_b must be different;
7. Choose freely a point A on the circle $k(M_c, A)$ (rule WOncircle);
8. Using the point A and the point M_c, construct a point B (rule W01); ;
9. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;
10. Using the point H_b and the point B, construct a line h_b (rule W02); % DET: points H_b and B are not the same;

11. Using the line h_a and the line h_b, construct a point H (rule W03); % NDG: lines h_a and h_b are not parallel % DET: lines h_a and h_b are not the same;

12. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: lines h_a and h_b are not parallel; circles $k(N, M_a)$ and $k(E_c, C)$ intersect; points H_a and E_c are not the same; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points H_a and N are not the same.

Determination conditions: lines h_a and h_b are not the same; points H_b and B are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(E_c, C)$ are not the same; points H_a and H_b must be different; points E_c and M_c must be different; points E_c and N are not the same.

Rules used: [W01,W02,W03,W05a,W06,W08,WOncircle1]

Lemmas used: [D20,D3,D30,D32,D5,D6,D8,D9,GD02,GL01,GL03,GL04,L18,L19,L20,L24,L41,L42,L53,L54]

Solving time: 57.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{a} 80 40
point N 72.5 61.93
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_r H_{a}
cmark_r N
cmark_r E_{c}
color 0 0 0
fontsize 8

% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{c} on the circle with center N through point H_{a}
oncircle E_{c} N H_{a}
cmark_r E_{c}
color 200 200 200
drawcircle N H_{a}
color 0 0 0


% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
```

```
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}


% NDG: points H_{a} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{a}
circle k(E_{c},C) E_{c} H_{a}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(E_{c},C) intersect% DET: circles k(N,M_{a}) and k(E_{c},C) are not
    the same; points H_{a} and H_{b} must be different
% Constructing a line L_{\_G90838} which passes through point N and point E_{c}
line L_{\_G90838} N E_{c}

color 200 200 200
drawline L_{\_G90838}
color 0 0 0


% Constructing a point H_{b} which is an image of the point H_{a} in the symmetry to point/line L
    _{\_G90838}
sim H_{b} L_{\_G90838} H_{a}
cmark_l H_{b}



% Choosing randomly a point A on the circle with center M_{c} through point H_{a}
oncircle A M_{c} H_{a}
cmark_t A
color 200 200 200
drawcircle M_{c} H_{a}
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
```

```
drawsegment A B
color 0 0 0


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% DET: points H_{b} and B are not the same
% Constructing a line h_{b} which passes through point H_{b} and point B
line h_{b} H_{b} B

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines h_{a} and h_{b} are not parallel% DET: lines h_{a} and h_{b} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{b}
intersec H h_{a} h_{b}
cmark_rt H



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{b} are not parallel; circles k(N,M_{a}) and k(E_{c
    },C) intersect; points H_{a} and E_{c} are not the same; line m(H_{b}H_{a}) and circle k(N,M_{a
    }) intersect; points H_{a} and N are not the same
% Determination conditions: lines h_{a} and h_{b} are not the same; points H_{b} and B are not the
    same; points A and H_{a} are not the same; circles k(N,M_{a}) and k(E_{c},C) are not the same;
    points H_{a} and H_{b} must be different; points E_{c} and M_{c} must be different; points E_{c
    } and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

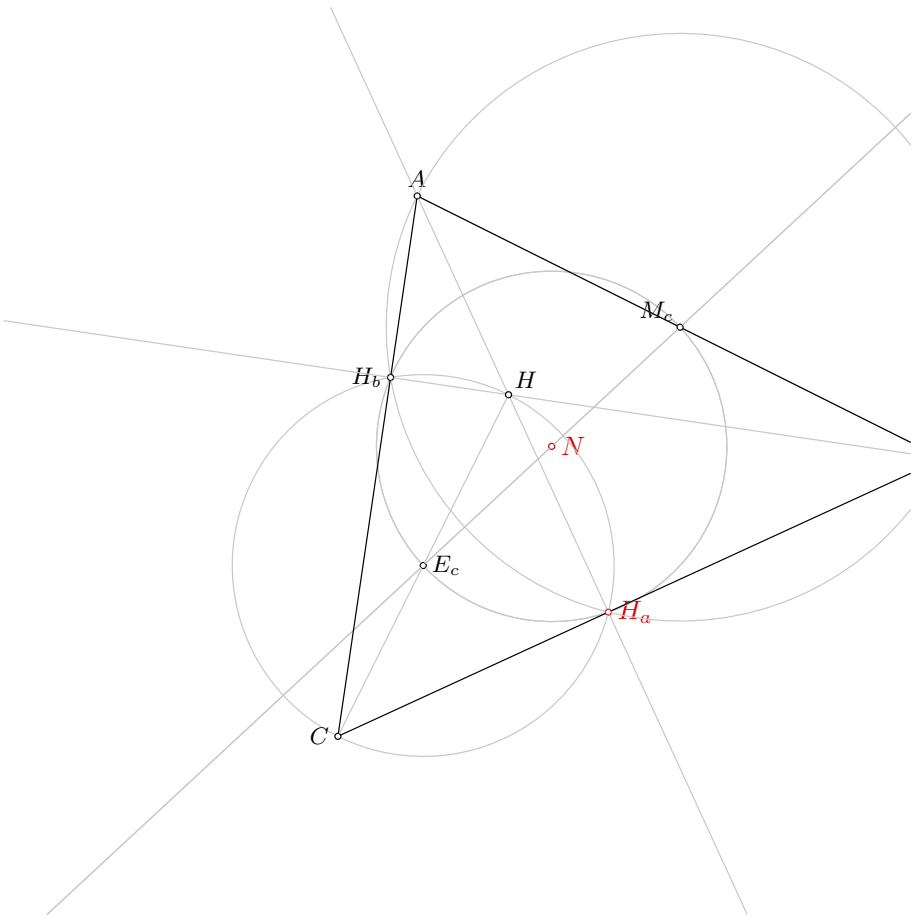

Figure 1: Illustration of the problem 1003

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_a=_H_a

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_a=_H_a

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_a=_H_a

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_a=_H_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 1004

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1004: Given a point E_c, a point H_a and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1005

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1005: Given a point E_c, a point H_a and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1006

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1006: Given a point E_c, a point H_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1007

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1007: Given a point E_c, a point H_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1008

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1008: Given a point E_c, a point H_b and a point H_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
3. Using the circle $k(E_c, C)$ and the line h_c, construct a point C and a point H (rule W04); % NDG: line h_c and circle $k(E_c, C)$ intersect;
4. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
5. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
6. Using the point H_c and the line h_c, construct a line c (rule W10a); ;
7. Using the line c and the line b, construct a point A (rule W03); % NDG: lines c and b are not parallel % DET: lines c and b are not the same;
8. Using the line h_b and the line c, construct a point B (rule W03); % NDG: lines h_b and c are not parallel % DET: lines h_b and c are not the same.

Non-degenerate conditions: lines h_b and c are not parallel; lines c and b are not parallel; line h_c and circle $k(E_c, C)$ intersect; points H_b and E_c are not the same.

Determination conditions: lines h_b and c are not the same; lines c and b are not the same; points H_b and H are not the same; points H_b and C are not the same; points E_c and H_c are not the same.

Rules used: [W02,W03,W04,W06,W10a]

Lemmas used: [D10,D3,D30,D6,D7,D9,GD01,GD02,GL09,L3,L52,L53]
Solving time: 6.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{b} 89.36 77.83
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_l H_{b}
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line h_{c} and circle k(E_{c},C) intersect
% Constructing points C and H which are in intersection of k(E_{c},C) and h_{c}
intersec2 C H k(E_{c},C) h_{c}
cmark_l C
cmark_rt H


% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0
```

```
% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% Constructing a line c which is perpendicular to line h_{c} and which passes through point H_{c}
perp c H_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: lines c and b are not parallel% DET: lines c and b are not the same
% Constructing a point A which belongs to line c and line b
intersec A c b
cmark_t A


% NDG: lines h_{b} and c are not parallel% DET: lines h_{b} and c are not the same
% Constructing a point B which belongs to line h_{b} and line c
intersec B h_{b} c
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and c are not parallel; lines c and b are not parallel;
    line h_{c} and circle k(E_{c},C) intersect; points H_{b} and E_{c} are not the same
% Determination conditions: lines h_{b} and c are not the same; lines c and b are not the same;
    points H_{b} and H are not the same; points H_{b} and C are not the same; points E_{c} and H_{c
    } are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

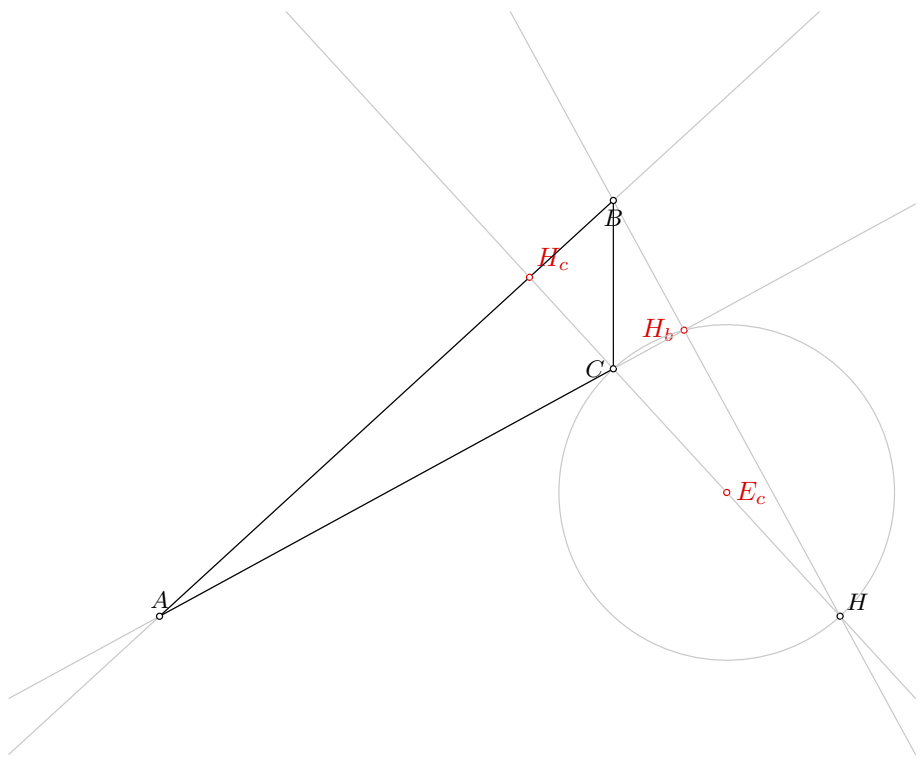

Figure 1: Illustration of the problem 1008

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving H_c=_H_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 1009

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1009: Given a point E_c, a point H_b and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1010

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1010: Given a point E_c, a point H_b and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
2. Using the point H_b and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points H_b and M_a are not the same;
3. Using the circle $k(E_c, C)$, the circle $k(M_a, B)$, the point H_b, the point E_c and the point M_a, construct a point C (rule W08); % NDG: circles $k(E_c, C)$ and $k(M_a, B)$ intersect % DET: circles $k(E_c, C)$ and $k(M_a, B)$ are not the same; points H_b and C must be different;
4. Using the point C and the point E_c, construct a point H (rule W01); ;
5. Using the point M_a and the point C, construct a point B (rule W01); ;
6. Using the point H_b and the point C, construct a line b (rule W02); % DET: points H_b and C are not the same;
7. Using the point M_a and the point C, construct a line a (rule W02); % DET: points M_a and C are not the same;
8. Using the circle $k(E_c, C)$, the line a, the point E_c and the point C, construct a point H_a (rule W05); % NDG: line a and circle $k(E_c, C)$ intersect % DET: points C and H_a must be different;
9. Using the point H and the point H_a, construct a line h_a (rule W02); % DET: points H and H_a are not the same;
10. Using the line b and the line h_a, construct a point A (rule W03); % NDG: lines b and h_a are not parallel % DET: lines b and h_a are not the same.

Non-degenerate conditions: lines b and h_a are not parallel; line a and circle $k(E_c, C)$ intersect; circles $k(E_c, C)$ and $k(M_a, B)$ intersect; points H_b and M_a are not the same; points H_b and E_c are not the same.

Determination conditions: lines b and h_a are not the same; points H and H_a are not the same; points C and H_a must be different; points M_a and C are not the same; points H_b and C are not the same; circles $k(E_c, C)$ and $k(M_a, B)$ are not the same; points H_b and C must be different.

Rules used: [W01,W02,W03,W05,W06,W08]

Lemmas used: [D21,D3,D30,D5,D6,D8,GD01,GD02,GL03,GL04,GL09,L37,L38,L53,L54]

Solving time: 9.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{b} 89.36 77.83
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_l H_{b}
cmark_r M_{a}
color 0 0 0
fontsize 8

% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: points H_{b} and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point H
    _{b}
circle k(M_{a},B) M_{a} H_{b}

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: circles k(E_{c},C) and k(M_{a},B) intersect% DET: circles k(E_{c},C) and k(M_{a},B) are not
    the same; points H_{b} and C must be different
% Constructing a line L_{\_G174172} which passes through point E_{c} and point M_{a}
line L_{\_G174172} E_{c} M_{a}
```

```
color 200 200 200
drawline L_{\_G174172}
color 0 0 0


% Constructing a point C which is an image of the point H_{b} in the symmetry to point/line L_{\_G
    174172}
sim C L_{\_G174172} H_{b}
cmark_l C



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0


% DET: points H_{b} and C are not the same
% Constructing a line b which passes through point H_{b} and point C
line b H_{b} C

color 200 200 200
drawline b
color 0 0 0



% DET: points M_{a} and C are not the same
% Constructing a line a which passes through point M_{a} and point C
line a M_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(E_{c},C) intersect% DET: points C and H_{a} must be different
% Constructing a point P_{\_G174589} which is a foot of the point E_{c} on the line a
foot P_{\_G174589} E_{c} a
cmark_r P_{\_G174589}
color 200 200 200
drawline E_{c} P_{\_G174589}
```

```
color 0 0 0

% Constructing a point H_{a} which is an image of the point C in the symmetry to point/line P_{\_G
    174589}
sim H_{a} P_{\_G174589} C
cmark_r H_{a}


% DET: points H and H_{a} are not the same
% Constructing a line h_{a} which passes through point H and point H_{a}
line h_{a} H H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines b and h_{a} are not parallel% DET: lines b and h_{a} are not the same
% Constructing a point A which belongs to line b and line h_{a}
intersec A b h_{a}
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{a} are not parallel; line a and circle k(E_{c},C)
    intersect; circles k(E_{c},C) and k(M_{a},B) intersect; points H_{b} and M_{a} are not the same
    ; points H_{b} and E_{c} are not the same
% Determination conditions: lines b and h_{a} are not the same; points H and H_{a} are not the same
    ; points C and H_{a} must be different; points M_{a} and C are not the same; points H_{b} and C
     are not the same; circles k(E_{c},C) and k(M_{a},B) are not the same; points H_{b} and C must
    be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

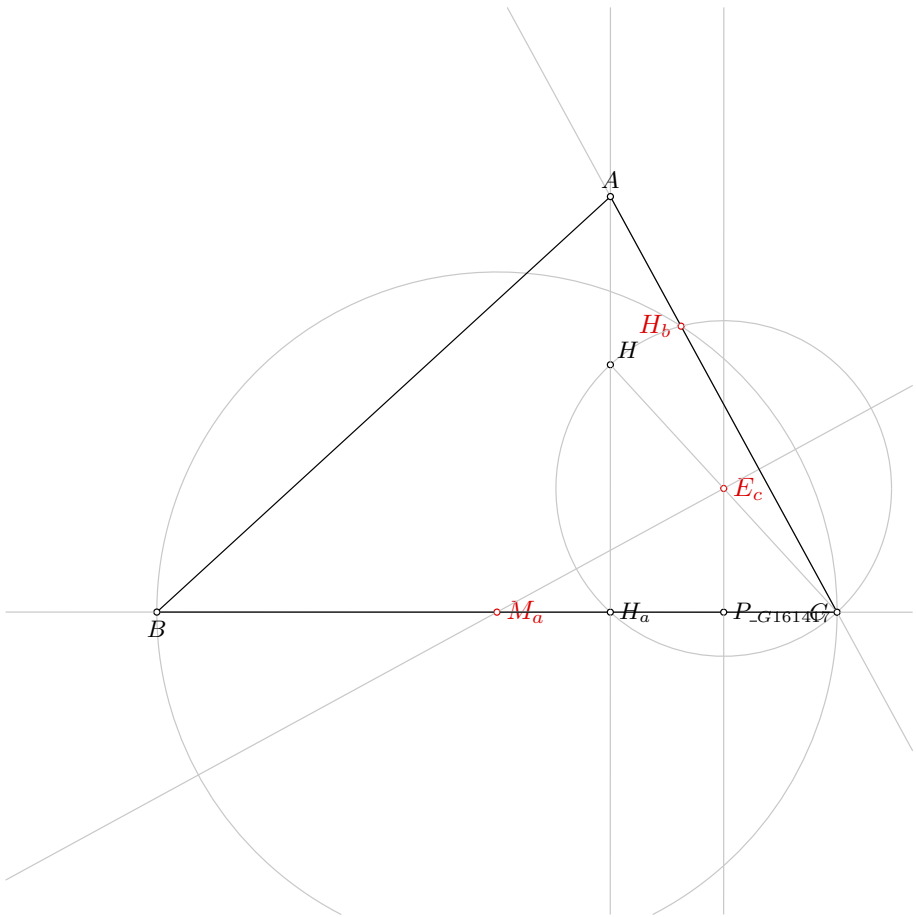

Figure 1: Illustration of the problem 1010

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.167 seconds.

NDG conditions Points H_b, E_c and M_a are not collinear

Points H_b, E_c and M_a are not collinear

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving M_a=_M_a

NDG conditions are:

$S_{H_bHH_a} \neq S_{CHH_a}$ i.e., lines H_bC and HH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 1011

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1011: Given a point E_c, a point H_b and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
2. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
3. Using the circle $k(E_c, C)$, the line b, the point E_c and the point H_b, construct a point C (rule W05); % NDG: line b and circle $k(E_c, C)$ intersect % DET: points H_b and C must be different;
4. Using the point C and the point E_c, construct a point H (rule W01); ;
5. Using the point M_b and the point C, construct a point A (rule W01); ;
6. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
7. Using the point H and the point A, construct a line h_a (rule W02); % DET: points H and A are not the same;
8. Using the circle $k(E_c, C)$, the line h_a, the point E_c and the point H, construct a point H_a (rule W05); % NDG: line h_a and circle $k(E_c, C)$ intersect % DET: points H and H_a must be different;
9. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;
10. Using the line h_b and the line a, construct a point B (rule W03); % NDG: lines h_b and a are not parallel % DET: lines h_b and a are not the same.

Non-degenerate conditions: lines h_b and a are not parallel; line h_a and circle $k(E_c, C)$ intersect; line b and circle $k(E_c, C)$ intersect; points H_b and E_c are not the same.

Determination conditions: lines h_b and a are not the same; points C and H_a are not the same; points H and H_a must be different; points H and A are not the same; points H_b and H are not the same; points H_b and C must be different; points H_b and M_b are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D22,D3,D30,D5,D6,D8,D9,GD01,GD02,GL03,GL04,GL09,L52,L53,L54]

Solving time: 9.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{b} 89.36 77.83
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_l H_{b}
cmark_lt M_{b}
color 0 0 0
fontsize 8

% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: line b and circle k(E_{c},C) intersect% DET: points H_{b} and C must be different
% Constructing a point P_{\_G200293} which is a foot of the point E_{c} on the line b
foot P_{\_G200293} E_{c} b
cmark_r P_{\_G200293}
color 200 200 200
drawline E_{c} P_{\_G200293}
color 0 0 0
```

```
% Constructing a point C which is an image of the point H_{b} in the symmetry to point/line P_{\_G
    200293}
sim C P_{\_G200293} H_{b}
cmark_l C



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point A such that M_{b}A/M_{b}C=-1
towards A M_{b} C -1
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% DET: points H and A are not the same
% Constructing a line h_{a} which passes through point H and point A
line h_{a} H A

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(E_{c},C) intersect% DET: points H and H_{a} must be different
% Constructing a point P_{\_G200730} which is a foot of the point E_{c} on the line h_{a}
foot P_{\_G200730} E_{c} h_{a}
cmark_r P_{\_G200730}
color 200 200 200
drawline E_{c} P_{\_G200730}
color 0 0 0

% Constructing a point H_{a} which is an image of the point H in the symmetry to point/line P_{\_G
    200730}
sim H_{a} P_{\_G200730} H
```

```
cmark_r H_{a}


% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines h_{b} and a are not parallel% DET: lines h_{b} and a are not the same
% Constructing a point B which belongs to line h_{b} and line a
intersec B h_{b} a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and a are not parallel; line h_{a} and circle k(E_{c},C)
    intersect; line b and circle k(E_{c},C) intersect; points H_{b} and E_{c} are not the same
% Determination conditions: lines h_{b} and a are not the same; points C and H_{a} are not the same
    ; points H and H_{a} must be different; points H and A are not the same; points H_{b} and H are
     not the same; points H_{b} and C must be different; points H_{b} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.232 seconds.

NDG conditions Points M_b, H_b and E_c are not collinear

Points M_b, H_b and E_c are not collinear

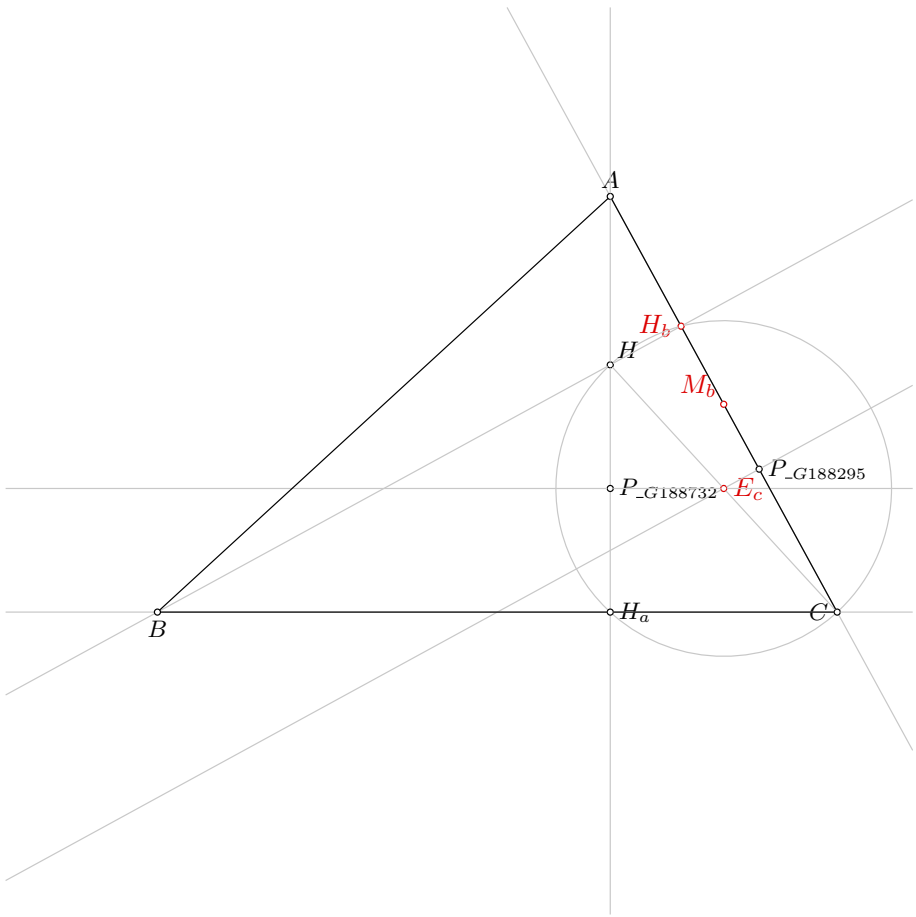

Figure 1: Illustration of the problem 1011

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving M_b=_M_b

NDG conditions are:

$S_{H_bCH_a} \neq S_{HCH_a}$ i.e., lines H_bH and CH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{CBF^1_{\_h_b}}$ i.e., lines AC and $BF^1_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving M_b=_M_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 1012

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1012: Given a point E_c, a point M_c and a point H_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
2. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;
3. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;
4. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
5. Choose freely a point H_b on the circle $k(N, M_a)$ (rule WOncircle);
6. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
7. Using the circle $k(N, M_a)$, the circle $k(E_c, C)$, the point H_b, the point N and the point E_c, construct a point H_a (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_c, C)$ intersect % DET: circles $k(N, M_a)$ and $k(E_c, C)$ are not the same; points H_b and H_a must be different;
8. Choose freely a point A on the circle $k(M_c, A)$ (rule WOncircle);
9. Using the point A and the point M_c, construct a point B (rule W01); ;
10. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;

11. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;

12. Using the line b and the line a, construct a point C (rule W03); % NDG: lines b and a are not parallel % DET: lines b and a are not the same.

Non-degenerate conditions: lines b and a are not parallel; circles $k(N, M_a)$ and $k(E_c, C)$ intersect; points H_b and E_c are not the same; points E_c and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: lines b and a are not the same; points H_a and B are not the same; points A and H_b are not the same; circles $k(N, M_a)$ and $k(E_c, C)$ are not the same; points H_b and H_a must be different; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points E_c and M_c are not the same.

Rules used: [W01,W02,W03,W06,W08,W14,WOncircle1]

Lemmas used: [D20,D32,D5,D6,GD01,GD02,GL01,GL03,L18,L19,L20,L24,L41,L42,L53,L54]

Solving time: 65.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point M_{c} 50 67.5
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_lt M_{c}
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
color 0 0 0
```

```
color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0


% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{b} on the circle with center N through point E_{c}
oncircle H_{b} N E_{c}
cmark_l H_{b}
color 200 200 200
drawcircle N E_{c}
color 0 0 0


% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(E_{c},C) intersect% DET: circles k(N,M_{a}) and k(E_{c},C) are not
    the same; points H_{b} and H_{a} must be different
% Constructing a line L_{\_G228720} which passes through point N and point E_{c}
line L_{\_G228720} N E_{c}

color 200 200 200
drawline L_{\_G228720}
color 0 0 0


% Constructing a point H_{a} which is an image of the point H_{b} in the symmetry to point/line L
    _{\_G228720}
sim H_{a} L_{\_G228720} H_{b}
cmark_r H_{a}
```

```
% Choosing randomly a point A on the circle with center M_{c} through point H_{b}
oncircle A M_{c} H_{b}
cmark_t A
color 200 200 200
drawcircle M_{c} H_{b}
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: lines b and a are not parallel% DET: lines b and a are not the same
% Constructing a point C which belongs to line b and line a
intersec C b a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and a are not parallel; circles k(N,M_{a}) and k(E_{c},C)
    intersect; points H_{b} and E_{c} are not the same; points E_{c} and N are not the same; lines
    m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel
% Determination conditions: lines b and a are not the same; points H_{a} and B are not the same;
    points A and H_{b} are not the same; circles k(N,M_{a}) and k(E_{c},C) are not the same; points
```

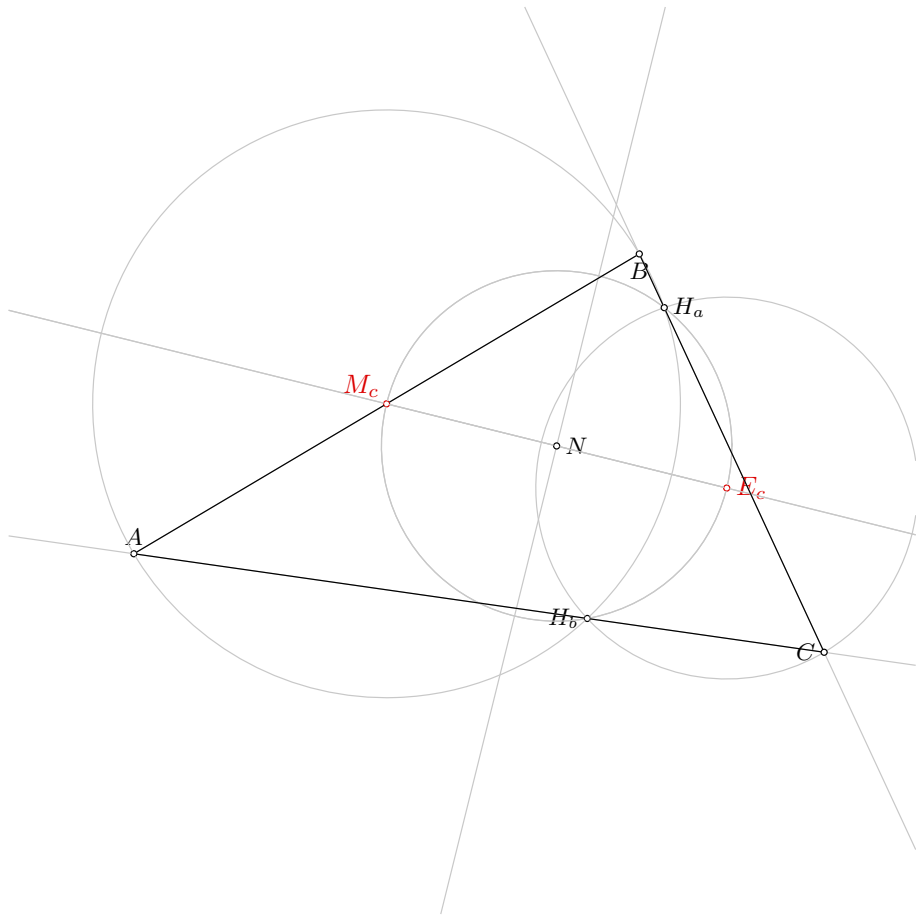

Figure 1: Illustration of the problem 1012

```
H_{b} and H_{a} must be different; lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the same;
points E_{c} and M_{c} are not the same; points E_{c} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.16 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving M_c=_M_c

NDG conditions are:

$S_{M^0_{m(E_cM_c)}E_cM_c} \neq S_{T^1_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^0_{m(E_cM_c)}T^1_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{AH_aB} \neq S_{H_bH_aB}$ i.e., lines AH_b and H_aB are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{CBF^3_{\_h_b}}$ i.e., lines AC and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 1013

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1013: Given a point H_b, a point N and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;
2. Choose freely a point E_c on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
4. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
5. Using the point H_b and the point E_c, construct a circle $k(E_c, C)$ (rule W06); % NDG: points H_b and E_c are not the same;
6. Using the circle $k(N, M_a)$, the circle $k(E_c, C)$, the point H_b, the point N and the point E_c, construct a point H_a (rule W08); % NDG: circles $k(N, M_a)$ and $k(E_c, C)$ intersect % DET: circles $k(N, M_a)$ and $k(E_c, C)$ are not the same; points H_b and H_a must be different;
7. Choose freely a point A on the circle $k(M_c, A)$ (rule WOncircle);
8. Using the point A and the point M_c, construct a point B (rule W01); ;
9. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
10. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;

11. Using the line b and the line a, construct a point C (rule W03); % NDG: lines b and a are not parallel % DET: lines b and a are not the same.

Non-degenerate conditions: lines b and a are not parallel; circles $k(N, M_a)$ and $k(E_c, C)$ intersect; points H_b and E_c are not the same; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points H_b and N are not the same.

Determination conditions: lines b and a are not the same; points H_a and B are not the same; points A and H_b are not the same; circles $k(N, M_a)$ and $k(E_c, C)$ are not the same; points H_b and H_a must be different; points E_c and M_c must be different; points E_c and N are not the same.

Rules used: [W01,W02,W03,W05a,W06,W08,WOncircle1]

Lemmas used: [D20,D32,D5,D6,GD01,GD02,GL01,GL03,L18,L19,L20,L24,L41,L42,L53,L54]

Solving time: 57.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{b} 89.36 77.83
point N 72.5 61.93
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_l H_{b}
cmark_r N
cmark_r E_{c}
color 0 0 0
fontsize 8

% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{c} on the circle with center N through point H_{b}
oncircle E_{c} N H_{b}
cmark_r E_{c}
color 200 200 200
drawcircle N H_{b}
color 0 0 0


% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N
```

```
color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0


% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}


% NDG: points H_{b} and E_{c} are not the same
% Constructing a circle k(E_{c},C) whose center is at point E_{c} and which passes through point H
    _{b}
circle k(E_{c},C) E_{c} H_{b}

color 200 200 200
drawcircle k(E_{c},C)
color 0 0 0


% NDG: circles k(N,M_{a}) and k(E_{c},C) intersect% DET: circles k(N,M_{a}) and k(E_{c},C) are not
    the same; points H_{b} and H_{a} must be different
% Constructing a line L_{\_G40337} which passes through point N and point E_{c}
line L_{\_G40337} N E_{c}

color 200 200 200
drawline L_{\_G40337}
color 0 0 0


% Constructing a point H_{a} which is an image of the point H_{b} in the symmetry to point/line L
    _{\_G40337}
sim H_{a} L_{\_G40337} H_{b}
cmark_r H_{a}


% Choosing randomly a point A on the circle with center M_{c} through point H_{b}
oncircle A M_{c} H_{b}
cmark_t A
color 200 200 200
drawcircle M_{c} H_{b}
color 0 0 0


% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0
```

```
% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: lines b and a are not parallel% DET: lines b and a are not the same
% Constructing a point C which belongs to line b and line a
intersec C b a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and a are not parallel; circles k(N,M_{a}) and k(E_{c},C)
    intersect; points H_{b} and E_{c} are not the same; line m(H_{b}H_{a}) and circle k(N,M_{a})
    intersect; points H_{b} and N are not the same
% Determination conditions: lines b and a are not the same; points H_{a} and B are not the same;
    points A and H_{b} are not the same; circles k(N,M_{a}) and k(E_{c},C) are not the same; points
     H_{b} and H_{a} must be different; points E_{c} and M_{c} must be different; points E_{c} and
    N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_b=_H_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 2976 terms.

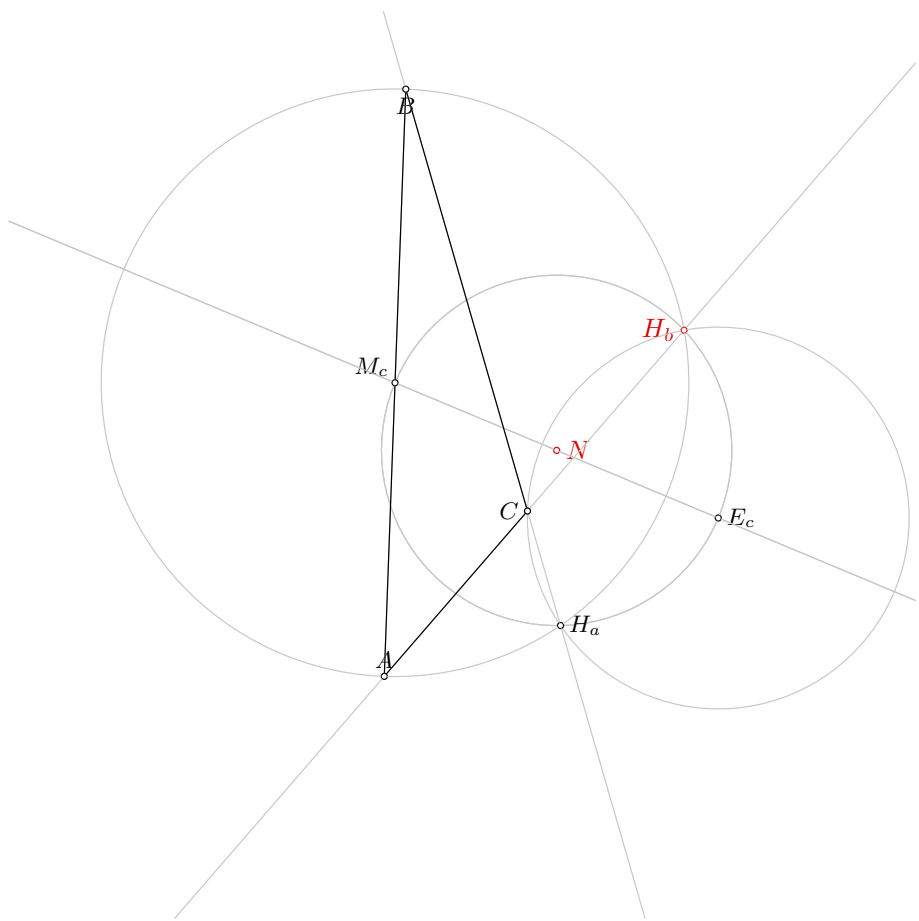

Figure 1: Illustration of the problem 1013

Time Complexity: Time spent by the prover is 12.568 seconds.
NDG conditions Points E_c and N are not identical
Line through points H_b and N is not perpendicular to line through points N and E_c
Line through points H_b and A is not parallel with line through points B and H_a
Points A and N are not identical
Points A and C are not identical
Line through points H_b and N is not parallel with line through points A and C

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_b=_H_b

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_b=_H_b

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_b=_H_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 1014

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1014: Given a point E_c, a point H_b and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1015

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1015: Given a point E_c, a point H_b and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1016

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1016: Given a point E_c, a point H_b and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1017

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1017: Given a point E_c, a point H_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1018

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1018: Given a point E_c, a point H_c and a point I, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1019

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1019: Given a point E_c, a point H_c and a point M_a, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Using the point H_c and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points H_c and M_a are not the same;
3. Using the circle $k(M_a, B)$, the line h_c, the point M_a and the point H_c, construct a point C (rule W05); % NDG: line h_c and circle $k(M_a, B)$ intersect % DET: points H_c and C must be different;
4. Using the point C and the point E_c, construct a point H (rule W01); ;
5. Using the point M_a and the point C, construct a point B (rule W01); ;
6. Using the point H_c and the point B, construct a line c (rule W02); % DET: points H_c and B are not the same;
7. Using the point H and the point B, construct a line h_b (rule W02); % DET: points H and B are not the same;
8. Using the circle $k(M_a, B)$, the line h_b, the point M_a and the point B, construct a point H_b (rule W05); % NDG: line h_b and circle $k(M_a, B)$ intersect % DET: points B and H_b must be different;
9. Using the point C and the point H_b, construct a line b (rule W02); % DET: points C and H_b are not the same;
10. Using the line c and the line b, construct a point A (rule W03); % NDG: lines c and b are not parallel % DET: lines c and b are not the same.

Non-degenerate conditions: lines c and b are not parallel; line h_b and circle $k(M_a, B)$ intersect; line h_c and circle $k(M_a, B)$ intersect; points H_c and M_a are not the same.

Determination conditions: lines c and b are not the same; points C and H_b are not the same; points B and H_b must be different; points H and B are not the same; points H_c and B are not the same; points H_c and C must be different; points E_c and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D21,D3,D30,D6,D7,D9,GD01,GD02,GL03,GL04,GL09,L3,L37,L38,L39]

Solving time: 8.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{c} 68.91 84.83
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H_{c}
cmark_r M_{a}
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{c} and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point H
    _{c}
circle k(M_{a},B) M_{a} H_{c}

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: line h_{c} and circle k(M_{a},B) intersect% DET: points H_{c} and C must be different
% Constructing a point P_{\_G98111} which is a foot of the point M_{a} on the line h_{c}
foot P_{\_G98111} M_{a} h_{c}
cmark_r P_{\_G98111}
color 200 200 200
drawline M_{a} P_{\_G98111}
color 0 0 0
```

```
% Constructing a point C which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    98111}
sim C P_{\_G98111} H_{c}
cmark_l C



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0


% DET: points H_{c} and B are not the same
% Constructing a line c which passes through point H_{c} and point B
line c H_{c} B

color 200 200 200
drawline c
color 0 0 0



% DET: points H and B are not the same
% Constructing a line h_{b} which passes through point H and point B
line h_{b} H B

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: line h_{b} and circle k(M_{a},B) intersect% DET: points B and H_{b} must be different
% Constructing a point P_{\_G98548} which is a foot of the point M_{a} on the line h_{b}
foot P_{\_G98548} M_{a} h_{b}
cmark_r P_{\_G98548}
color 200 200 200
drawline M_{a} P_{\_G98548}
color 0 0 0

% Constructing a point H_{b} which is an image of the point B in the symmetry to point/line P_{\_G
    98548}
sim H_{b} P_{\_G98548} B
```

```
cmark_l H_{b}


% DET: points C and H_{b} are not the same
% Constructing a line b which passes through point C and point H_{b}
line b C H_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines c and b are not parallel% DET: lines c and b are not the same
% Constructing a point A which belongs to line c and line b
intersec A c b
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and b are not parallel; line h_{b} and circle k(M_{a},B)
    intersect; line h_{c} and circle k(M_{a},B) intersect; points H_{c} and M_{a} are not the same
% Determination conditions: lines c and b are not the same; points C and H_{b} are not the same;
    points B and H_{b} must be different; points H and B are not the same; points H_{c} and B are
    not the same; points H_{c} and C must be different; points E_{c} and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

4.1.3 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.12 seconds.

NDG conditions There are no NDG conditions for this theorem

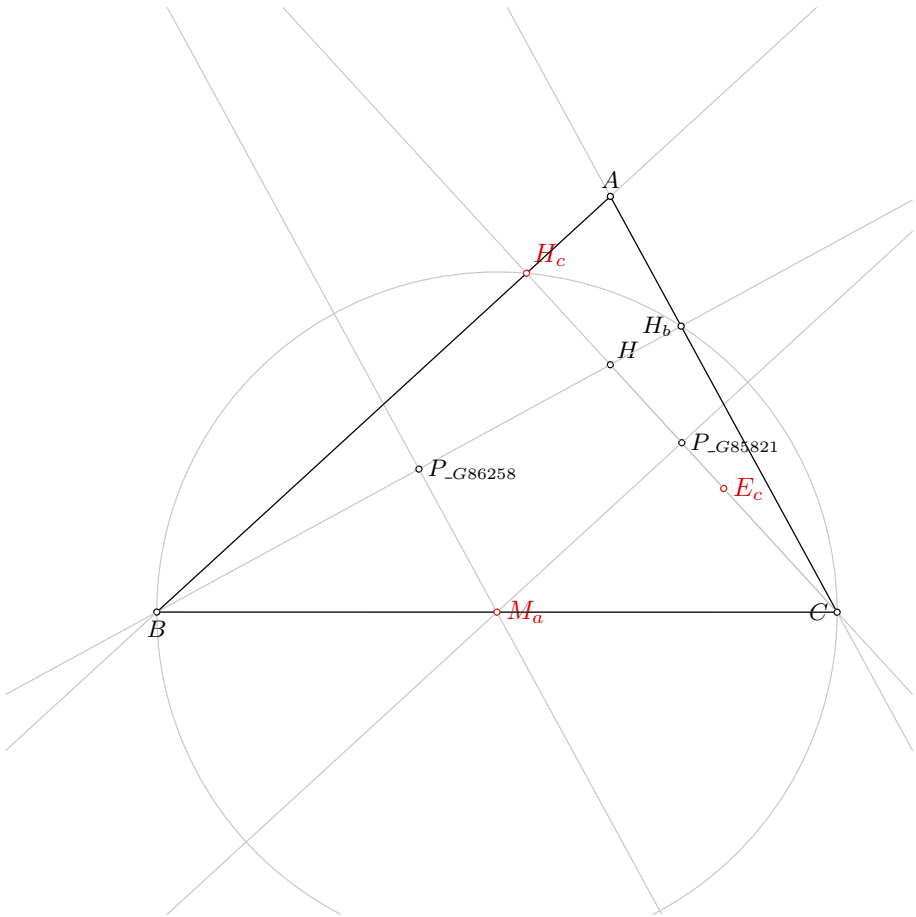

Figure 1: Illustration of the problem 1019

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving M_a=_M_a

NDG conditions are:

$S_{H_cCH_b} \neq S_{BCH_b}$ i.e., lines H_cB and CH_b are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^2_{\_h_c}} \neq S_{BCF^2_{\_h_c}}$ i.e., lines AB and $CF^2_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 44
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving M_a=_M_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 1020

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1020: Given a point E_c, a point H_c and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Using the point H_c and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points H_c and M_b are not the same;
3. Using the circle $k(M_b, C)$, the line h_c, the point M_b and the point H_c, construct a point C (rule W05); % NDG: line h_c and circle $k(M_b, C)$ intersect % DET: points H_c and C must be different;
4. Using the point C and the point E_c, construct a point H (rule W01); ;
5. Using the point M_b and the point C, construct a point A (rule W01); ;
6. Using the point H_c and the point A, construct a line c (rule W02); % DET: points H_c and A are not the same;
7. Using the point H and the point A, construct a line h_a (rule W02); % DET: points H and A are not the same;
8. Using the circle $k(M_b, C)$, the line h_a, the point M_b and the point A, construct a point H_a (rule W05); % NDG: line h_a and circle $k(M_b, C)$ intersect % DET: points A and H_a must be different;
9. Using the point C and the point H_a, construct a line a (rule W02); % DET: points C and H_a are not the same;
10. Using the line c and the line a, construct a point B (rule W03); % NDG: lines c and a are not parallel % DET: lines c and a are not the same.

Non-degenerate conditions: lines c and a are not parallel; line h_a and circle $k(M_b, C)$ intersect; line h_c and circle $k(M_b, C)$ intersect; points H_c and M_b are not the same.

Determination conditions: lines c and a are not the same; points C and H_a are not the same; points A and H_a must be different; points H and A are not the same; points H_c and A are not the same; points H_c and C must be different; points E_c and H_c are not the same.

Rules used: [W01,W02,W03,W05,W06]

Lemmas used: [D10,D22,D3,D30,D5,D7,D8,GD01,GD02,GL03,GL04,GL09,L3,L43,L44,L45]

Solving time: 8.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{c} 68.91 84.83
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H_{c}
cmark_lt M_{b}
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{c} and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point H
    _{c}
circle k(M_{b},C) M_{b} H_{c}

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: line h_{c} and circle k(M_{b},C) intersect% DET: points H_{c} and C must be different
% Constructing a point P_{\_G124467} which is a foot of the point M_{b} on the line h_{c}
foot P_{\_G124467} M_{b} h_{c}
cmark_r P_{\_G124467}
color 200 200 200
drawline M_{b} P_{\_G124467}
color 0 0 0
```

```
% Constructing a point C which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    124467}
sim C P_{\_G124467} H_{c}
cmark_l C



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point A such that M_{b}A/M_{b}C=-1
towards A M_{b} C -1
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0


% DET: points H_{c} and A are not the same
% Constructing a line c which passes through point H_{c} and point A
line c H_{c} A

color 200 200 200
drawline c
color 0 0 0



% DET: points H and A are not the same
% Constructing a line h_{a} which passes through point H and point A
line h_{a} H A

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: line h_{a} and circle k(M_{b},C) intersect% DET: points A and H_{a} must be different
% Constructing a point P_{\_G124904} which is a foot of the point M_{b} on the line h_{a}
foot P_{\_G124904} M_{b} h_{a}
cmark_r P_{\_G124904}
color 200 200 200
drawline M_{b} P_{\_G124904}
color 0 0 0

% Constructing a point H_{a} which is an image of the point A in the symmetry to point/line P_{\_G
    124904}
sim H_{a} P_{\_G124904} A
```

```
cmark_r H_{a}


% DET: points C and H_{a} are not the same
% Constructing a line a which passes through point C and point H_{a}
line a C H_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines c and a are not parallel% DET: lines c and a are not the same
% Constructing a point B which belongs to line c and line a
intersec B c a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and a are not parallel; line h_{a} and circle k(M_{b},C)
    intersect; line h_{c} and circle k(M_{b},C) intersect; points H_{c} and M_{b} are not the same
% Determination conditions: lines c and a are not the same; points C and H_{a} are not the same;
    points A and H_{a} must be different; points H and A are not the same; points H_{c} and A are
    not the same; points H_{c} and C must be different; points E_{c} and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.119 seconds.

NDG conditions There are no NDG conditions for this theorem

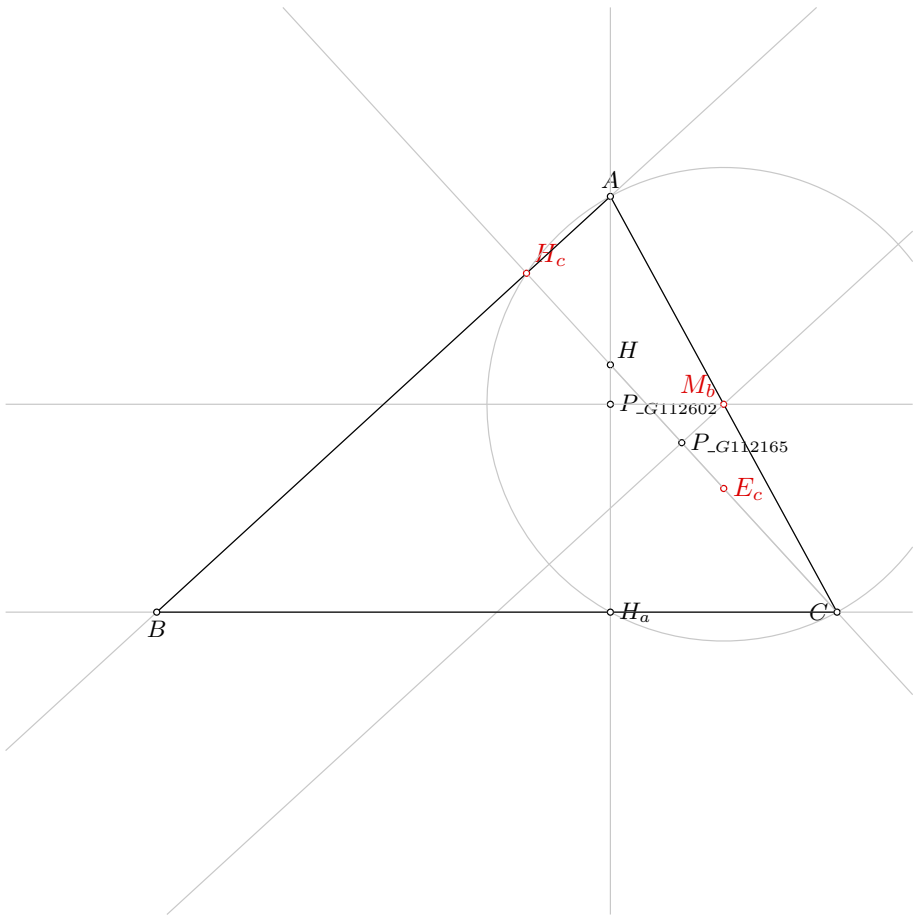

Figure 1: Illustration of the problem 1020

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving M_b=_M_b

NDG conditions are:

$S_{H_cCH_a} \neq S_{ACH_a}$ i.e., lines H_cA and CH_a are not parallel (construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^1_{\_h_b}} \neq S_{F^0_{\_h_a}BF^1_{\_h_b}}$ i.e., lines $AF^0_{\_h_a}$ and $BF^1_{\_h_b}$ are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^2_{\_h_c}} \neq S_{BCF^2_{\_h_c}}$ i.e., lines AB and $CF^2_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving M_b=_M_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 1021

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1021: Given a point H_c, a point M_c and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
2. Using the point H_c and the line c, construct a line h_c (rule W10b); ;
3. Choose freely a point E_c on the line h_c (rule WOnline2);
4. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
5. Using the point E_c and the point H_c, construct a line $m(E_cH_c)$ (rule W14); % DET: points E_c and H_c are not the same;
6. Using the line $m(E_cH_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not the same;
7. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
8. Choose freely a point A on the line c (rule WOnline1) ;
9. Using the point A and the point M_c, construct a point B (rule W01); ;
10. Using the point A and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points A and M_c are not the same;

11. Using the circle $k(N, M_a)$ and the circle $k(M_c, A)$, construct a point H_a and a point H_b (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_c, A)$ intersect % DET: circles $k(N, M_a)$ and $k(M_c, A)$ are not the same;

12. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

13. Using the line h_c and the line h_a, construct a point H (rule W03); % NDG: lines h_c and h_a are not parallel % DET: lines h_c and h_a are not the same;

14. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: lines h_c and h_a are not parallel; circles $k(N, M_a)$ and $k(M_c, A)$ intersect; points A and M_c are not the same; points E_c and N are not the same; lines $m(E_cH_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: lines h_c and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; lines $m(E_cH_c)$ and $m(H_bH_a)$ are not the same; points E_c and H_c are not the same; points E_c and M_c are not the same; points H_c and M_c are not the same.

Rules used: [W01,W02,W03,W06,W07,W10b,W14,WOnline1,WOnline2]

Lemmas used: [D10,D20,D3,D30,D32,D5,D7,D8,GD01,GD02,GL01,GL03,GL04,GL09,L19,L20,L21,L24,L3,L41

Solving time: 689.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{c} 68.91 84.83
point M_{c} 50 67.5
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_rt H_{c}
cmark_lt M_{c}
cmark_r E_{c}
color 0 0 0
fontsize 8

% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% Constructing a line h_{c} which is perpendicular to line c and which passes through point H_{c}
```

```
perp h_{c} H_{c} c

color 200 200 200
drawline h_{c}
color 0 0 0




% Generating random value V[_G154872]
random V[_G154872]


% Calculating value V[_G154893] using formula V[_G154872]*20
expression V[_G154893] { V[_G154872]*20 }


% Constructing a point E_{c} which is a point for which holds H_{c}E_{c} = V[_G154893] and angle M
    _{c}H_{c}E_{c} = 90
turtle E_{c} M_{c} H_{c} 90 V[_G154893]
cmark_r E_{c}


% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% DET: points E_{c} and H_{c} are not the same
% Constructing bisector m(E_{c}H_{c}) of the segment E_{c}H_{c}
med m(E_{c}H_{c}) E_{c} H_{c}

color 200 200 200
drawline m(E_{c}H_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} H_{c}
color 0 0 0


% NDG: lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}H_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}H_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}H_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}
```

```
color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% Choosing randomly a point A on the line H_{c}M_{c}
online A H_{c} M_{c}
cmark_t A
color 200 200 200
drawline H_{c} M_{c}
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% NDG: points A and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point A
circle k(M_{c},A) M_{c} A

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{c},A) intersect% DET: circles k(N,M_{a}) and k(M_{c},A) are not
    the same
% Constructing points H_{a} and H_{b} which are in intersection of k(N,M_{a}) and k(M_{c},A)
intersec2 H_{a} H_{b} k(N,M_{a}) k(M_{c},A)
cmark_r H_{a}
cmark_l H_{b}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{c} and h_{a} are not parallel% DET: lines h_{c} and h_{a} are not the same
% Constructing a point H which belongs to line h_{c} and line h_{a}
intersec H h_{c} h_{a}
```

```
cmark_rt H



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{c
    },A) intersect; points A and M_{c} are not the same; points E_{c} and N are not the same; lines
     m(E_{c}H_{c}) and m(H_{b}H_{a}) are not parallel
% Determination conditions: lines h_{c} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{c},A) are not the same; lines m(E_{c}H_{c}) and m(H_{b}H_{a})
     are not the same; points E_{c} and H_{c} are not the same; points E_{c} and M_{c} are not the
    same; points H_{c} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_c=_H_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 13 terms.

Time Complexity: Time spent by the prover is 0.205 seconds.

NDG conditions Points A and E_c are not identical

Points M_c and N are not identical

Line through points N and M_c is not perpendicular to line through points M_c and H_c

Line through points E_c and H_c is not parallel with line through points A and H_a

Line through points A and M_c is not perpendicular to line through points M_c and B

4.1.2 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.039 seconds.

NDG conditions There are no NDG conditions for this theorem

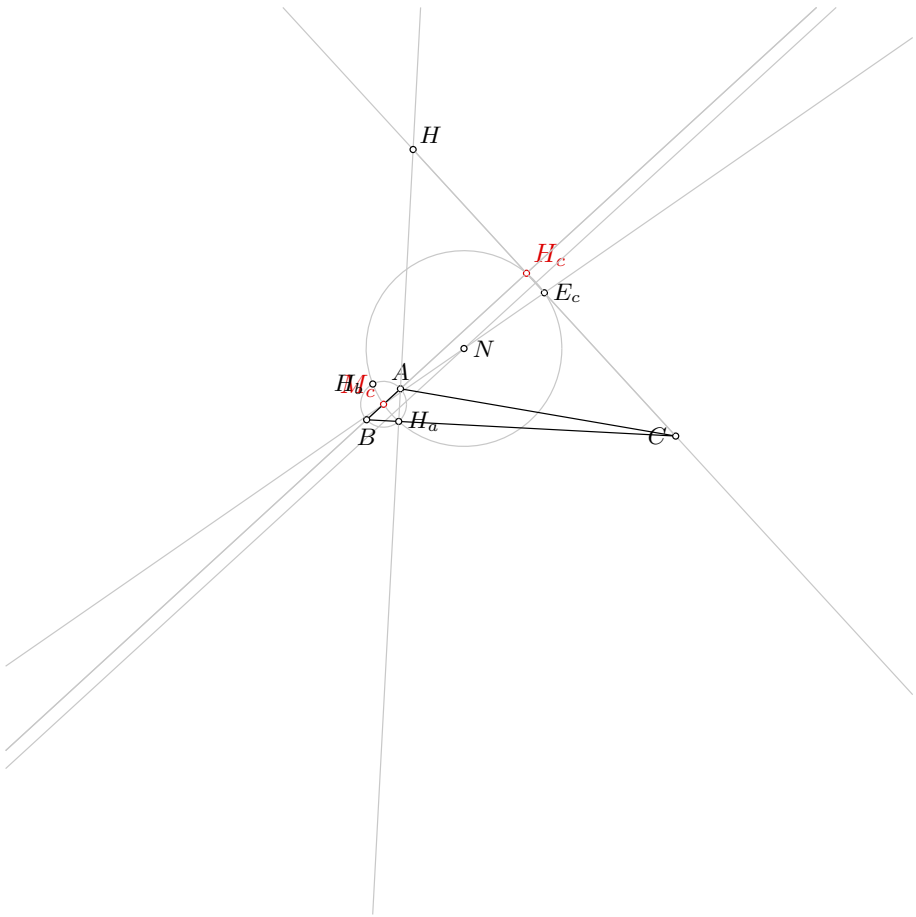

Figure 1: Illustration of the problem 1021

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_c=_H_c

Proving failed

4.2.2 Proving M_c=_M_c

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_c=_H_c

Proving failed

4.3.2 Proving M_c=_M_c

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_c=_H_c

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 1022

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1022: Given a point H_c, a point N and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;
2. Choose freely a point E_c on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
4. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
5. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
6. Using the point M_c and the point H_c, construct a line c (rule W02); % DET: points M_c and H_c are not the same;
7. Choose freely a point A on the line c (rule WOnline1) ;
8. Using the point A and the point M_c, construct a point B (rule W01); ;
9. Using the point A and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points A and M_c are not the same;
10. Using the circle $k(N, M_a)$ and the circle $k(M_c, A)$, construct a point H_a and a point H_b (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_c, A)$ intersect % DET: circles $k(N, M_a)$ and $k(M_c, A)$ are not the same;

11. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

12. Using the line h_c and the line h_a, construct a point H (rule W03); % NDG: lines h_c and h_a are not parallel % DET: lines h_c and h_a are not the same;

13. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: lines h_c and h_a are not parallel; circles $k(N, M_a)$ and $k(M_c, A)$ intersect; points A and M_c are not the same; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: lines h_c and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points M_c and H_c are not the same; points E_c and M_c must be different; points E_c and N are not the same; points E_c and H_c are not the same.

Rules used: [W01,W02,W03,W05a,W06,W07,WOncircle1,WOnline1]

Lemmas used: [D10,D20,D3,D30,D32,D5,D7,D8,GD01,GD02,GL01,GL03,GL04,GL09,L18,L19,L20,L21,L24,L3

Solving time: 571.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{c} 68.91 84.83
point N 72.5 61.93
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_rt H_{c}
cmark_r N
cmark_r E_{c}
color 0 0 0
fontsize 8

% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{c} on the circle with center N through point H_{c}
oncircle E_{c} N H_{c}
cmark_r E_{c}
color 200 200 200
drawcircle N H_{c}
color 0 0 0
```

```
% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}


% DET: points M_{c} and H_{c} are not the same
% Constructing a line c which passes through point M_{c} and point H_{c}
line c M_{c} H_{c}

color 200 200 200
drawline c
color 0 0 0



% Choosing randomly a point A on the line H_{c}M_{c}
online A H_{c} M_{c}
cmark_t A
color 200 200 200
drawline H_{c} M_{c}
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0
```

```
% NDG: points A and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point A
circle k(M_{c},A) M_{c} A

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{c},A) intersect% DET: circles k(N,M_{a}) and k(M_{c},A) are not
    the same
% Constructing points H_{a} and H_{b} which are in intersection of k(N,M_{a}) and k(M_{c},A)
intersec2 H_{a} H_{b} k(N,M_{a}) k(M_{c},A)
cmark_r H_{a}
cmark_l H_{b}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{c} and h_{a} are not parallel% DET: lines h_{c} and h_{a} are not the same
% Constructing a point H which belongs to line h_{c} and line h_{a}
intersec H h_{c} h_{a}
cmark_rt H



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{c
    },A) intersect; points A and M_{c} are not the same; line m(H_{b}H_{a}) and circle k(N,M_{a})
    intersect; points H_{c} and N are not the same
% Determination conditions: lines h_{c} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{c},A) are not the same; points M_{c} and H_{c} are not the
    same; points E_{c} and M_{c} must be different; points E_{c} and N are not the same; points E_{
    c} and H_{c} are not the same
```

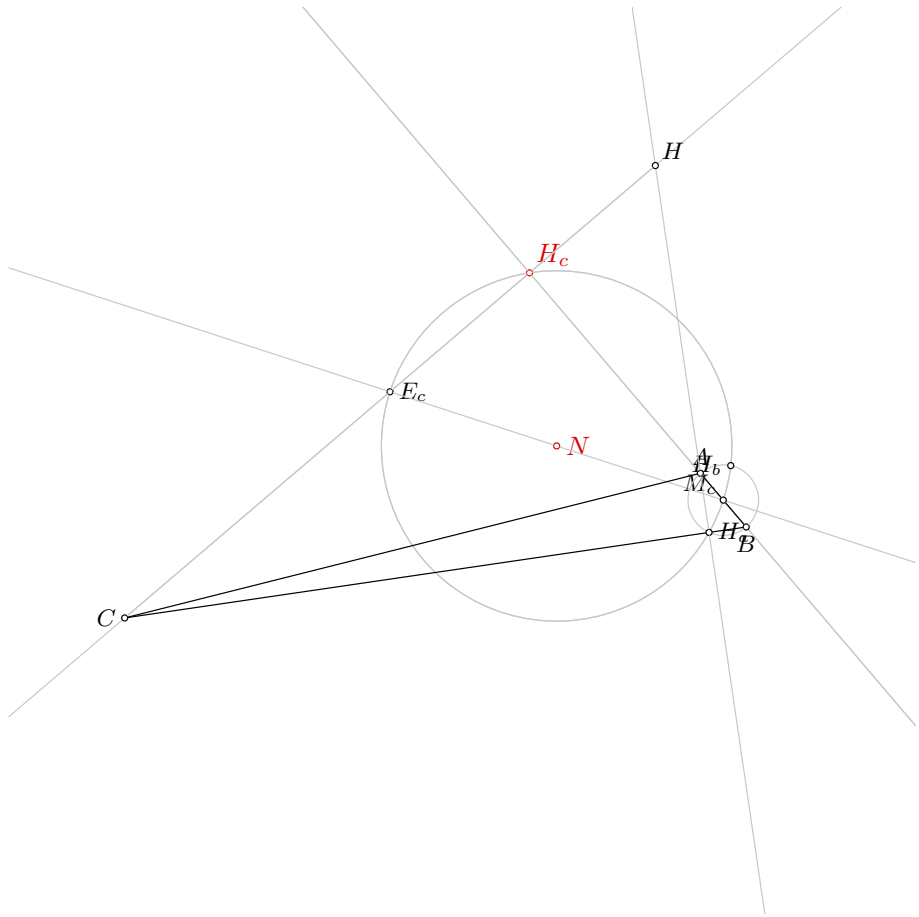

Figure 1: Illustration of the problem 1022

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_c=_H_c

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_c=_H_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_c=_H_c

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_c=_H_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 1023

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1023: Given a point E_c, a point H_c and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
2. Using the point H_c and the line h_c, construct a line c (rule W10a); ;
3. Using the point O and the line c, construct a line m_c (rule W10b); ;
4. Using the line m_c and the line c, construct a point M_c (rule W03); % NDG: lines m_c and c are not parallel % DET: lines m_c and c are not the same;
5. Using the point M_c and the point E_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points M_c and E_c are not the same;
6. Using the point E_c and the point H_c, construct a line $m(E_cH_c)$ (rule W14); % DET: points E_c and H_c are not the same;
7. Using the line $m(E_cH_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not the same;
8. Using the point O and the point N, construct a point H (rule W01); ;
9. Using the point E_c and the point H, construct a point C (rule W01); ;
10. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
11. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; lines $m(E_cH_c)$ and $m(H_bH_a)$ are not parallel; lines m_c and c are not parallel.

Determination conditions: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not the same; points E_c and H_c are not the same; points M_c and E_c are not the same; lines m_c and c are not the same; points E_c and H_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W10b,W14]

Lemmas used: [D10,D13,D20,D26,D30,D31,D32,D7,GD01,GD02,GL01,GL03,GL04,GL09,L1,L11,L12,L19,L20,

Solving time: 3.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point H_{c} 68.91 84.83
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_rt H_{c}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0




% Constructing a line c which is perpendicular to line h_{c} and which passes through point H_{c}
perp c H_{c} h_{c}

color 200 200 200
drawline c
color 0 0 0




% Constructing a line m_{c} which is perpendicular to line c and which passes through point O
perp m_{c} O c

color 200 200 200
drawline m_{c}
color 0 0 0
```

```
% NDG: lines m_{c} and c are not parallel% DET: lines m_{c} and c are not the same
% Constructing a point M_{c} which belongs to line m_{c} and line c
intersec M_{c} m_{c} c
cmark_lt M_{c}


% DET: points M_{c} and E_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point M_{c} and point E_{c}
line m(H_{b}H_{a}) M_{c} E_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% DET: points E_{c} and H_{c} are not the same
% Constructing bisector m(E_{c}H_{c}) of the segment E_{c}H_{c}
med m(E_{c}H_{c}) E_{c} H_{c}

color 200 200 200
drawline m(E_{c}H_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} H_{c}
color 0 0 0


% NDG: lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}H_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}H_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}H_{c}) m(H_{b}H_{a})
cmark_r N



% Constructing a point H such that OH/ON=2
towards H O N 2
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0
```

```
% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not parallel; lines m_{c} and c are not parallel
% Determination conditions: lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and H_{c} are not the same; points M_{c} and E_{c} are not the same; lines m_{c} and c are not
    the same; points E_{c} and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

4.1.3 Proving O=_O

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 513 terms.

Time Complexity: Time spent by the prover is 1.126 seconds.

NDG conditions Points A and B are not identical

Points A, B and C are not collinear

Point M_c is not the midpoint of segment with endpoints B and C

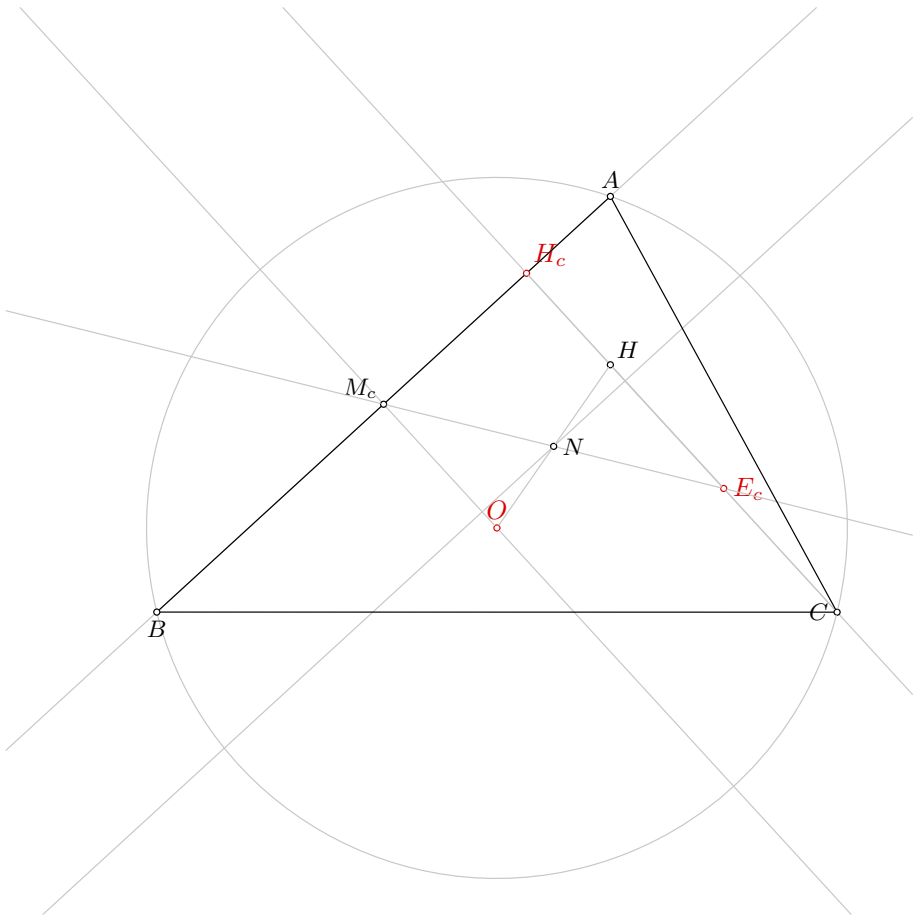

Figure 1: Illustration of the problem 1023

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 8016 terms.

Time Complexity: Time spent by the prover is 24.470 seconds.There are no ndg conditions.

4.3.2 Proving H_c=_H_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 18 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 1497 terms.

Time Complexity: Time spent by the prover is 3.590 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 1024

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1024: Given a point E_c, a point H_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1025

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1025: Given a point E_c, a point H_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1026

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1026: Given a point H_c, a point T_c and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point T_c, construct a line c (rule W02); % DET: points H_c and T_c are not the same;
2. Using the point H_c and the line c, construct a line h_c (rule W10b); ;
3. Choose freely a point E_c on the line h_c (rule WOnline2);
4. Using the point E_c and the point H_c, construct a line $m(E_cH_c)$ (rule W14); % DET: points E_c and H_c are not the same;
5. Choose freely a point A on the line c (rule WOnline1) ;
6. Using the point A and the point H_c, construct a line $m(AH_c)$ (rule W14); % DET: points A and H_c are not the same;
7. Choose freely a point B on the line c (rule WOnline1) ;
8. Using the point B and the point A, construct a point M_c (rule W01); ;
9. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
10. Using the line $m(E_cH_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not the same;
11. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;

12. Using the circle $k(N, M_a)$ and the line $m(AH_c)$, construct a point M_b and a point E_a (rule W04); % NDG: line $m(AH_c)$ and circle $k(N, M_a)$ intersect;

13. Using the point A and the point M_b, construct a point C (rule W01); .

Non-degenerate conditions: line $m(AH_c)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same; lines $m(E_cH_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: lines $m(E_cH_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points A and H_c are not the same; points E_c and H_c are not the same; points H_c and T_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W10b,W14,WOnline1,WOnline2]

Lemmas used: [D10,D20,D22,D25,D32,D7,GD02,GL01,GL03,GL04,L17,L19,L20,L21,L22,L24,L41,L42,L43,L45

Solving time: 209.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{c} 68.91 84.83
point T_{c} 55.38 72.43
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_rt H_{c}
cmark_rt T_{c}
cmark_r E_{c}
color 0 0 0
fontsize 8

% DET: points H_{c} and T_{c} are not the same
% Constructing a line c which passes through point H_{c} and point T_{c}
line c H_{c} T_{c}

color 200 200 200
drawline c
color 0 0 0




% Constructing a line h_{c} which is perpendicular to line c and which passes through point H_{c}
perp h_{c} H_{c} c

color 200 200 200
drawline h_{c}
color 0 0 0




% Generating random value V[_G44665]
```

```
random V[_G44665]


% Calculating value V[_G44686] using formula V[_G44665]*20
expression V[_G44686] { V[_G44665]*20 }


% Constructing a point E_{c} which is a point for which holds H_{c}E_{c} = V[_G44686] and angle T_{
    c}H_{c}E_{c} = 90
turtle E_{c} T_{c} H_{c} 90 V[_G44686]
cmark_r E_{c}


% DET: points E_{c} and H_{c} are not the same
% Constructing bisector m(E_{c}H_{c}) of the segment E_{c}H_{c}
med m(E_{c}H_{c}) E_{c} H_{c}

color 200 200 200
drawline m(E_{c}H_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} H_{c}
color 0 0 0



% Choosing randomly a point A on the line H_{c}T_{c}
online A H_{c} T_{c}
cmark_t A
color 200 200 200
drawline H_{c} T_{c}
color 0 0 0


% DET: points A and H_{c} are not the same
% Constructing bisector m(AH_{c}) of the segment AH_{c}
med m(AH_{c}) A H_{c}

color 200 200 200
drawline m(AH_{c})
color 0 0 0

color 200 200 200
drawsegment A H_{c}
color 0 0 0



% Choosing randomly a point B on the line AH_{c}
online B A H_{c}
cmark_b B
color 200 200 200
drawline A H_{c}
color 0 0 0
```

```
% Constructing a point M_{c} such that BM_{c}/BA=0.5
towards M_{c} B A 0.5
cmark_lt M_{c}
color 200 200 200
drawsegment B A
color 0 0 0


% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}H_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}H_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}H_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(AH_{c}) and circle k(N,M_{a}) intersect
% Constructing points M_{b} and E_{a} which are in intersection of k(N,M_{a}) and m(AH_{c})
intersec2 M_{b} E_{a} k(N,M_{a}) m(AH_{c})
cmark_lt M_{b}
cmark_r E_{a}



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



drawsegment A B
drawsegment A C
```

Figure 1: Illustration of the problem 1026

```
drawsegment B C

% Non-degenerate conditions: line m(AH_{c}) and circle k(N,M_{a}) intersect; points E_{c} and N are
     not the same; lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not parallel
% Determination conditions: lines m(E_{c}H_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and M_{c} are not the same; points A and H_{c} are not the same; points E_{c} and H_{c} are not
     the same; points H_{c} and T_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_c=_H_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.144 seconds.

NDG conditions Points A and E_c are not identical

4.1.2 Proving T_c=_T_c

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_c=_H_c

Proving failed

4.2.2 Proving T_c=_T_c

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_c=_H_c

Proving failed

4.3.2 Proving T_c=_T_c

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 52 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_c=_H_c

Proving failed

4.4.2 Proving T_c=_T_c

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 1027

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1027: Given a point E_c, a point I and a point M_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1028

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1028: Given a point E_c, a point I and a point M_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1029

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1029: Given a point E_c, a point I and a point M_c, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;

2. Using the point I and the point M_c, construct a line IM_c (rule W02); % DET: points I and M_c are not the same;

3. Using the point I and the point M_c, construct a circle $k_over(I, M_c)$ (rule W09); % NDG: points I and M_c are not the same;

4. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;

5. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;

6. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;

7. Using the point I, the circle $k(N, M_a)$, the point N and the point E_c, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

8. Using the circle $k(I, P_a)$ and the circle $k_over(I, M_c)$, construct a point C_{fi} and a point P_c (rule W07); % NDG: circles $k(I, P_a)$ and $k_over(I, M_c)$ intersect % DET: circles $k(I, P_a)$ and $k_over(I, M_c)$ are not the same;

9. Using the point P_c and the point M_c, construct a point $P`_c$ (rule W01); ;

10. Using the circle $k(I, P_a)$, the point M_c and the point I, construct a line $x3$ and a line c (rule W12); % NDG: point M_c is outside the circle $k(I, P_a)$;

11. Using the circle $k(N, M_a)$, the line c, the point N and the point M_c, construct a point H_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points M_c and H_c must be different;

12. Using the point H_c and the point E_c, construct a line h_c (rule W02); % DET: points H_c and E_c are not the same;

13. Using the point M_c and the line c, construct a line m_c (rule W10b); ;

14. Using the point $P`_c$ and the line $IM_c$, construct a line $CP`_c$ (rule W16); ;

15. Using the line $CP`_c$ and the line $h_c$, construct a point $C$ (rule W03); % NDG: lines $CP`_c$ and h_c are not parallel % DET: lines $CP`_c$ and h_c are not the same;

16. Using the point I and the point C, construct a line s_c (rule W02); % DET: points I and C are not the same;

17. Using the line m_c and the line s_c, construct a point N_c (rule W03); % NDG: lines m_c and s_c are not parallel % DET: lines m_c and s_c are not the same;

18. Using the point I and the point N_c, construct a circle $k(N_c, B)$ (rule W06); % NDG: points I and N_c are not the same;

19. Using the circle $k(N_c, B)$ and the line c, construct a point B and a point A (rule W04); % NDG: line c and circle $k(N_c, B)$ intersect.

Non-degenerate conditions: line c and circle $k(N_c, B)$ intersect; points I and N_c are not the same; lines m_c and s_c are not parallel; lines $CP`_c$ and h_c are not parallel; line c and circle $k(N, M_a)$ intersect; point M_c is outside the circle $k(I, P_a)$; circles $k(I, P_a)$ and $k_over(I, M_c)$ intersect; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points E_c and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel; points I and M_c are not the same.

Determination conditions: lines m_c and s_c are not the same; points I and C are not the same; lines $CP`_c$ and h_c are not the same; points H_c and E_c are not the same; points M_c and H_c must be different; circles $k(I, P_a)$ and $k_over(I, M_c)$ are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points I and M_c are not the same; points E_c and M_c are not the same.

Rules used: [W01,W02,W03,W04,W05,W06,W07,W09,W10b,W12,W14,W16,W22]

Lemmas used: [D10,D13,D20,D27,D30,D32,D49,D67,D7,D87,GD01,GD02,GL01,GL03,GL09,L119,L14,L18,L19

Solving time: 52.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point I 74.37 61.15
point M_{c} 50 67.5
```

```
color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_b I
cmark_lt M_{c}
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% DET: points I and M_{c} are not the same
% Constructing a line IM_{c} which passes through point I and point M_{c}
line IM_{c} I M_{c}

color 200 200 200
drawline IM_{c}
color 0 0 0



% NDG: points I and M_{c} are not the same
% Constructing midpoint P_{\_G106330} of the segment IM_{c}
midpoint P_{\_G106330} I M_{c}
cmark_r P_{\_G106330}

% Constructing a circle k_over(I,M_{c}) whose center is at point P_{\_G106330} and which passes
    through point I
circle k_over(I,M_{c}) P_{\_G106330} I

color 200 200 200
drawcircle k_over(I,M_{c})
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0
```

```
% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G106885] from point N to point E_{c}
distance V[_G106885] N E_{c}


% Calculating distance V[_G106909] from point N to point I
distance V[_G106909] N I


% Calculating value V[_G106930] using formula V[_G106885]/V[_G106909]
expression V[_G106930] { V[_G106885]/V[_G106909] }


% Constructing a point P_{\_G106961} such that NP_{\_G106961}/NI=V[_G106885]/V[_G106909]
towards P_{\_G106961} N I V[_G106930]
cmark_r P_{\_G106961}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    106961}
circle k(I,P_{a}) I P_{\_G106961}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: circles k(I,P_{a}) and k_over(I,M_{c}) intersect% DET: circles k(I,P_{a}) and k_over(I,M_{c
    }) are not the same
% Constructing points C_{fi} and P_{c} which are in intersection of k(I,P_{a}) and k_over(I,M_{c})
intersec2 C_{fi} P_{c} k(I,P_{a}) k_over(I,M_{c})
cmark_r C_{fi}
cmark_r P_{c}



% Constructing a point P‘_{c} such that P_{c}P‘_{c}/P_{c}M_{c}=2
```

```
towards P‘_{c} P_{c} M_{c} 2
cmark_r P‘_{c}
color 200 200 200
drawsegment P_{c} P‘_{c}
color 0 0 0


% NDG: point M_{c} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G107567} of the segment M_{c}I
midpoint P_{\_G107567} M_{c} I
cmark_r P_{\_G107567}

% Constructing a circle C_{\_G107570} whose center is at point P_{\_G107567} and which passes
    through point M_{c}
circle C_{\_G107570} P_{\_G107567} M_{c}

color 200 200 200
drawcircle C_{\_G107570}
color 0 0 0


% Constructing points P_{\_G107573} and P_{\_G107576} which are in intersection of C_{\_G107570}
    and k(I,P_{a})
intersec2 P_{\_G107573} P_{\_G107576} C_{\_G107570} k(I,P_{a})
cmark_r P_{\_G107573}
cmark_r P_{\_G107576}

% Constructing a line x3 which passes through point M_{c} and point P_{\_G107573}
line x3 M_{c} P_{\_G107573}

color 200 200 200
drawline x3
color 0 0 0


% Constructing a line c which passes through point M_{c} and point P_{\_G107576}
line c M_{c} P_{\_G107576}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(N,M_{a}) intersect% DET: points M_{c} and H_{c} must be different
% Constructing a point P_{\_G107910} which is a foot of the point N on the line c
foot P_{\_G107910} N c
cmark_r P_{\_G107910}
color 200 200 200
drawline N P_{\_G107910}
color 0 0 0

% Constructing a point H_{c} which is an image of the point M_{c} in the symmetry to point/line P
    _{\_G107910}
sim H_{c} P_{\_G107910} M_{c}
cmark_rt H_{c}
```

```
% DET: points H_{c} and E_{c} are not the same
% Constructing a line h_{c} which passes through point H_{c} and point E_{c}
line h_{c} H_{c} E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% Constructing a line m_{c} which is perpendicular to line c and which passes through point M_{c}
perp m_{c} M_{c} c

color 200 200 200
drawline m_{c}
color 0 0 0



% Constructing a line CP‘_{c} which contains the point P‘_{c} and is parallel to the line IM_{c}
parallel CP‘_{c} P‘_{c} IM_{c}

color 200 200 200
drawline CP‘_{c}
color 0 0 0



% NDG: lines CP‘_{c} and h_{c} are not parallel% DET: lines CP‘_{c} and h_{c} are not the same
% Constructing a point C which belongs to line CP‘_{c} and line h_{c}
intersec C CP‘_{c} h_{c}
cmark_l C


% DET: points I and C are not the same
% Constructing a line s_{c} which passes through point I and point C
line s_{c} I C

color 200 200 200
drawline s_{c}
color 0 0 0



% NDG: lines m_{c} and s_{c} are not parallel% DET: lines m_{c} and s_{c} are not the same
% Constructing a point N_{c} which belongs to line m_{c} and line s_{c}
intersec N_{c} m_{c} s_{c}
cmark_b N_{c}


% NDG: points I and N_{c} are not the same
% Constructing a circle k(N_{c},B) whose center is at point N_{c} and which passes through point I
```

```
circle k(N_{c},B) N_{c} I

color 200 200 200
drawcircle k(N_{c},B)
color 0 0 0



% NDG: line c and circle k(N_{c},B) intersect
% Constructing points B and A which are in intersection of k(N_{c},B) and c
intersec2 B A k(N_{c},B) c
cmark_b B
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(N_{c},B) intersect; points I and N_{c} are not the
     same; lines m_{c} and s_{c} are not parallel; lines CP'_{c} and h_{c} are not parallel; line c
     and circle k(N,M_{a}) intersect; point M_{c} is outside the circle k(I,P_{a}); circles k(I,P_{
    a}) and k_over(I,M_{c}) intersect; point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points E_{c} and N are not the same; lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are
    not parallel; points I and M_{c} are not the same
% Determination conditions: lines m_{c} and s_{c} are not the same; points I and C are not the same
    ; lines CP'_{c} and h_{c} are not the same; points H_{c} and E_{c} are not the same; points M_{
    c} and H_{c} must be different; circles k(I,P_{a}) and k_over(I,M_{c}) are not the same; lines
    m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the same; points E_{c} and M_{c} are not the same;
    points I and M_{c} are not the same; points E_{c} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving I=_I

Proving failed

4.1.3 Proving M_c=_M_c

Proving failed

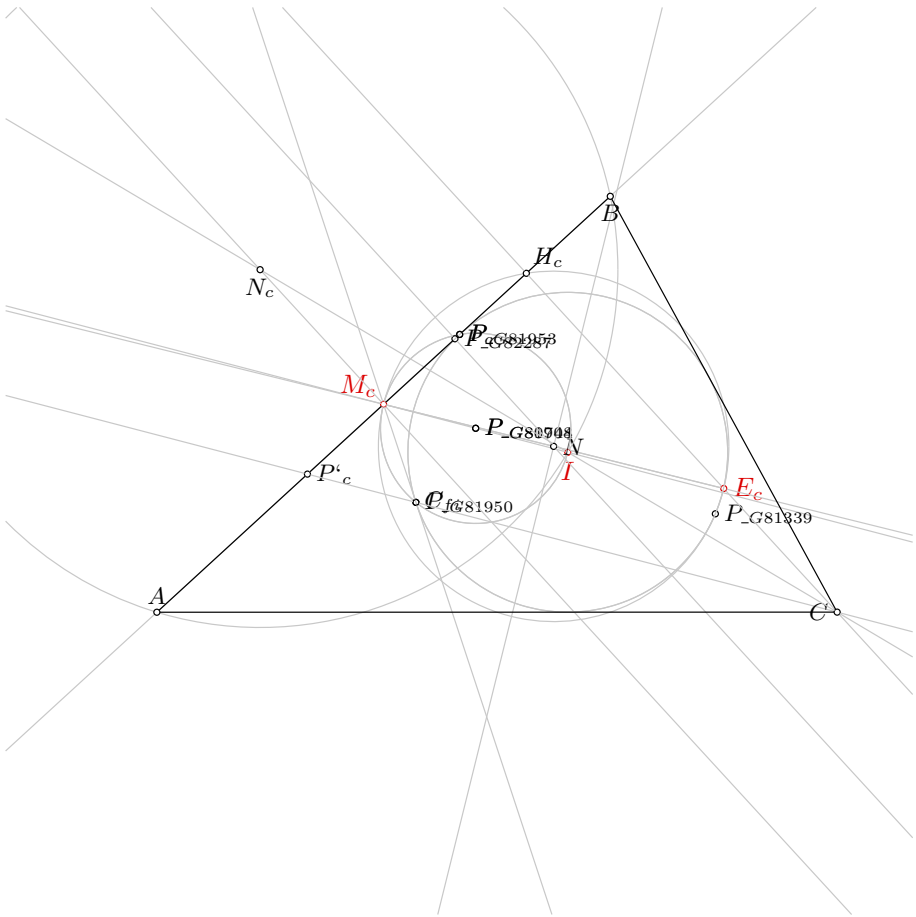

Figure 1: Illustration of the problem 1029

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving I=_I

Proving failed

4.2.3 Proving M_c=_M_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving I=_I

Proving failed

4.3.3 Proving M_c=_M_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving I=_I

Proving failed

4.4.3 Proving M_c=_M_c

Proving failed

Problem 1030

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1030: Given a point E_c, a point I and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;

2. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;

3. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;

4. Using the point M_c and the point I, construct a line IM_c (rule W02); % DET: points M_c and I are not the same;

5. Using the point I and the point M_c, construct a circle $k_over(I, M_c)$ (rule W09); % NDG: points I and M_c are not the same;

6. Using the point I, the circle $k(N, M_a)$, the point N and the point E_c, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

7. Using the circle $k(I, P_a)$ and the circle $k_over(I, M_c)$, construct a point C_{fi} and a point P_c (rule W07); % NDG: circles $k(I, P_a)$ and $k_over(I, M_c)$ intersect % DET: circles $k(I, P_a)$ and $k_over(I, M_c)$ are not the same;

8. Using the point P_c and the point M_c, construct a point $P`_c$ (rule W01); ;

9. Using the circle $k(I, P_a)$, the point M_c and the point I, construct a line $x3$ and a line c (rule W12); % NDG: point M_c is outside the circle $k(I, P_a)$;

10. Using the circle $k(N, M_a)$, the line c, the point N and the point M_c, construct a point H_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points M_c and H_c must be different;

11. Using the point H_c and the point E_c, construct a line h_c (rule W02); % DET: points H_c and E_c are not the same;

12. Using the point M_c and the line c, construct a line m_c (rule W10b); ;

13. Using the point $P`_c$ and the line $IM_c$, construct a line $CP`_c$ (rule W16); ;

14. Using the line $CP`_c$ and the line $h_c$, construct a point $C$ (rule W03); % NDG: lines $CP`_c$ and h_c are not parallel % DET: lines $CP`_c$ and h_c are not the same;

15. Using the point I and the point C, construct a line s_c (rule W02); % DET: points I and C are not the same;

16. Using the line m_c and the line s_c, construct a point N_c (rule W03); % NDG: lines m_c and s_c are not parallel % DET: lines m_c and s_c are not the same;

17. Using the point I and the point N_c, construct a circle $k(N_c, B)$ (rule W06); % NDG: points I and N_c are not the same;

18. Using the circle $k(N_c, B)$ and the line c, construct a point B and a point A (rule W04); % NDG: line c and circle $k(N_c, B)$ intersect.

Non-degenerate conditions: line c and circle $k(N_c, B)$ intersect; points I and N_c are not the same; lines m_c and s_c are not parallel; lines $CP`_c$ and h_c are not parallel; line c and circle $k(N, M_a)$ intersect; point M_c is outside the circle $k(I, P_a)$; circles $k(I, P_a)$ and $k_over(I, M_c)$ intersect; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points I and M_c are not the same; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: lines m_c and s_c are not the same; points I and C are not the same; lines $CP`_c$ and h_c are not the same; points H_c and E_c are not the same; points M_c and H_c must be different; circles $k(I, P_a)$ and $k_over(I, M_c)$ are not the same; points M_c and I are not the same; points E_c and M_c must be different; points E_c and N are not the same.

Rules used: [W01,W02,W03,W04,W05,W05a,W06,W07,W09,W10b,W12,W16,W22]

Lemmas used: [D10,D13,D20,D27,D30,D32,D49,D67,D7,D87,GD01,GD02,GL01,GL03,GL09,L119,L14,L18,L19

Solving time: 53.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point I 74.37 61.15
point N 72.5 61.93

color 220 0 0
fontsize 9
```

```
cmark_r E_{c}
cmark_b I
cmark_r N
color 0 0 0
fontsize 8

% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}


% DET: points M_{c} and I are not the same
% Constructing a line IM_{c} which passes through point M_{c} and point I
line IM_{c} M_{c} I

color 200 200 200
drawline IM_{c}
color 0 0 0



% NDG: points I and M_{c} are not the same
% Constructing midpoint P_{\_G169156} of the segment IM_{c}
midpoint P_{\_G169156} I M_{c}
cmark_r P_{\_G169156}

% Constructing a circle k_over(I,M_{c}) whose center is at point P_{\_G169156} and which passes
    through point I
circle k_over(I,M_{c}) P_{\_G169156} I

color 200 200 200
drawcircle k_over(I,M_{c})
color 0 0 0
```

```
% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G169342] from point N to point E_{c}
distance V[_G169342] N E_{c}


% Calculating distance V[_G169366] from point N to point I
distance V[_G169366] N I


% Calculating value V[_G169387] using formula V[_G169342]/V[_G169366]
expression V[_G169387] { V[_G169342]/V[_G169366] }


% Constructing a point P_{\_G169418} such that NP_{\_G169418}/NI=V[_G169342]/V[_G169366]
towards P_{\_G169418} N I V[_G169387]
cmark_r P_{\_G169418}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    169418}
circle k(I,P_{a}) I P_{\_G169418}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: circles k(I,P_{a}) and k_over(I,M_{c}) intersect% DET: circles k(I,P_{a}) and k_over(I,M_{c
    }) are not the same
% Constructing points C_{fi} and P_{c} which are in intersection of k(I,P_{a}) and k_over(I,M_{c})
intersec2 C_{fi} P_{c} k(I,P_{a}) k_over(I,M_{c})
cmark_r C_{fi}
cmark_r P_{c}



% Constructing a point P‘_{c} such that P_{c}P‘_{c}/P_{c}M_{c}=2
towards P‘_{c} P_{c} M_{c} 2
cmark_r P‘_{c}
color 200 200 200
drawsegment P_{c} P‘_{c}
color 0 0 0


% NDG: point M_{c} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G170024} of the segment M_{c}I
midpoint P_{\_G170024} M_{c} I
cmark_r P_{\_G170024}

% Constructing a circle C_{\_G170027} whose center is at point P_{\_G170024} and which passes
    through point M_{c}
circle C_{\_G170027} P_{\_G170024} M_{c}

color 200 200 200
```

```
drawcircle C_{\_G170027}
color 0 0 0


% Constructing points P_{\_G170030} and P_{\_G170033} which are in intersection of C_{\_G170027}
    and k(I,P_{a})
intersec2 P_{\_G170030} P_{\_G170033} C_{\_G170027} k(I,P_{a})
cmark_r P_{\_G170030}
cmark_r P_{\_G170033}

% Constructing a line x3 which passes through point M_{c} and point P_{\_G170030}
line x3 M_{c} P_{\_G170030}

color 200 200 200
drawline x3
color 0 0 0


% Constructing a line c which passes through point M_{c} and point P_{\_G170033}
line c M_{c} P_{\_G170033}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(N,M_{a}) intersect% DET: points M_{c} and H_{c} must be different
% Constructing a point P_{\_G170367} which is a foot of the point N on the line c
foot P_{\_G170367} N c
cmark_r P_{\_G170367}
color 200 200 200
drawline N P_{\_G170367}
color 0 0 0

% Constructing a point H_{c} which is an image of the point M_{c} in the symmetry to point/line P
    _{\_G170367}
sim H_{c} P_{\_G170367} M_{c}
cmark_rt H_{c}


% DET: points H_{c} and E_{c} are not the same
% Constructing a line h_{c} which passes through point H_{c} and point E_{c}
line h_{c} H_{c} E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0




% Constructing a line m_{c} which is perpendicular to line c and which passes through point M_{c}
perp m_{c} M_{c} c

color 200 200 200
```

```
drawline m_{c}
color 0 0 0



% Constructing a line CP‘_{c} which contains the point P‘_{c} and is parallel to the line IM_{c}
parallel CP‘_{c} P‘_{c} IM_{c}

color 200 200 200
drawline CP‘_{c}
color 0 0 0



% NDG: lines CP‘_{c} and h_{c} are not parallel% DET: lines CP‘_{c} and h_{c} are not the same
% Constructing a point C which belongs to line CP‘_{c} and line h_{c}
intersec C CP‘_{c} h_{c}
cmark_l C


% DET: points I and C are not the same
% Constructing a line s_{c} which passes through point I and point C
line s_{c} I C

color 200 200 200
drawline s_{c}
color 0 0 0



% NDG: lines m_{c} and s_{c} are not parallel% DET: lines m_{c} and s_{c} are not the same
% Constructing a point N_{c} which belongs to line m_{c} and line s_{c}
intersec N_{c} m_{c} s_{c}
cmark_b N_{c}


% NDG: points I and N_{c} are not the same
% Constructing a circle k(N_{c},B) whose center is at point N_{c} and which passes through point I
circle k(N_{c},B) N_{c} I

color 200 200 200
drawcircle k(N_{c},B)
color 0 0 0



% NDG: line c and circle k(N_{c},B) intersect
% Constructing points B and A which are in intersection of k(N_{c},B) and c
intersec2 B A k(N_{c},B) c
cmark_b B
cmark_t A



drawsegment A B
```

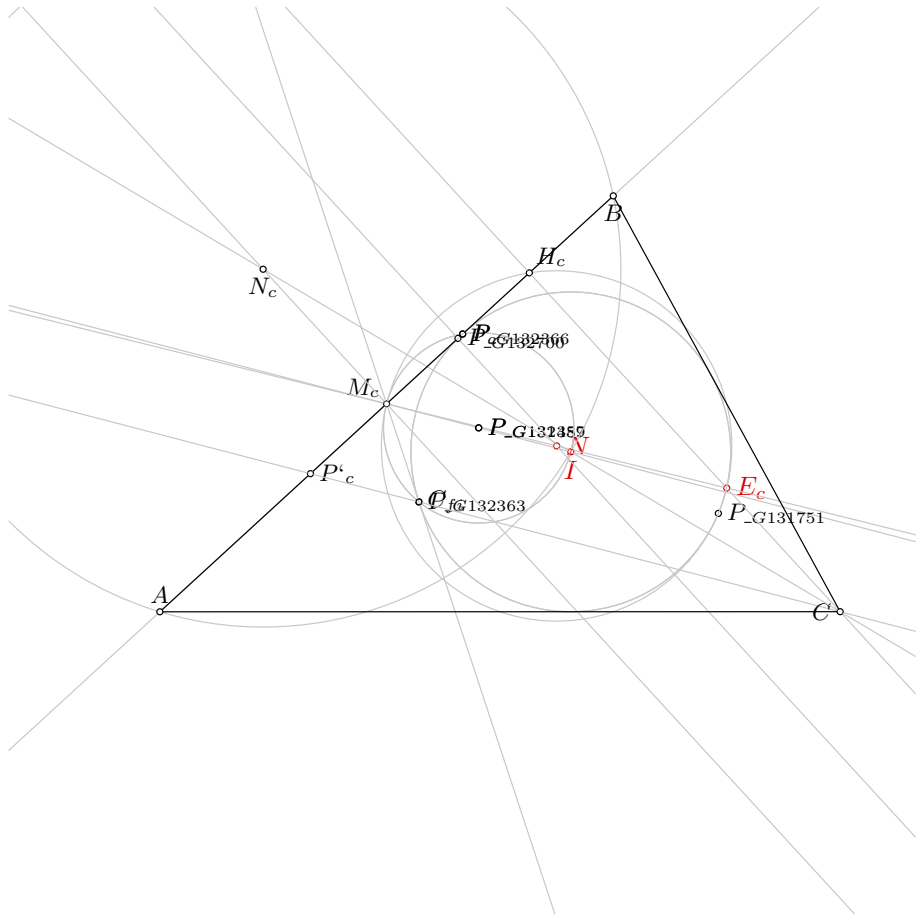

Figure 1: Illustration of the problem 1030

```
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(N_{c},B) intersect; points I and N_{c} are not the
     same; lines m_{c} and s_{c} are not parallel; lines CP‘_{c} and h_{c} are not parallel; line c
     and circle k(N,M_{a}) intersect; point M_{c} is outside the circle k(I,P_{a}); circles k(I,P_{
    a}) and k_over(I,M_{c}) intersect; point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points I and M_{c} are not the same; line m(H_{b}H_{a}) and circle k(N,M_{a})
    intersect; points E_{c} and N are not the same
% Determination conditions: lines m_{c} and s_{c} are not the same; points I and C are not the same
    ; lines CP‘_{c} and h_{c} are not the same; points H_{c} and E_{c} are not the same; points M_{
    c} and H_{c} must be different; circles k(I,P_{a}) and k_over(I,M_{c}) are not the same; points
     M_{c} and I are not the same; points E_{c} and M_{c} must be different; points E_{c} and N are
     not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving I=_I

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving I=_I

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving I=_I

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving I=_I

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1031

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1031: Given a point E_c, a point I and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1032

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1032: Given a point E_c, a point I and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1033

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1033: Given a point E_c, a point I and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1034

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1034: Given a point E_c, a point I and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1035

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1035: Given a point E_c, a point M_a and a point M_b, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_a, construct a line $m(E_cM_a)$ (rule W14); % DET: points E_c and M_a are not the same;

2. Using the point E_c and the point M_b, construct a line $m(E_cM_b)$ (rule W14); % DET: points E_c and M_b are not the same;

3. Using the line $m(E_cM_b)$ and the line $m(E_cM_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_b)$ and $m(E_cM_a)$ are not parallel % DET: lines $m(E_cM_b)$ and $m(E_cM_a)$ are not the same;

4. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;

5. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;

6. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;

7. Using the point M_b and the point E_a, construct a line $m(AH_c)$ (rule W02); % DET: points M_b and E_a are not the same;

8. Using the point E_c and the line $m(AH_c)$, construct a line h_c (rule W16); ;

9. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;

10. Using the point H_c and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points H_c and M_a are not the same;

11. Using the circle $k(M_a, B)$, the line h_c, the point M_a and the point H_c, construct a point C (rule W05); % NDG: line h_c and circle $k(M_a, B)$ intersect % DET: points H_c and C must be different;

12. Using the point M_a and the point C, construct a point B (rule W01); ;

13. Using the point M_b and the point C, construct a point A (rule W01); .

Non-degenerate conditions: line h_c and circle $k(M_a, B)$ intersect; points H_c and M_a are not the same; line h_c and circle $k(N, M_a)$ intersect; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points E_c and N are not the same; lines $m(E_cM_b)$ and $m(E_cM_a)$ are not parallel.

Determination conditions: points H_c and C must be different; points E_c and H_c must be different; points M_b and E_a are not the same; points M_a and E_a must be different; points M_a and N are not the same; lines $m(E_cM_b)$ and $m(E_cM_a)$ are not the same; points E_c and M_b are not the same; points E_c and M_a are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W14,W16]

Lemmas used: [D10,D21,D22,D30,D32,D7,GD02,GL01,GL03,GL04,GL09,L17,L20,L21,L22,L24,L3,L37,L38,L3

Solving time: 26.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point M_{a} 65 40
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_r M_{a}
cmark_lt M_{b}
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{a} are not the same
% Constructing bisector m(E_{c}M_{a}) of the segment E_{c}M_{a}
med m(E_{c}M_{a}) E_{c} M_{a}

color 200 200 200
drawline m(E_{c}M_{a})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{a}
color 0 0 0
```

```
% DET: points E_{c} and M_{b} are not the same
% Constructing bisector m(E_{c}M_{b}) of the segment E_{c}M_{b}
med m(E_{c}M_{b}) E_{c} M_{b}

color 200 200 200
drawline m(E_{c}M_{b})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{b}
color 0 0 0


% NDG: lines m(E_{c}M_{b}) and m(E_{c}M_{a}) are not parallel% DET: lines m(E_{c}M_{b}) and m(E_{c}
    M_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{b}) and line m(E_{c}M_{a})
intersec N m(E_{c}M_{b}) m(E_{c}M_{a})
cmark_r N


% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% DET: points M_{b} and E_{a} are not the same
% Constructing a line m(AH_{c}) which passes through point M_{b} and point E_{a}
line m(AH_{c}) M_{b} E_{a}

color 200 200 200
drawline m(AH_{c})
color 0 0 0
```

```
% Constructing a line h_{c} which contains the point E_{c} and is parallel to the line m(AH_{c})
parallel h_{c} E_{c} m(AH_{c})

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G234725} which is a foot of the point N on the line h_{c}
foot P_{\_G234725} N h_{c}
cmark_r P_{\_G234725}
color 200 200 200
drawline N P_{\_G234725}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G234725}
sim H_{c} P_{\_G234725} E_{c}
cmark_rt H_{c}


% NDG: points H_{c} and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point H
    _{c}
circle k(M_{a},B) M_{a} H_{c}

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: line h_{c} and circle k(M_{a},B) intersect% DET: points H_{c} and C must be different
% Constructing a point P_{\_G235029} which is a foot of the point M_{a} on the line h_{c}
foot P_{\_G235029} M_{a} h_{c}
cmark_r P_{\_G235029}
color 200 200 200
drawline M_{a} P_{\_G235029}
color 0 0 0

% Constructing a point C which is an image of the point H_{c} in the symmetry to point/line P_{\_G
    235029}
sim C P_{\_G235029} H_{c}
cmark_l C



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
```

```
color 0 0 0



% Constructing a point A such that M_{b}A/M_{b}C=-1
towards A M_{b} C -1
cmark_t A
color 200 200 200
drawsegment C A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line h_{c} and circle k(M_{a},B) intersect; points H_{c} and M_{a} are
     not the same; line h_{c} and circle k(N,M_{a}) intersect; line m(H_{b}H_{c}) and circle k(N,M
    _{a}) intersect; points E_{c} and N are not the same; lines m(E_{c}M_{b}) and m(E_{c}M_{a}) are
     not parallel
% Determination conditions: points H_{c} and C must be different; points E_{c} and H_{c} must be
    different; points M_{b} and E_{a} are not the same; points M_{a} and E_{a} must be different;
    points M_{a} and N are not the same; lines m(E_{c}M_{b}) and m(E_{c}M_{a}) are not the same;
    points E_{c} and M_{b} are not the same; points E_{c} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 9 terms.

Time Complexity: Time spent by the prover is 0.27 seconds.

NDG conditions Points M_b, E_c and M_a are not collinear

Points M_b, E_c and M_a are not collinear

Line through points M_b and E_a is not parallel with line through points E_c and M_a

Points E_c and tempPoint-961h_c are not identical

Points E_c, tempPoint-961h_c and M_a are not collinear

Points E_c and $P_{\_G229746}$ are not identical

Points E_c and $P_{\_G229746}$ are not identical

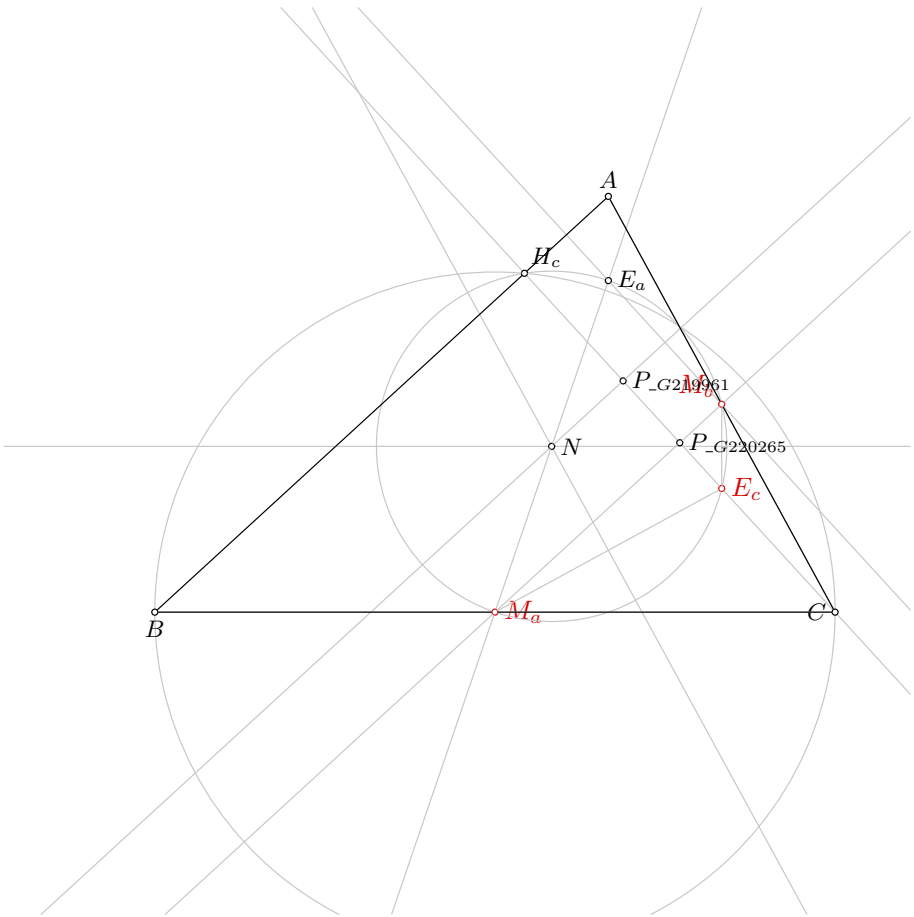

Figure 1: Illustration of the problem 1035

4.1.3 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.278 seconds.

NDG conditions Points M_b, E_c and M_a are not collinear

Points M_b, E_c and M_a are not collinear

Line through points M_b and E_a is not parallel with line through points E_c and M_a

Points E_c and tempPoint-450h_c are not identical

Points E_c, tempPoint-450h_c and M_a are not collinear

Points $P_{\_G231082}$ and E_c are not identical

Points $P_{\_G231082}$ and E_c are not identical

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving M_a=_M_a

NDG conditions are:

$S_{M^2_{m(E_cM_b)}M^0_{m(E_cM_a)}T^1_{m(E_cM_a)}} \neq S_{T^3_{m(E_cM_b)}M^0_{m(E_cM_a)}T^1_{m(E_cM_a)}}$ i.e., lines $M^2_{m(E_cM_b)}T^3_{m(E_cM_b)}$ and $M^0_{m(E_cM_a)}T^1_{m(E_cM_a)}$ are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.2.3 Proving M_b=_M_b

NDG conditions are:

$S_{M^2_{m(E_cM_b)}M^0_{m(E_cM_a)}T^1_{m(E_cM_a)}} \neq S_{T^3_{m(E_cM_b)}M^0_{m(E_cM_a)}T^1_{m(E_cM_a)}}$ i.e., lines $M^2_{m(E_cM_b)}T^3_{m(E_cM_b)}$ and $M^0_{m(E_cM_a)}T^1_{m(E_cM_a)}$ are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving M_a=_M_a

Proving failed

4.3.3 Proving M_b=_M_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 1036

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1036: Given a point E_c, a point M_c and a point M_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
2. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;
3. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;
4. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
5. Choose freely a point M_a on the circle $k(N, M_a)$ (rule WOncircle);
6. Choose freely a point A (rule free);
7. Using the point A and the point M_c, construct a point B (rule W01); ;
8. Using the point M_a and the point B, construct a point C (rule W01); .

Non-degenerate conditions: points E_c and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points E_c and M_c are not the same.

Rules used: [W01,W02,W03,W06,W14,WOncircle1,free]

Lemmas used: [D20,D21,D32,GD02,GL01,GL03,GL04,L18,L19,L20,L24,L41,L42,L53,L54]

Solving time: 203.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point M_{c} 50 67.5
point M_{a} 65 40

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_lt M_{c}
cmark_r M_{a}
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0


% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% Choosing randomly a point M_{a} on the circle with center N through point E_{c}
oncircle M_{a} N E_{c}
cmark_r M_{a}
color 200 200 200
drawcircle N E_{c}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points E_{c} and N are not the same; lines m(E_{c}M_{c}) and m(H_{b}H
    _{a}) are not parallel
% Determination conditions: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and M_{c} are not the same; points E_{c} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

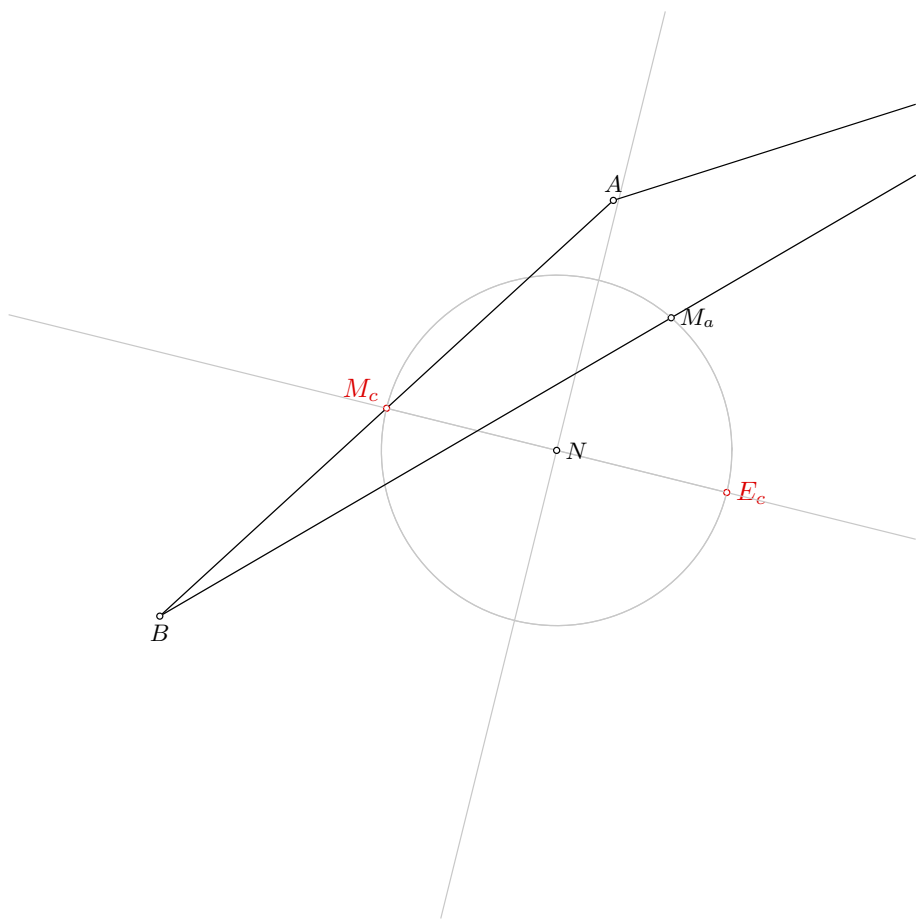

Figure 1: Illustration of the problem 1036

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=$\_E_c$

Proving failed

4.1.2 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.068 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving M_a=$\_M_a$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=$\_E_c$

Proving failed

4.2.2 Proving M_c=$\_M_c$

NDG conditions are:

$S_{M^0_{m(E_cM_c)}E_cM_c} \neq S_{T^1_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^0_{m(E_cM_c)}T^1_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving M_a=$\_M_a$

NDG conditions are:

$S_{M^0_{m(E_cM_c)}E_cM_c} \neq S_{T^1_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^0_{m(E_cM_c)}T^1_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=$\_E_c$

Proving failed

4.3.2 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 28 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 1037

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1037: Given a point M_a, a point N and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;
2. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
3. Choose freely a point E_c on the circle $k(N, M_a)$ (rule WOncircle);
4. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
5. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;
6. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
7. Choose freely a point A (rule free);
8. Using the point A and the point E_a, construct a point H (rule W01); ;
9. Using the point A and the point M_c, construct a point B (rule W01); ;
10. Using the point E_c and the point H, construct a point C (rule W01); .

Non-degenerate conditions: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points M_a and N are not the same.

Determination conditions: points E_c and M_c must be different; points M_a and E_a must be different; points E_c and N are not the same; points M_a and N are not the same.

Rules used: [W01,W02,W05a,W06,WOncircle1,free]

Lemmas used: [D20,D28,D30,D32,GD02,GL01,GL03,GL04,L18,L19,L20,L21,L22,L24,L38,L39,L41,L42,L47,L48

Solving time: 150.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{a} 65 40
point N 72.5 61.93
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_r M_{a}
cmark_r N
cmark_r E_{c}
color 0 0 0
fontsize 8

% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% Choosing randomly a point E_{c} on the circle with center N through point M_{a}
oncircle E_{c} N M_{a}
cmark_r E_{c}
color 200 200 200
drawcircle N M_{a}
color 0 0 0
```

```
% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0
```

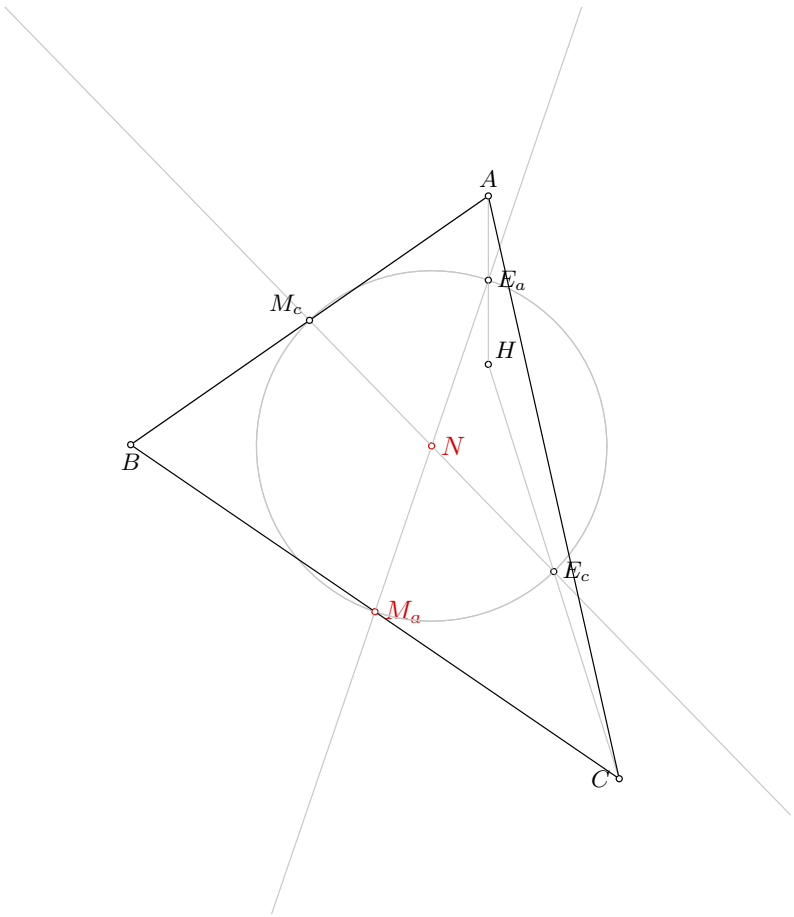

Figure 1: Illustration of the problem 1037

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect; line m(H_{b}H_{c})
     and circle k(N,M_{a}) intersect; points M_{a} and N are not the same
% Determination conditions: points E_{c} and M_{c} must be different; points M_{a} and E_{a} must
    be different; points E_{c} and N are not the same; points M_{a} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_a=_M_a

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 15 terms.

Time Complexity: Time spent by the prover is 0.283 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_a=_M_a

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_a=_M_a

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_a=_M_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 1038

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1038: Given a point E_c, a point M_a and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_a, construct a line $m(CH_b)$ (rule W02); % DET: points E_c and M_a are not the same;
2. Using the point M_a and the point O, construct a line m_a (rule W02); % DET: points M_a and O are not the same;
3. Using the point M_a and the line m_a, construct a line a (rule W10a); ;
4. Using the point E_c and the line m_a, construct a line $m(CH_a)$ (rule W16); ;
5. Using the point O and the line $m(CH_b)$, construct a line m_b (rule W16); ;
6. Using the line m_b and the line $m(CH_a)$, construct a point M_b (rule W03); % NDG: lines m_b and $m(CH_a)$ are not parallel % DET: lines m_b and $m(CH_a)$ are not the same;
7. Using the point M_b and the line m_b, construct a line b (rule W10a); ;
8. Using the line b and the line a, construct a point C (rule W03); % NDG: lines b and a are not parallel % DET: lines b and a are not the same;
9. Using the point C and the point E_c, construct a point H (rule W01); ;
10. Using the point M_a and the point C, construct a point B (rule W01); ;
11. Using the point O and the point H, construct a point G (rule W01); ;
12. Using the point M_a and the point G, construct a point A (rule W01); .

Non-degenerate conditions: lines b and a are not parallel; lines m_b and $m(CH_a)$ are not parallel.

Determination conditions: lines b and a are not the same; lines m_b and $m(CH_a)$ are not the same; points M_a and O are not the same; points E_c and M_a are not the same.

Rules used: [W01,W02,W03,W10a,W16]

Lemmas used: [D1,D11,D12,D21,D22,D30,GD01,GD02,GL01,GL03,GL04,GL09,L37,L38,L44,L53,L54,L55,L58

Solving time: 3.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point M_{a} 65 40
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_r M_{a}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{a} are not the same
% Constructing a line m(CH_{b}) which passes through point E_{c} and point M_{a}
line m(CH_{b}) E_{c} M_{a}

color 200 200 200
drawline m(CH_{b})
color 0 0 0



% DET: points M_{a} and O are not the same
% Constructing a line m_{a} which passes through point M_{a} and point O
line m_{a} M_{a} O

color 200 200 200
drawline m_{a}
color 0 0 0



% Constructing a line a which is perpendicular to line m_{a} and which passes through point M_{a}
perp a M_{a} m_{a}

color 200 200 200
drawline a
color 0 0 0
```

```
% Constructing a line m(CH_{a}) which contains the point E_{c} and is parallel to the line m_{a}
parallel m(CH_{a}) E_{c} m_{a}

color 200 200 200
drawline m(CH_{a})
color 0 0 0



% Constructing a line m_{b} which contains the point O and is parallel to the line m(CH_{b})
parallel m_{b} O m(CH_{b})

color 200 200 200
drawline m_{b}
color 0 0 0



% NDG: lines m_{b} and m(CH_{a}) are not parallel% DET: lines m_{b} and m(CH_{a}) are not the same
% Constructing a point M_{b} which belongs to line m_{b} and line m(CH_{a})
intersec M_{b} m_{b} m(CH_{a})
cmark_lt M_{b}



% Constructing a line b which is perpendicular to line m_{b} and which passes through point M_{b}
perp b M_{b} m_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: lines b and a are not parallel% DET: lines b and a are not the same
% Constructing a point C which belongs to line b and line a
intersec C b a
cmark_l C



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
```

```
drawsegment C B
color 0 0 0


% Constructing a line L_{\_G97165} which passes through point O and point H
line L_{\_G97165} O H

color 200 200 200
drawline L_{\_G97165}
color 0 0 0


% Constructing a point P_{\_G97266} with coordinates (0,0)
point P_{\_G97266} 0 0
cmark_r P_{\_G97266}

% Constructing a point P_{\_G97190} such that OP_{\_G97190}/OP_{\_G97266}=1
towards P_{\_G97190} O P_{\_G97266} 1
cmark_r P_{\_G97190}
color 200 200 200
drawsegment O P_{\_G97190}
color 0 0 0

% Constructing a point P_{\_G97235} such that OP_{\_G97235}/OP_{\_G97266}=3
towards P_{\_G97235} O P_{\_G97266} 3
cmark_r P_{\_G97235}
color 200 200 200
drawsegment O P_{\_G97235}
color 0 0 0

% Constructing a line L_{\_G97196} which passes through point H and point P_{\_G97235}
line L_{\_G97196} H P_{\_G97235}

color 200 200 200
drawline L_{\_G97196}
color 0 0 0


% Constructing a line L_{\_G97159} which contains the point P_{\_G97190} and is parallel to the
    line L_{\_G97196}
parallel L_{\_G97159} P_{\_G97190} L_{\_G97196}

color 200 200 200
drawline L_{\_G97159}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G97159} and line L_{\_G97165}
intersec G L_{\_G97159} L_{\_G97165}
cmark_t G



% Constructing a point A such that M_{a}A/M_{a}G=3
towards A M_{a} G 3
```

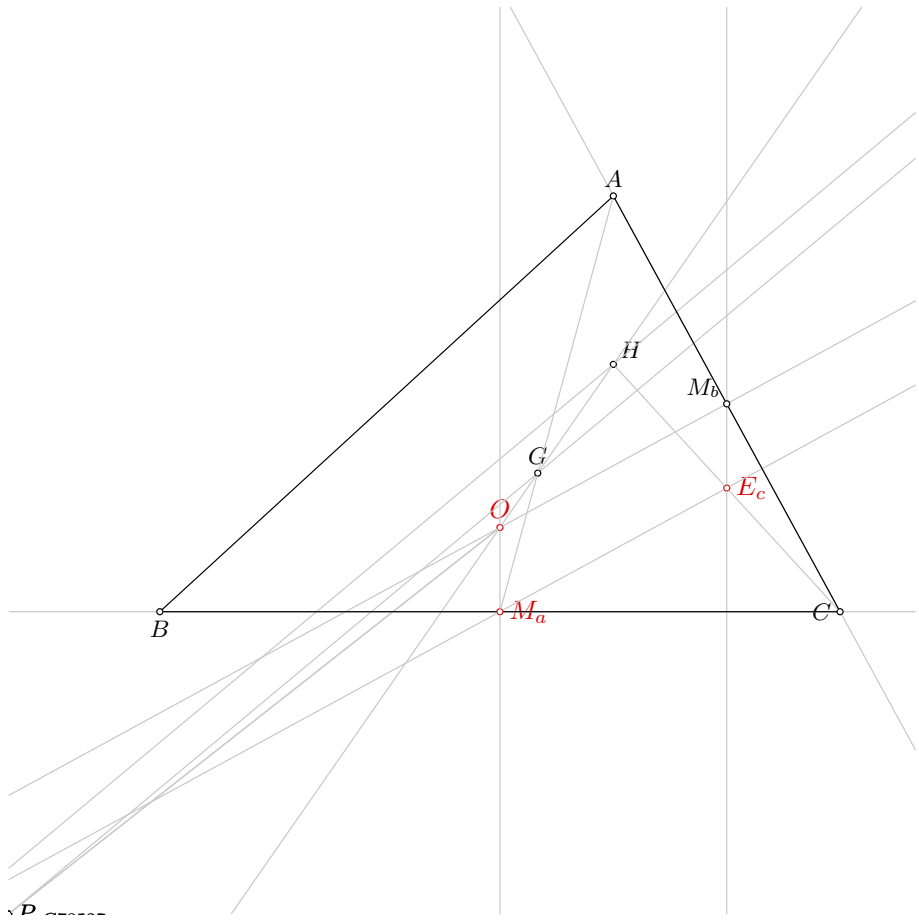

Figure 1: Illustration of the problem 1038

```
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and a are not parallel; lines m_{b} and m(CH_{a}) are not
    parallel
% Determination conditions: lines b and a are not the same; lines m_{b} and m(CH_{a}) are not the
    same; points M_{a} and O are not the same; points E_{c} and M_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=$\_E_c$

Proving failed

4.1.2 Proving M_a=$\_M_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 9 terms.

Time Complexity: Time spent by the prover is 0.188 seconds.

NDG conditions Points M_b, E_c and M_a are not collinear

Points M_b, M_a and O are not collinear

4.1.3 Proving O=$\_O$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=$\_E_c$

Proving failed

4.2.2 Proving M_a=$\_M_a$

NDG conditions are:

$S_{OE_cP^1_{m(CH_a)}} \neq S_{P^2_{m_b}E_cP^1_{m(CH_a)}}$ i.e., lines $OP^2_{m_b}$ and $E_cP^1_{m(CH_a)}$ are not parallel (construction based assumption)

$S_{M_bOP^2_{m_b}} \neq 0$ i.e., points M_b, O and $P^2_{m_b}$ are not collinear (foot is not the point itself; construction based assumption)

$S_{M_bM_aT^0_a} \neq S_{F^3_bM_aT^0_a}$ i.e., lines $M_bF^3_b$ and $M_aT^0_a$ are not parallel (construction based assumption)

$S_{P\_G83301OH} \neq S_{P^4_{L\_G83270}OH}$ i.e., lines $P\_G83301P^4_{L\_G83270}$ and OH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^8_{\_m_b}} \neq S_{F^7_{\_m_a}\_M_bF^8_{\_m_b}}$ i.e., lines $\_M_aF^7_{\_m_a}$ and $\_M_bF^8_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44

Time spent by the prover: 0.000 seconds

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.080 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 1039

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1039: Given a point E_c, a point M_a and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1040

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1040: Given a point E_c, a point M_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1041

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1041: Given a point E_c, a point M_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1042

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1042: Given a point E_c, a point M_c and a point M_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
2. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;
3. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;
4. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
5. Choose freely a point M_b on the circle $k(N, M_a)$ (rule WOncircle);
6. Choose freely a point A (rule free);
7. Using the point A and the point M_b, construct a point C (rule W01); ;
8. Using the point A and the point M_c, construct a point B (rule W01); .

Non-degenerate conditions: points E_c and N are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points E_c and M_c are not the same.

Rules used: [W01,W02,W03,W06,W14,WOncircle1,free]

Lemmas used: [D20,D22,D32,GD02,GL01,GL03,GL04,L18,L19,L20,L24,L41,L42,L53,L54]

Solving time: 202.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point M_{c} 50 67.5
point M_{b} 95 67.5

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_lt M_{c}
cmark_lt M_{b}
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0


% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N


% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% Choosing randomly a point M_{b} on the circle with center N through point E_{c}
oncircle M_{b} N E_{c}
cmark_lt M_{b}
color 200 200 200
drawcircle N E_{c}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points E_{c} and N are not the same; lines m(E_{c}M_{c}) and m(H_{b}H
    _{a}) are not parallel
% Determination conditions: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and M_{c} are not the same; points E_{c} and M_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

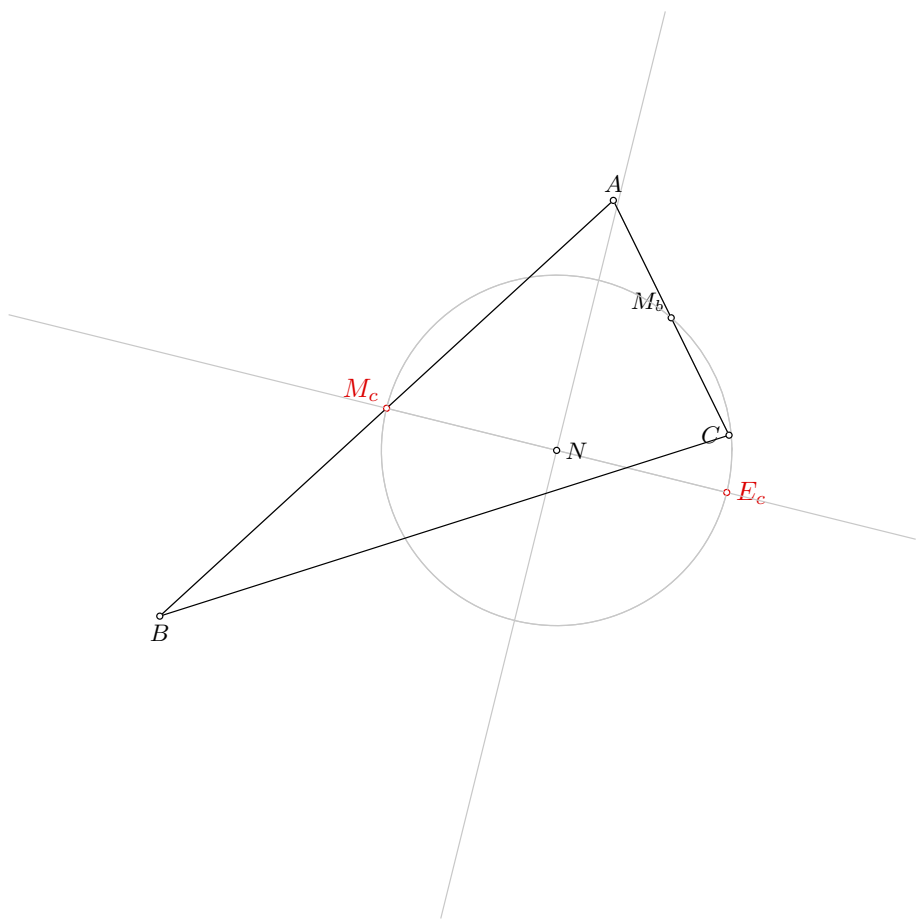

Figure 1: Illustration of the problem 1042

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=$\_E_c$

Proving failed

4.1.2 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.056 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.3 Proving M_b=$\_M_b$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=$\_E_c$

Proving failed

4.2.2 Proving M_c=$\_M_c$

NDG conditions are:

$S_{M^0_{m(E_cM_c)}E_cM_c} \neq S_{T^1_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^0_{m(E_cM_c)}T^1_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving M_b=$\_M_b$

NDG conditions are:

$S_{M^0_{m(E_cM_c)}E_cM_c} \neq S_{T^1_{m(E_cM_c)}E_cM_c}$ i.e., lines $M^0_{m(E_cM_c)}T^1_{m(E_cM_c)}$ and E_cM_c are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 42

Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving E_c=$\_E_c$

Proving failed

4.3.2 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 19 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.3 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 28 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 1043

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1043: Given a point M_b, a point N and a point E_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
2. Choose freely a point E_c on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point E_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and N are not the same;
4. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point E_c, construct a point M_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points E_c and M_c must be different;
5. Choose freely a point A (rule free);
6. Using the point A and the point M_b, construct a point C (rule W01); ;
7. Using the point A and the point M_c, construct a point B (rule W01); .

Non-degenerate conditions: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points M_b and N are not the same.

Determination conditions: points E_c and M_c must be different; points E_c and N are not the same.

Rules used: [W01,W02,W05a,W06,WOncircle1,free]

Lemmas used: [D20,D22,D32,GD02,GL01,GL03,GL04,L17,L18,L19,L20,L24,L41,L42,L53,L54]

Solving time: 151.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{b} 95 67.5
point N 72.5 61.93
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_lt M_{b}
cmark_r N
cmark_r E_{c}
color 0 0 0
fontsize 8

% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point E_{c} on the circle with center N through point M_{b}
oncircle E_{c} N M_{b}
cmark_r E_{c}
color 200 200 200
drawcircle N M_{b}
color 0 0 0


% DET: points E_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point N
line m(H_{b}H_{a}) E_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points E_{c} and M_{c} must be
    different
% Constructing a point M_{c} which is an image of the point E_{c} in the symmetry to point/line N
sim M_{c} N E_{c}
cmark_lt M_{c}



% Constructing a free point A
point A 80 95
```

```
cmark_t A



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect; points M_{b} and N
     are not the same
% Determination conditions: points E_{c} and M_{c} must be different; points E_{c} and N are not
    the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.055 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

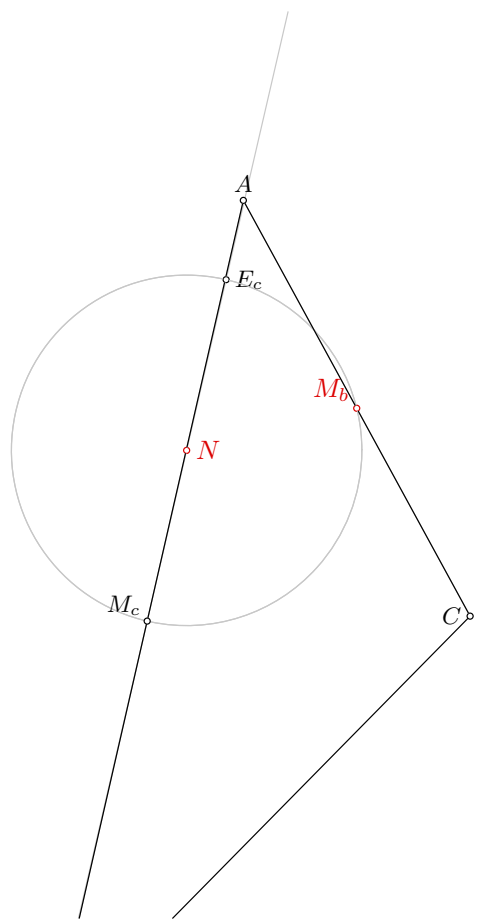

Figure 1: Illustration of the problem 1043

4.2 GCLC - Area method

4.2.1 Proving M_b=$\_M_b$

NDG conditions are:

$S_{\_M_a BC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_b AC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a} BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a \_M_b F^1_{\_m_b}} \neq S_{F^0_{\_m_a} \_M_b F^1_{\_m_b}}$ i.e., lines $\_M_a F^0_{\_m_a}$ and $\_M_b F^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 42
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving E_c=$\_E_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_b=$\_M_b$

Proving failed

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving E_c=$\_E_c$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_b=$\_M_b$

Proving failed

4.4.2 Proving N=$\_N$

Proving failed

4.4.3 Proving E_c=$\_E_c$

Proving failed

Problem 1044

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1044: Given a point E_c, a point M_b and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_b, construct a line $m(CH_a)$ (rule W02); % DET: points E_c and M_b are not the same;
2. Using the point M_b and the point O, construct a line m_b (rule W02); % DET: points M_b and O are not the same;
3. Using the point M_b and the line m_b, construct a line b (rule W10a); ;
4. Using the point E_c and the line m_b, construct a line $m(CH_b)$ (rule W16); ;
5. Using the point O and the line $m(CH_a)$, construct a line m_a (rule W16); ;
6. Using the line m_a and the line $m(CH_b)$, construct a point M_a (rule W03); % NDG: lines m_a and $m(CH_b)$ are not parallel % DET: lines m_a and $m(CH_b)$ are not the same;
7. Using the point M_a and the line m_a, construct a line a (rule W10a); ;
8. Using the line a and the line b, construct a point C (rule W03); % NDG: lines a and b are not parallel % DET: lines a and b are not the same;
9. Using the point C and the point E_c, construct a point H (rule W01); ;
10. Using the point M_b and the point C, construct a point A (rule W01); ;
11. Using the point O and the point H, construct a point G (rule W01); ;
12. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: lines a and b are not parallel; lines m_a and $m(CH_b)$ are not parallel.

Determination conditions: lines a and b are not the same; lines m_a and $m(CH_b)$ are not the same; points M_b and O are not the same; points E_c and M_b are not the same.

Rules used: [W01,W02,W03,W10a,W16]

Lemmas used: [D1,D11,D12,D21,D22,D30,GD01,GD02,GL01,GL03,GL04,GL09,L37,L38,L44,L53,L54,L56,L58

Solving time: 3.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point M_{b} 95 67.5
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_lt M_{b}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{b} are not the same
% Constructing a line m(CH_{a}) which passes through point E_{c} and point M_{b}
line m(CH_{a}) E_{c} M_{b}

color 200 200 200
drawline m(CH_{a})
color 0 0 0



% DET: points M_{b} and O are not the same
% Constructing a line m_{b} which passes through point M_{b} and point O
line m_{b} M_{b} O

color 200 200 200
drawline m_{b}
color 0 0 0



% Constructing a line b which is perpendicular to line m_{b} and which passes through point M_{b}
perp b M_{b} m_{b}

color 200 200 200
drawline b
color 0 0 0
```

```
% Constructing a line m(CH_{b}) which contains the point E_{c} and is parallel to the line m_{b}
parallel m(CH_{b}) E_{c} m_{b}

color 200 200 200
drawline m(CH_{b})
color 0 0 0



% Constructing a line m_{a} which contains the point O and is parallel to the line m(CH_{a})
parallel m_{a} O m(CH_{a})

color 200 200 200
drawline m_{a}
color 0 0 0



% NDG: lines m_{a} and m(CH_{b}) are not parallel% DET: lines m_{a} and m(CH_{b}) are not the same
% Constructing a point M_{a} which belongs to line m_{a} and line m(CH_{b})
intersec M_{a} m_{a} m(CH_{b})
cmark_r M_{a}



% Constructing a line a which is perpendicular to line m_{a} and which passes through point M_{a}
perp a M_{a} m_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: lines a and b are not parallel% DET: lines a and b are not the same
% Constructing a point C which belongs to line a and line b
intersec C a b
cmark_l C



% Constructing a point H such that CH/CE_{c}=2
towards H C E_{c} 2
cmark_rt H
color 200 200 200
drawsegment C H
color 0 0 0



% Constructing a point A such that M_{b}A/M_{b}C=-1
towards A M_{b} C -1
cmark_t A
color 200 200 200
```

```
drawsegment C A
color 0 0 0


% Constructing a line L_{\_G200292} which passes through point O and point H
line L_{\_G200292} O H

color 200 200 200
drawline L_{\_G200292}
color 0 0 0


% Constructing a point P_{\_G200393} with coordinates (0,0)
point P_{\_G200393} 0 0
cmark_r P_{\_G200393}

% Constructing a point P_{\_G200317} such that OP_{\_G200317}/OP_{\_G200393}=1
towards P_{\_G200317} O P_{\_G200393} 1
cmark_r P_{\_G200317}
color 200 200 200
drawsegment O P_{\_G200317}
color 0 0 0

% Constructing a point P_{\_G200362} such that OP_{\_G200362}/OP_{\_G200393}=3
towards P_{\_G200362} O P_{\_G200393} 3
cmark_r P_{\_G200362}
color 200 200 200
drawsegment O P_{\_G200362}
color 0 0 0

% Constructing a line L_{\_G200323} which passes through point H and point P_{\_G200362}
line L_{\_G200323} H P_{\_G200362}

color 200 200 200
drawline L_{\_G200323}
color 0 0 0


% Constructing a line L_{\_G200286} which contains the point P_{\_G200317} and is parallel to the
    line L_{\_G200323}
parallel L_{\_G200286} P_{\_G200317} L_{\_G200323}

color 200 200 200
drawline L_{\_G200286}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G200286} and line L_{\_G200292}
intersec G L_{\_G200286} L_{\_G200292}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
```

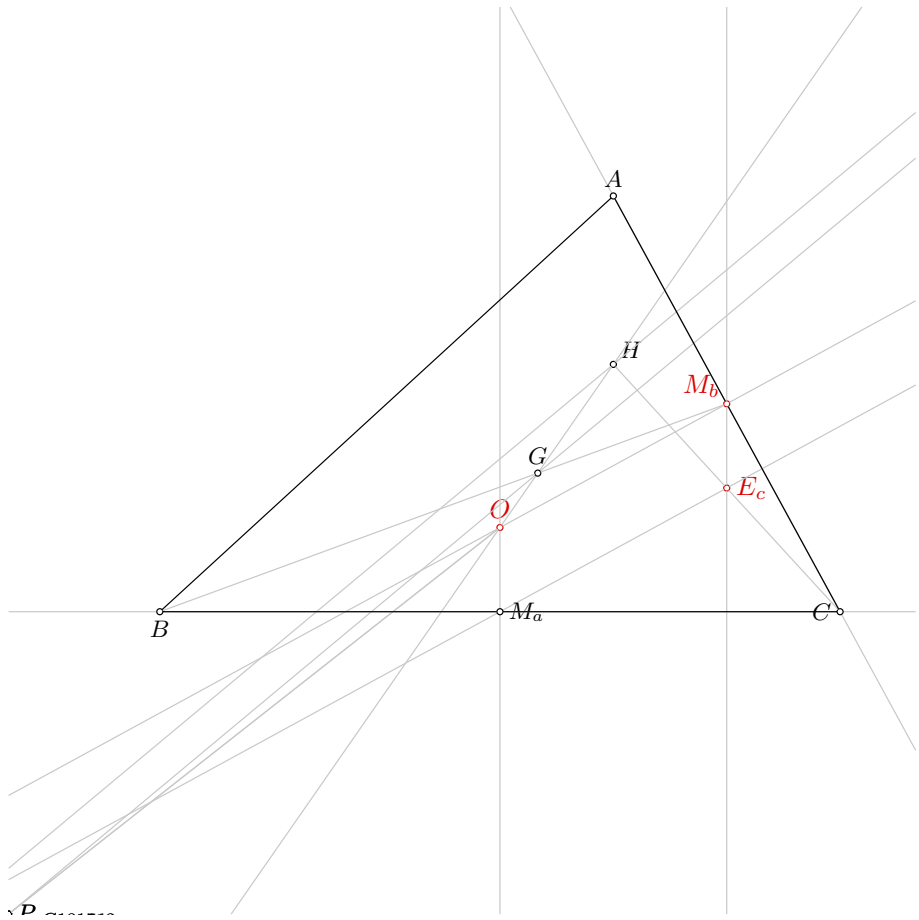

Figure 1: Illustration of the problem 1044

```
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines a and b are not parallel; lines m_{a} and m(CH_{b}) are not
    parallel
% Determination conditions: lines a and b are not the same; lines m_{a} and m(CH_{b}) are not the
    same; points M_{b} and O are not the same; points E_{c} and M_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=$\_E_c$

Proving failed

4.1.2 Proving M_b=$\_M_b$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 9 terms.

Time Complexity: Time spent by the prover is 0.186 seconds.

NDG conditions Points M_b and O are not identical

Points M_b, M_a and O are not collinear

4.1.3 Proving O=$\_O$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=$\_E_c$

Proving failed

4.2.2 Proving M_b=$\_M_b$

NDG conditions are:

$S_{OE_cP^1_{m(CH_b)}} \neq S_{P^2_{m_a}E_cP^1_{m(CH_b)}}$ i.e., lines $OP^2_{m_a}$ and $E_cP^1_{m(CH_b)}$ are not parallel (construction based assumption)

$S_{M_aOP^2_{m_a}} \neq 0$ i.e., points M_a, O and $P^2_{m_a}$ are not collinear (foot is not the point itself; construction based assumption)

$S_{M_aM_bT^0_b} \neq S_{F^3_aM_bT^0_b}$ i.e., lines $M_aF^3_a$ and $M_bT^0_b$ are not parallel (construction based assumption)

$S_{P_{\_G186422}OH} \neq S_{P^4_{L_{\_G186391}}OH}$ i.e., lines $P_{\_G186422}P^4_{L_{\_G186391}}$ and OH are not parallel (construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABF^6_{\_h_b}} \neq S_{F^5_{\_h_a}BF^6_{\_h_b}}$ i.e., lines $AF^5_{\_h_a}$ and $BF^6_{\_h_b}$ are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_a\_M_bF^8_{\_m_b}} \neq S_{F^7_{\_m_a}\_M_bF^8_{\_m_b}}$ i.e., lines $\_M_aF^7_{\_m_a}$ and $\_M_bF^8_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41

Time spent by the prover: 0.000 seconds

4.2.3 Proving O=$\_O$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.080 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 1045

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1045: Given a point E_c, a point M_b and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1046

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1046: Given a point E_c, a point M_b and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1047

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1047: Given a point E_c, a point M_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1048

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1048: Given a point M_c, a point N and a point E_c, construct the triangle ABC.

2 Status

Problem is redundant.

3 Solution

3.1 Construction in natural language form

1. Using the point M_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points M_c and N are not the same;
2. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
3. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point M_c, construct a point E_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points M_c and E_c must be different;
4. Choose freely a point A (rule free);
5. Using the point A and the point M_c, construct a point B (rule W01); ;
6. Using the point A and the point M_c, construct a line c (rule W02); % DET: points A and M_c are not the same;
7. Using the circle $k(N, M_a)$, the line c, the point N and the point M_c, construct a point H_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points M_c and H_c must be different;
8. Using the point H_c and the point E_c, construct a line h_c (rule W02); % DET: points H_c and E_c are not the same;
9. Using the point A and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points A and M_c are not the same;

10. Using the circle $k(N, M_a)$ and the circle $k(M_c, A)$, construct a point H_a and a point H_b (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_c, A)$ intersect % DET: circles $k(N, M_a)$ and $k(M_c, A)$ are not the same;

11. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

12. Using the line h_c and the line h_a, construct a point H (rule W03); % NDG: lines h_c and h_a are not parallel % DET: lines h_c and h_a are not the same;

13. Using the point N and the point H, construct a point G (rule W01); ;

14. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: lines h_c and h_a are not parallel; circles $k(N, M_a)$ and $k(M_c, A)$ intersect; points A and M_c are not the same; line c and circle $k(N, M_a)$ intersect; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points M_c and N are not the same.

Determination conditions: lines h_c and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points H_c and E_c are not the same; points M_c and H_c must be different; points A and M_c are not the same; points M_c and E_c must be different; points M_c and N are not the same.

Rules used: [W01,W02,W03,W05,W05a,W06,W07,free]

Lemmas used: [D10,D20,D3,D30,D32,D5,D7,D8,GD01,GD02,GL01,GL03,GL04,GL09,L16,L18,L19,L20,L21,L2

Solving time: 5.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{c} 50 67.5
point N 72.5 61.93
point E_{c} 95 56.36

color 220 0 0
fontsize 9

cmark_lt M_{c}
cmark_r N
cmark_r E_{c}
color 0 0 0
fontsize 8

% DET: points M_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point M_{c} and point N
line m(H_{b}H_{a}) M_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0
```

```
% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points M_{c} and E_{c} must be
    different
% Constructing a point E_{c} which is an image of the point M_{c} in the symmetry to point/line N
sim E_{c} N M_{c}
cmark_r E_{c}



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and M_{c} are not the same
% Constructing a line c which passes through point A and point M_{c}
line c A M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(N,M_{a}) intersect% DET: points M_{c} and H_{c} must be different
% Constructing a point P_{\_G260322} which is a foot of the point N on the line c
foot P_{\_G260322} N c
cmark_r P_{\_G260322}
color 200 200 200
drawline N P_{\_G260322}
color 0 0 0

% Constructing a point H_{c} which is an image of the point M_{c} in the symmetry to point/line P
    _{\_G260322}
sim H_{c} P_{\_G260322} M_{c}
cmark_rt H_{c}
```

```
% DET: points H_{c} and E_{c} are not the same
% Constructing a line h_{c} which passes through point H_{c} and point E_{c}
line h_{c} H_{c} E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points A and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point A
circle k(M_{c},A) M_{c} A

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{c},A) intersect% DET: circles k(N,M_{a}) and k(M_{c},A) are not
    the same
% Constructing points H_{a} and H_{b} which are in intersection of k(N,M_{a}) and k(M_{c},A)
intersec2 H_{a} H_{b} k(N,M_{a}) k(M_{c},A)
cmark_r H_{a}
cmark_l H_{b}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{c} and h_{a} are not parallel% DET: lines h_{c} and h_{a} are not the same
% Constructing a point H which belongs to line h_{c} and line h_{a}
intersec H h_{c} h_{a}
cmark_rt H



% Constructing a line L_{\_G260866} which passes through point N and point H
line L_{\_G260866} N H

color 200 200 200
drawline L_{\_G260866}
color 0 0 0


% Constructing a point P_{\_G260967} with coordinates (0,0)
point P_{\_G260967} 0 0
```

```
cmark_r P_{\_G260967}

% Constructing a point P_{\_G260891} such that NP_{\_G260891}/NP_{\_G260967}=-1
towards P_{\_G260891} N P_{\_G260967} -1
cmark_r P_{\_G260891}
color 200 200 200
drawsegment P_{\_G260967} P_{\_G260891}
color 0 0 0

% Constructing a point P_{\_G260936} such that NP_{\_G260936}/NP_{\_G260967}=3
towards P_{\_G260936} N P_{\_G260967} 3
cmark_r P_{\_G260936}
color 200 200 200
drawsegment N P_{\_G260936}
color 0 0 0

% Constructing a line L_{\_G260897} which passes through point H and point P_{\_G260936}
line L_{\_G260897} H P_{\_G260936}

color 200 200 200
drawline L_{\_G260897}
color 0 0 0


% Constructing a line L_{\_G260860} which contains the point P_{\_G260891} and is parallel to the
    line L_{\_G260897}
parallel L_{\_G260860} P_{\_G260891} L_{\_G260897}

color 200 200 200
drawline L_{\_G260860}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G260860} and line L_{\_G260866}
intersec G L_{\_G260860} L_{\_G260866}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{c
    },A) intersect; points A and M_{c} are not the same; line c and circle k(N,M_{a}) intersect;
    line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect; points M_{c} and N are not the same
```

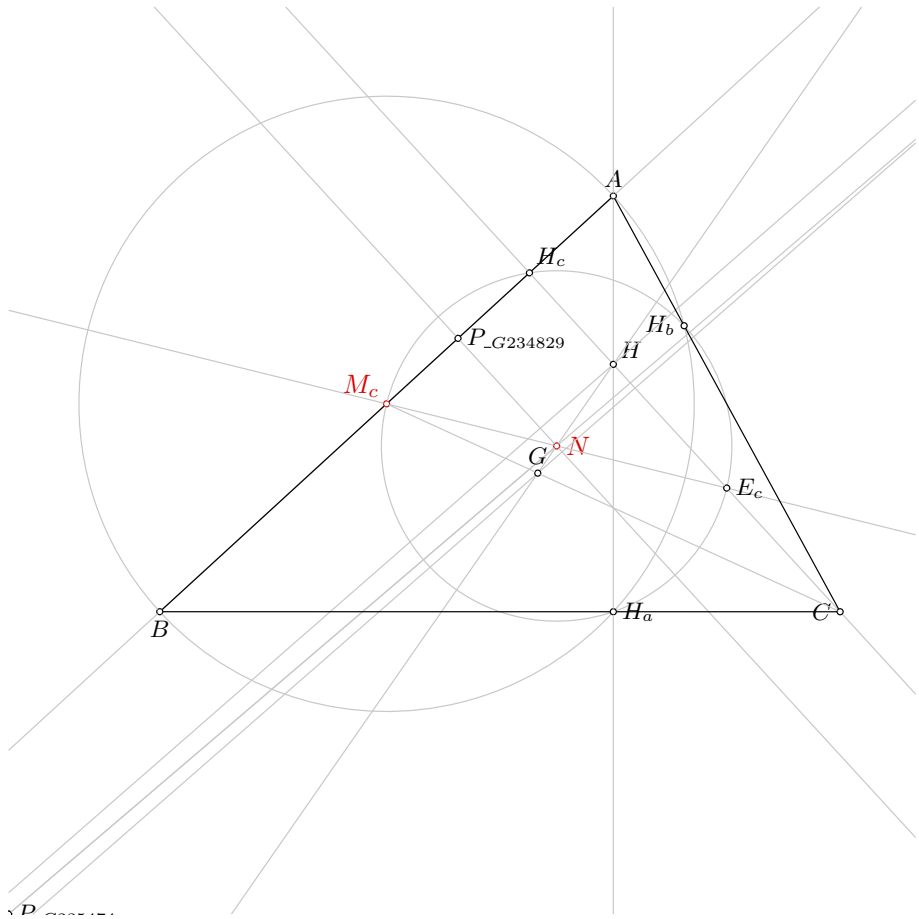

Figure 1: Illustration of the problem 1048

```
% Determination conditions: lines h_{c} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{c},A) are not the same; points H_{c} and E_{c} are not the
    same; points M_{c} and H_{c} must be different; points A and M_{c} are not the same; points M_{
    c} and E_{c} must be different; points M_{c} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.036 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving E_c=_E_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_c=_M_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving E_c=_E_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.080 seconds.There are no ndg conditions.

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving E_c=_E_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_c=_M_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving E_c=_E_c

Proving failed

Problem 1049

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1049: Given a point E_c, a point M_c and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point E_c and the point M_c, construct a line $m(H_bH_a)$ (rule W02); % DET: points E_c and M_c are not the same;
2. Using the point M_c and the point O, construct a line m_c (rule W02); % DET: points M_c and O are not the same;
3. Using the point M_c and the line m_c, construct a line c (rule W10a); ;
4. Using the point E_c and the point M_c, construct a line $m(E_cM_c)$ (rule W14); % DET: points E_c and M_c are not the same;
5. Using the line $m(E_cM_c)$ and the line $m(H_bH_a)$, construct a point N (rule W03); % NDG: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel % DET: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same;
6. Using the point N and the point O, construct a point G (rule W01); ;
7. Using the point M_c and the point G, construct a point C (rule W01); ;
8. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
9. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; lines $m(E_cM_c)$ and $m(H_bH_a)$ are not parallel.

Determination conditions: lines $m(E_cM_c)$ and $m(H_bH_a)$ are not the same; points E_c and M_c are not the same; points M_c and O are not the same; points E_c and M_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W10a,W14]

Lemmas used: [D13,D20,D26,D32,GD01,GD02,GL01,GL03,GL04,GL09,L1,L11,L12,L15,L18,L19,L20,L24,L41,

Solving time: 6.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point M_{c} 50 67.5
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_lt M_{c}
cmark_t O
color 0 0 0
fontsize 8

% DET: points E_{c} and M_{c} are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point E_{c} and point M_{c}
line m(H_{b}H_{a}) E_{c} M_{c}

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% DET: points M_{c} and O are not the same
% Constructing a line m_{c} which passes through point M_{c} and point O
line m_{c} M_{c} O

color 200 200 200
drawline m_{c}
color 0 0 0




% Constructing a line c which is perpendicular to line m_{c} and which passes through point M_{c}
perp c M_{c} m_{c}

color 200 200 200
drawline c
color 0 0 0



% DET: points E_{c} and M_{c} are not the same
```

```
% Constructing bisector m(E_{c}M_{c}) of the segment E_{c}M_{c}
med m(E_{c}M_{c}) E_{c} M_{c}

color 200 200 200
drawline m(E_{c}M_{c})
color 0 0 0

color 200 200 200
drawsegment E_{c} M_{c}
color 0 0 0


% NDG: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel% DET: lines m(E_{c}M_{c}) and m(H_{b}
    H_{a}) are not the same
% Constructing a point N which belongs to line m(E_{c}M_{c}) and line m(H_{b}H_{a})
intersec N m(E_{c}M_{c}) m(H_{b}H_{a})
cmark_r N



% Constructing a line L_{\_G73528} which passes through point N and point O
line L_{\_G73528} N O

color 200 200 200
drawline L_{\_G73528}
color 0 0 0


% Constructing a point P_{\_G73629} with coordinates (0,0)
point P_{\_G73629} 0 0
cmark_r P_{\_G73629}

% Constructing a point P_{\_G73553} such that NP_{\_G73553}/NP_{\_G73629}=1
towards P_{\_G73553} N P_{\_G73629} 1
cmark_r P_{\_G73553}
color 200 200 200
drawsegment N P_{\_G73553}
color 0 0 0

% Constructing a point P_{\_G73598} such that NP_{\_G73598}/NP_{\_G73629}=3
towards P_{\_G73598} N P_{\_G73629} 3
cmark_r P_{\_G73598}
color 200 200 200
drawsegment N P_{\_G73598}
color 0 0 0

% Constructing a line L_{\_G73559} which passes through point O and point P_{\_G73598}
line L_{\_G73559} O P_{\_G73598}

color 200 200 200
drawline L_{\_G73559}
color 0 0 0


% Constructing a line L_{\_G73522} which contains the point P_{\_G73553} and is parallel to the
    line L_{\_G73559}
```

```
parallel L_{\_G73522} P_{\_G73553} L_{\_G73559}

color 200 200 200
drawline L_{\_G73522}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G73522} and line L_{\_G73528}
intersec G L_{\_G73522} L_{\_G73528}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0


% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not parallel
% Determination conditions: lines m(E_{c}M_{c}) and m(H_{b}H_{a}) are not the same; points E_{c}
    and M_{c} are not the same; points M_{c} and O are not the same; points E_{c} and M_{c} are not
     the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

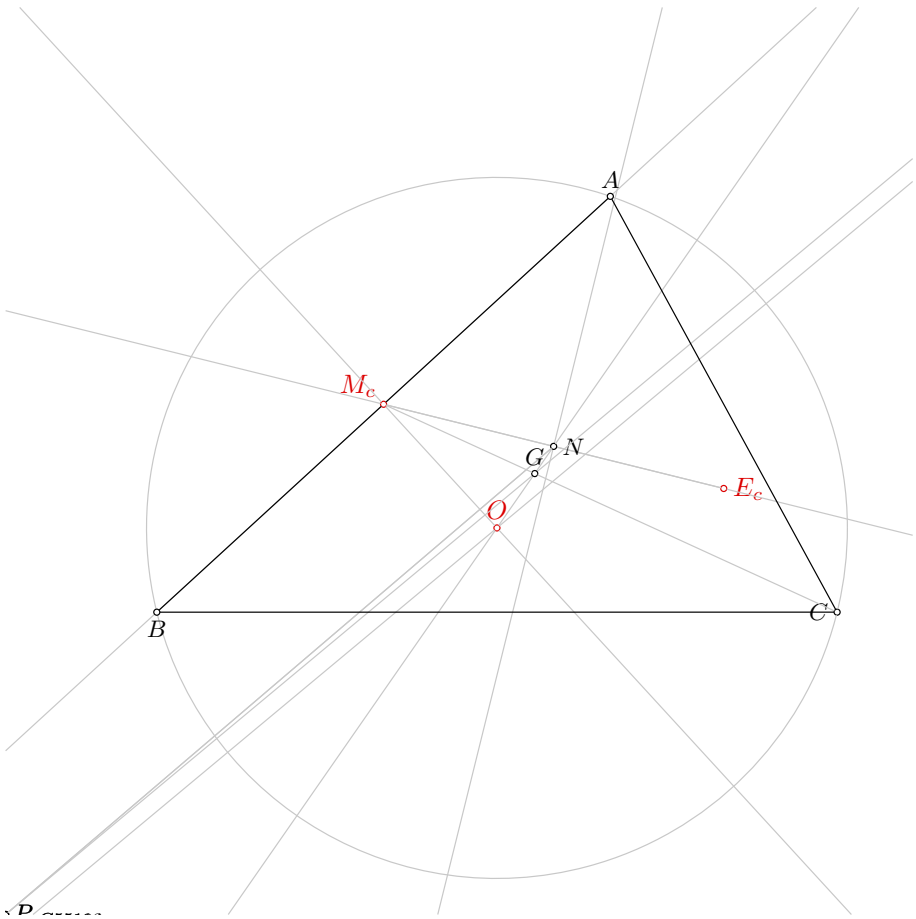

Figure 1: Illustration of the problem 1049

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving M_c=_M_c

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving M_c=_M_c

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 923 terms.

Time Complexity: Time spent by the prover is 1.960 seconds.There are no ndg conditions.

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving $O{=}\_O$

Proving failed

Problem 1050

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1050: Given a point E_c, a point M_c and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1051

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1051: Given a point E_c, a point M_c and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1052

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1052: Given a point E_c, a point M_c and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1053

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1053: Given a point E_c, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point N and the point O, construct a point H (rule W01); ;
3. Using the point E_c and the point H, construct a point C (rule W01); ;
4. Using the point G and the point C, construct a point M_c (rule W01); ;
5. Using the point E_c and the point H, construct a line h_c (rule W02); % DET: points E_c and H are not the same;
6. Using the point E_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points E_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points E_c and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L15,L21,L24,L3,L57]

Solving time: 7.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point E_{c} 95 56.36
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r E_{c}
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G134783} which passes through point N and point O
line L_{\_G134783} N O

color 200 200 200
drawline L_{\_G134783}
color 0 0 0


% Constructing a point P_{\_G134884} with coordinates (0,0)
point P_{\_G134884} 0 0
cmark_r P_{\_G134884}

% Constructing a point P_{\_G134808} such that NP_{\_G134808}/NP_{\_G134884}=1
towards P_{\_G134808} N P_{\_G134884} 1
cmark_r P_{\_G134808}
color 200 200 200
drawsegment N P_{\_G134808}
color 0 0 0

% Constructing a point P_{\_G134853} such that NP_{\_G134853}/NP_{\_G134884}=3
towards P_{\_G134853} N P_{\_G134884} 3
cmark_r P_{\_G134853}
color 200 200 200
drawsegment N P_{\_G134853}
color 0 0 0

% Constructing a line L_{\_G134814} which passes through point O and point P_{\_G134853}
line L_{\_G134814} O P_{\_G134853}
```

```
color 200 200 200
drawline L_{\_G134814}
color 0 0 0


% Constructing a line L_{\_G134777} which contains the point P_{\_G134808} and is parallel to the
    line L_{\_G134814}
parallel L_{\_G134777} P_{\_G134808} L_{\_G134814}

color 200 200 200
drawline L_{\_G134777}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G134777} and line L_{\_G134783}
intersec G L_{\_G134777} L_{\_G134783}
cmark_t G



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point M_{c} such that GM_{c}/GC=-0.5
towards M_{c} G C -0.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points E_{c} and H are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H
line h_{c} E_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points E_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{c}
circle k(N,M_{a}) N E_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G135868} which is a foot of the point N on the line h_{c}
foot P_{\_G135868} N h_{c}
cmark_r P_{\_G135868}
color 200 200 200
drawline N P_{\_G135868}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G135868}
sim H_{c} P_{\_G135868} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

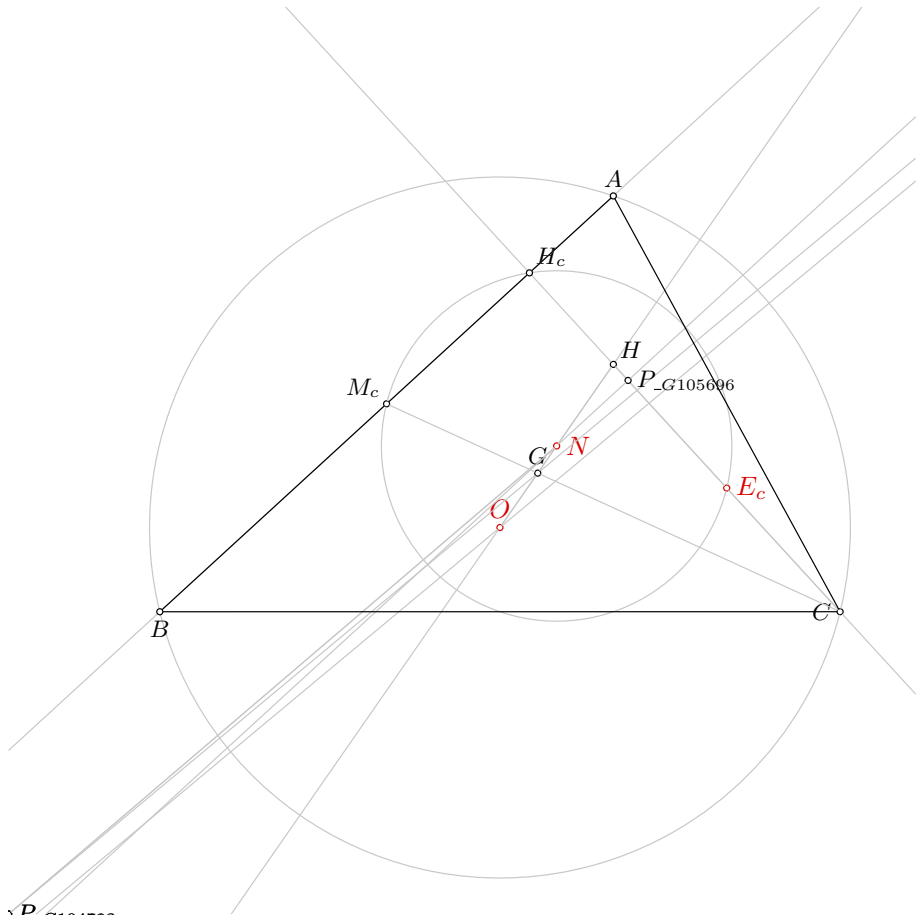

Figure 1: Illustration of the problem 1053

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points E_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points E_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving E_c=_E_c

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving E_c=_E_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving E_c=_E_c

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving E_c=_E_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 1054

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1054: Given a point E_c, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1055

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1055: Given a point E_c, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1056

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1056: Given a point E_c, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1057

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1057: Given a point E_c, a point O and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1058

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1058: Given a point E_c, a point O and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1059

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1059: Given a point E_c, a point O and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1060

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1060: Given a point E_c, a point T_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1061

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1061: Given a point E_c, a point T_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1062

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1062: Given a point E_c, a point T_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1063

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1063: Given a point H, a point N and a point G, construct the triangle ABC.

2 Status

Problem is redundant.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point N, construct a point O (rule W01); ;
2. Using the point H and the point N, construct a point G (rule W01); ;
3. Choose freely a point A (rule free);
4. Using the point A and the point H, construct a point E_a (rule W01); ;
5. Using the point A and the point G, construct a point M_a (rule W01); ;
6. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
7. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
8. Using the point E_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points E_a and N are not the same;
9. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
10. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
11. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points E_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and H are not the same.

Rules used: [W01,W02,W04,W05,W06,free]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL09,L11,L12,L16,L19,L22,L55]

Solving time: 8.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point N 72.5 61.93
point G 70 58.33

color 220 0 0
fontsize 9

cmark_rt H
cmark_r N
cmark_t G
color 0 0 0
fontsize 8


% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G234721} which passes through point H and point N
line L_{\_G234721} H N

color 200 200 200
drawline L_{\_G234721}
color 0 0 0


% Constructing a point P_{\_G234822} with coordinates (0,0)
point P_{\_G234822} 0 0
cmark_r P_{\_G234822}

% Constructing a point P_{\_G234746} such that HP_{\_G234746}/HP_{\_G234822}=4
towards P_{\_G234746} H P_{\_G234822} 4
cmark_r P_{\_G234746}
color 200 200 200
drawsegment H P_{\_G234746}
color 0 0 0
```

```
% Constructing a point P_{\_G234791} such that HP_{\_G234791}/HP_{\_G234822}=3
towards P_{\_G234791} H P_{\_G234822} 3
cmark_r P_{\_G234791}
color 200 200 200
drawsegment H P_{\_G234791}
color 0 0 0

% Constructing a line L_{\_G234752} which passes through point N and point P_{\_G234791}
line L_{\_G234752} N P_{\_G234791}

color 200 200 200
drawline L_{\_G234752}
color 0 0 0


% Constructing a line L_{\_G234715} which contains the point P_{\_G234746} and is parallel to the
    line L_{\_G234752}
parallel L_{\_G234715} P_{\_G234746} L_{\_G234752}

color 200 200 200
drawline L_{\_G234715}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G234715} and line L_{\_G234721}
intersec G L_{\_G234715} L_{\_G234721}
cmark_t G



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
```

```
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points E_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point E_{a}
circle k(N,M_{a}) N E_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G235825} which is a foot of the point N on the line h_{a}
foot P_{\_G235825} N h_{a}
cmark_r P_{\_G235825}
color 200 200 200
drawline N P_{\_G235825}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G235825}
sim H_{a} P_{\_G235825} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
```

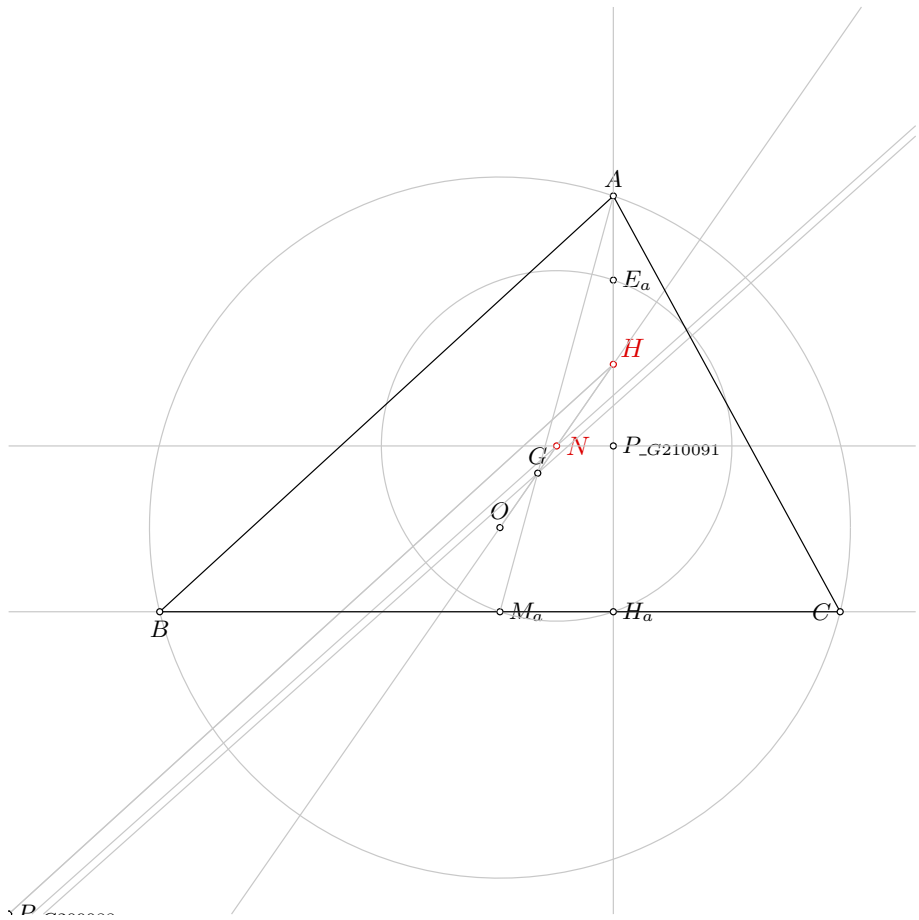

Figure 1: Illustration of the problem 1063

```
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points E_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving G=_G

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving G=_G

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving G=_G

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving G=_G

Proving failed

Problem 1064

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1064: Given a point G, a point H_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point N, construct a point H (rule W01); ;
2. Using the point G and the point N, construct a point O (rule W01); ;
3. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
4. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;
5. Using the circle $k(N, M_a)$, the line h_a, the point N and the point H_a, construct a point E_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points H_a and E_a must be different;
6. Using the point E_a and the point H, construct a point A (rule W01); ;
7. Using the point G and the point A, construct a point M_a (rule W01); ;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points H_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points H_a and E_a must be different; points H_a and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L19,L22,L55]

Solving time: 5.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point G 70 58.33
point H_{a} 80 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t G
cmark_r H_{a}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GN=-2
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{a} and N are not the same
```

```
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points H_{a} and E_{a} must be different
% Constructing a point P_{\_G50813} which is a foot of the point N on the line h_{a}
foot P_{\_G50813} N h_{a}
cmark_r P_{\_G50813}
color 200 200 200
drawline N P_{\_G50813}
color 0 0 0

% Constructing a point E_{a} which is an image of the point H_{a} in the symmetry to point/line P
    _{\_G50813}
sim E_{a} P_{\_G50813} H_{a}
cmark_r E_{a}



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point M_{a} such that GM_{a}/GA=-0.5
towards M_{a} G A -0.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points H_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points H_{a} and E_{a} must be
     different; points H_{a} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving G=_G

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving G=_G

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving N=_N

Proving failed

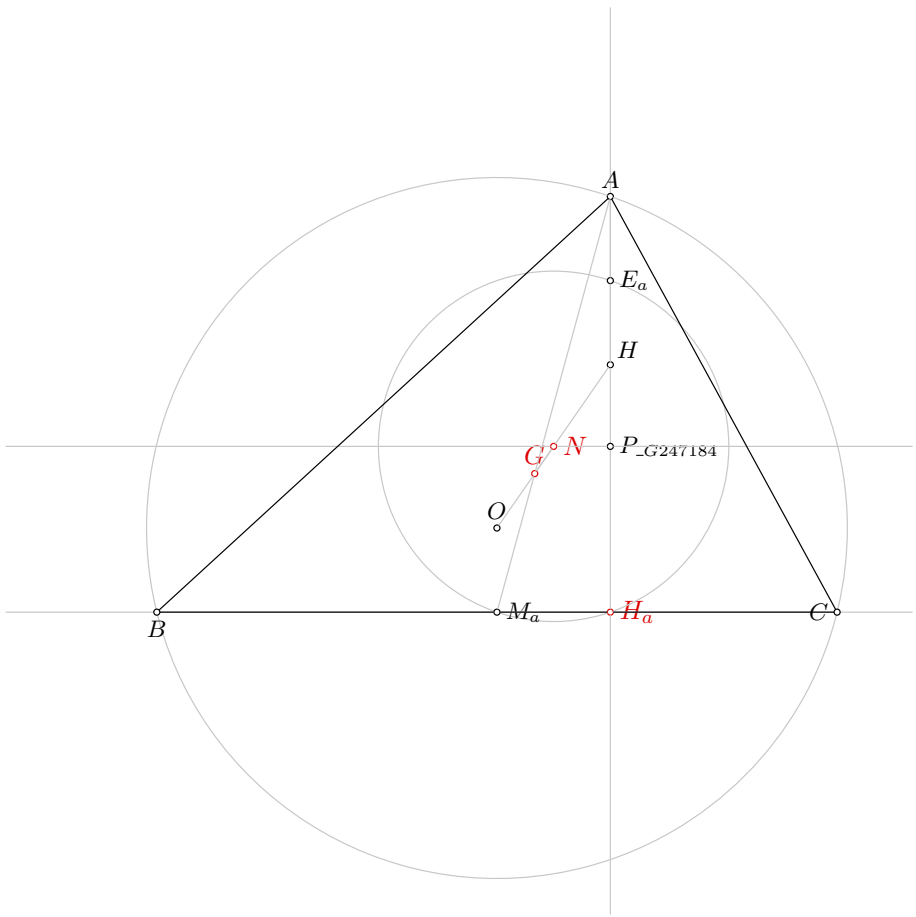

Figure 1: Illustration of the problem 1064

4.3 GCLC - Wu method

4.3.1 Proving G=_G

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving G=_G

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1065

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1065: Given a point G, a point H_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point N, construct a point H (rule W01); ;
2. Using the point G and the point N, construct a point O (rule W01); ;
3. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
4. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;
5. Using the circle $k(N, M_a)$, the line h_b, the point N and the point H_b, construct a point E_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points H_b and E_b must be different;
6. Using the point E_b and the point H, construct a point B (rule W01); ;
7. Using the point G and the point B, construct a point M_b (rule W01); ;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points H_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points H_b and E_b must be different; points H_b and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L20,L23,L56]

Solving time: 5.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point G 70 58.33
point H_{b} 89.36 77.83
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t G
cmark_l H_{b}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GN=-2
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{b} and N are not the same
```

```
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points H_{b} and E_{b} must be different
% Constructing a point P_{\_G87905} which is a foot of the point N on the line h_{b}
foot P_{\_G87905} N h_{b}
cmark_r P_{\_G87905}
color 200 200 200
drawline N P_{\_G87905}
color 0 0 0

% Constructing a point E_{b} which is an image of the point H_{b} in the symmetry to point/line P
    _{\_G87905}
sim E_{b} P_{\_G87905} H_{b}
cmark_r E_{b}



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point M_{b} such that GM_{b}/GB=-0.5
towards M_{b} G B -0.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points H_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points H_{b} and E_{b} must be
     different; points H_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving G=_G

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving G=_G

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving N=_N

Proving failed

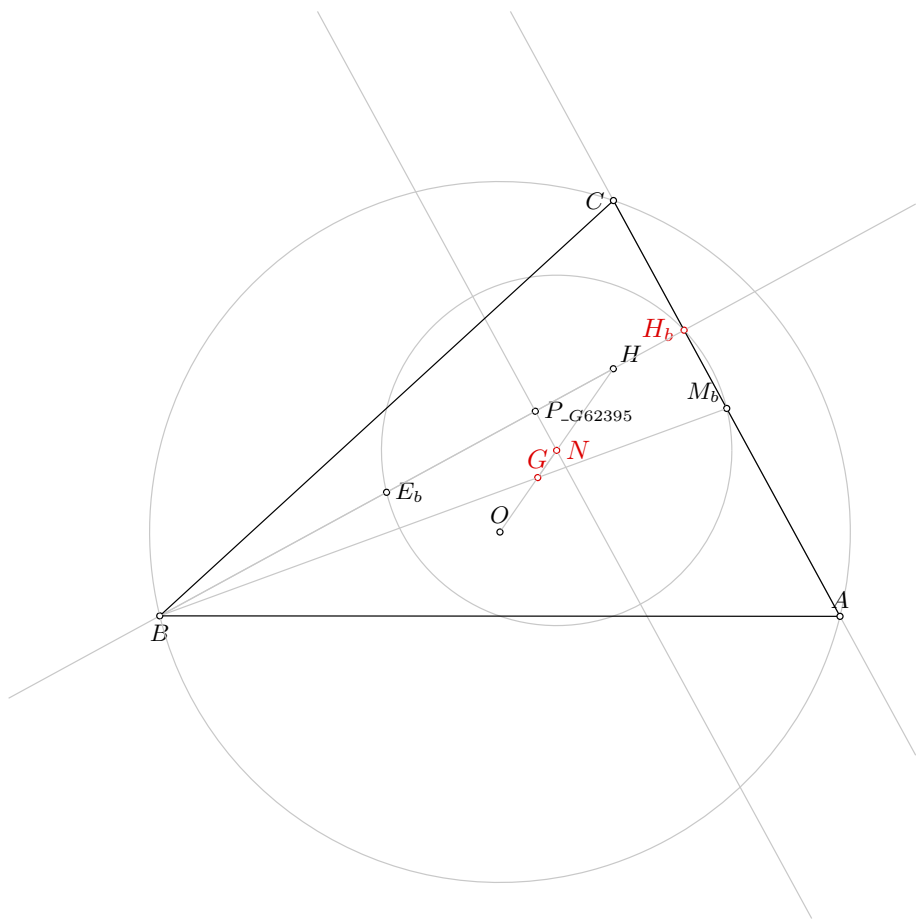

Figure 1: Illustration of the problem 1065

4.3 GCLC - Wu method

4.3.1 Proving G=_G

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving G=_G

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1066

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1066: Given a point G, a point H_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point N, construct a point H (rule W01); ;
2. Using the point G and the point N, construct a point O (rule W01); ;
3. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
4. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;
5. Using the circle $k(N, M_a)$, the line h_c, the point N and the point H_c, construct a point E_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points H_c and E_c must be different;
6. Using the point E_c and the point H, construct a point C (rule W01); ;
7. Using the point G and the point C, construct a point M_c (rule W01); ;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points H_c and E_c must be different; points H_c and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L21,L24,L3,L57]

Solving time: 5.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point G 70 58.33
point H_{c} 68.91 84.83
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t G
cmark_rt H_{c}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GN=-2
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{c} and N are not the same
```

```
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points H_{c} and E_{c} must be different
% Constructing a point P_{\_G126340} which is a foot of the point N on the line h_{c}
foot P_{\_G126340} N h_{c}
cmark_r P_{\_G126340}
color 200 200 200
drawline N P_{\_G126340}
color 0 0 0

% Constructing a point E_{c} which is an image of the point H_{c} in the symmetry to point/line P
    _{\_G126340}
sim E_{c} P_{\_G126340} H_{c}
cmark_r E_{c}



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point M_{c} such that GM_{c}/GC=-0.5
towards M_{c} G C -0.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points H_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points H_{c} and E_{c} must be
     different; points H_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving G=_G

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving G=_G

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving N=_N

Proving failed

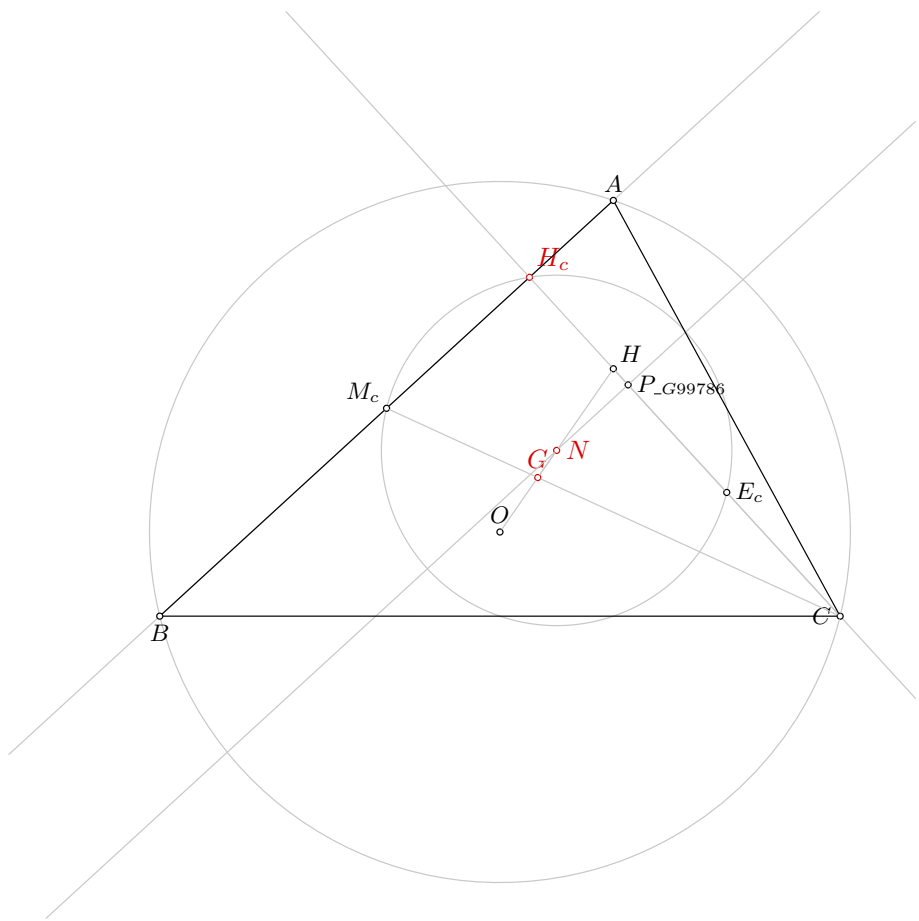

Figure 1: Illustration of the problem 1066

4.3 GCLC - Wu method

4.3.1 Proving G=_G

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving G=_G

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1067

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1067: Given a point G, a point I and a point N, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1068

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1068: Given a point G, a point M_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point M_a, construct a point A (rule W01); ;
2. Using the point G and the point N, construct a point H (rule W01); ;
3. Using the point G and the point N, construct a point O (rule W01); ;
4. Using the point A and the point H, construct a point E_a (rule W01); ;
5. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
6. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points M_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L19,L22,L55]

Solving time: 7.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point G 70 58.33
point M_{a} 65 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t G
cmark_r M_{a}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point A such that GA/GM_{a}=-2
towards A G M_{a} -2
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0



% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GN=-2
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0



% Constructing a point E_{a} such that AE_{a}/AH=0.5
```

```
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G170151} which is a foot of the point N on the line h_{a}
foot P_{\_G170151} N h_{a}
cmark_r P_{\_G170151}
color 200 200 200
drawline N P_{\_G170151}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G170151}
sim H_{a} P_{\_G170151} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points M_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving G=_G

Proving failed

4.1.2 Proving M_a=_M_a

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving G=_G

Proving failed

4.2.2 Proving M_a=_M_a

Proving failed

4.2.3 Proving N=_N

Proving failed

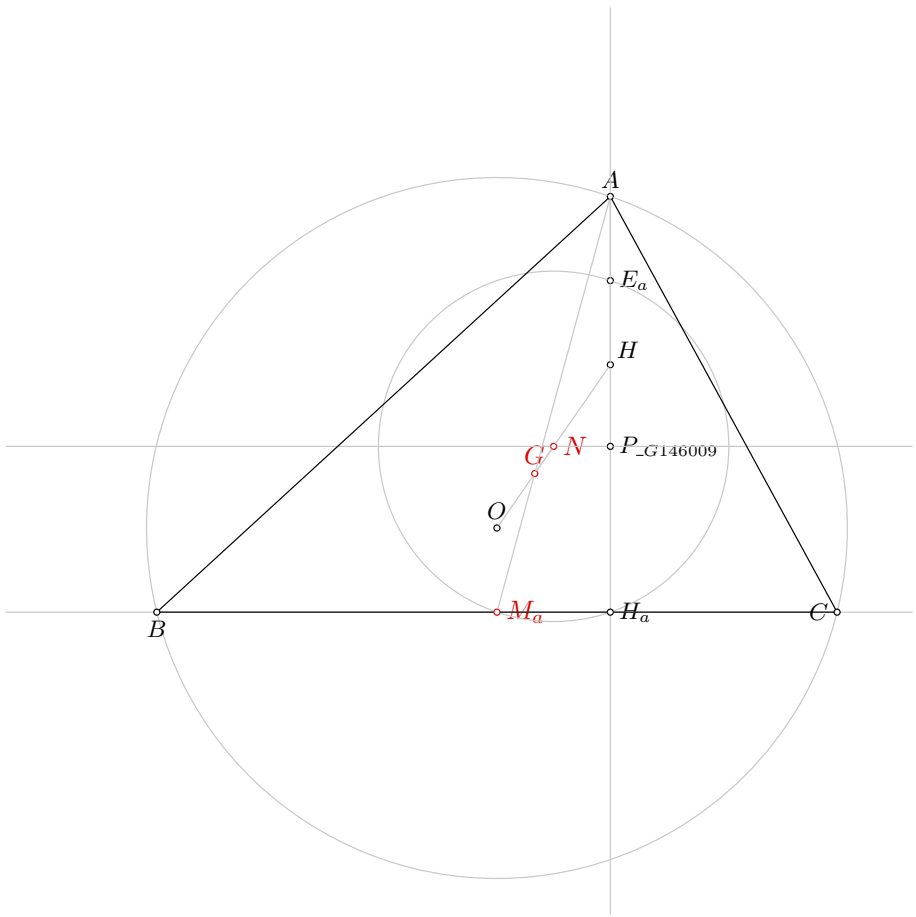

Figure 1: Illustration of the problem 1068

4.3 GCLC - Wu method

4.3.1 Proving G=_G

Proving failed

4.3.2 Proving M_a=_M_a

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 874 terms.

Time Complexity: Time spent by the prover is 3.580 seconds.There are no ndg conditions.

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving G=_G

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1069

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1069: Given a point G, a point M_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point M_b, construct a point B (rule W01); ;
2. Using the point G and the point N, construct a point H (rule W01); ;
3. Using the point G and the point N, construct a point O (rule W01); ;
4. Using the point B and the point H, construct a point E_b (rule W01); ;
5. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
6. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points M_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points B and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L17,L20,L23,L56]

Solving time: 7.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point G 70 58.33
point M_{b} 95 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t G
cmark_lt M_{b}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point B such that GB/GM_{b}=-2
towards B G M_{b} -2
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GN=-2
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0



% Constructing a point E_{b} such that BE_{b}/BH=0.5
```

```
towards E_{b} B H 0.5
cmark_r E_{b}
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G206417} which is a foot of the point N on the line h_{b}
foot P_{\_G206417} N h_{b}
cmark_r P_{\_G206417}
color 200 200 200
drawline N P_{\_G206417}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G206417}
sim H_{b} P_{\_G206417} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points M_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points B and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving G=_G

Proving failed

4.1.2 Proving M_b=_M_b

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving G=_G

Proving failed

4.2.2 Proving M_b=_M_b

Proving failed

4.2.3 Proving N=_N

Proving failed

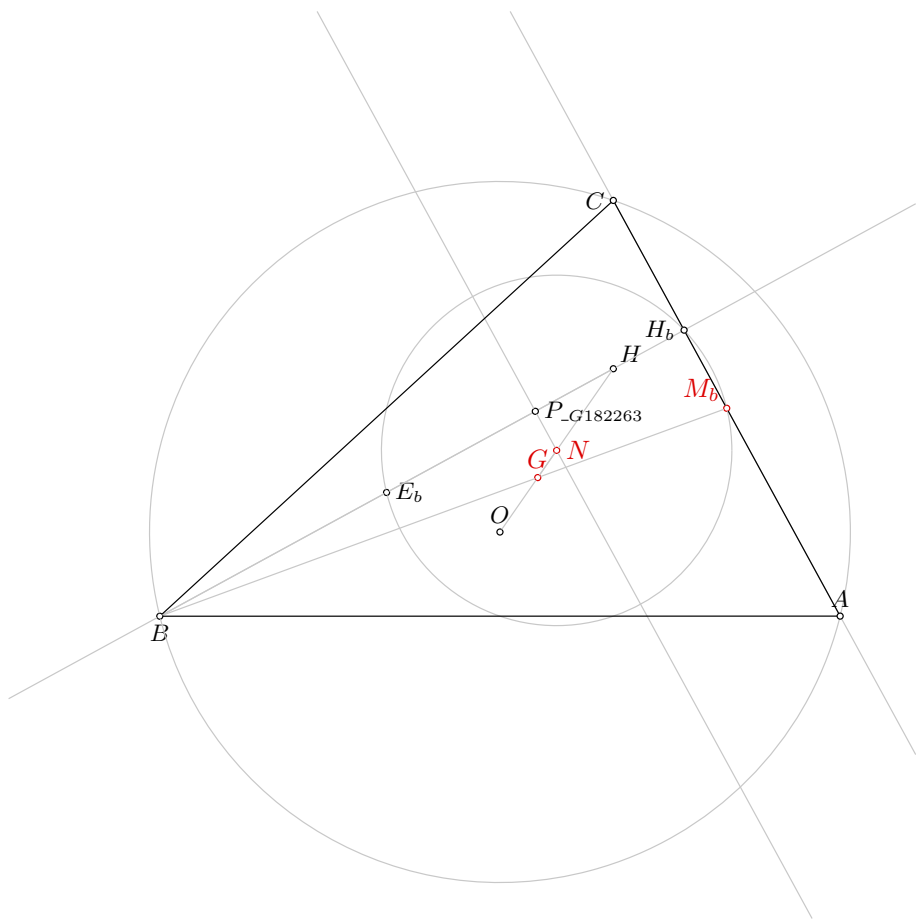

Figure 1: Illustration of the problem 1069

4.3 GCLC - Wu method

4.3.1 Proving G=_G

Proving failed

4.3.2 Proving M_b=_M_b

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 874 terms.

Time Complexity: Time spent by the prover is 3.480 seconds.There are no ndg conditions.

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving G=_G

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1070

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1070: Given a point G, a point M_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point G and the point M_c, construct a point C (rule W01); ;
2. Using the point G and the point N, construct a point H (rule W01); ;
3. Using the point G and the point N, construct a point O (rule W01); ;
4. Using the point C and the point H, construct a point E_c (rule W01); ;
5. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
6. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points M_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points C and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L15,L16,L18,L21,L24,L3,L57]

Solving time: 7.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point G 70 58.33
point M_{c} 50 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_t G
cmark_lt M_{c}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point C such that GC/GM_{c}=-2
towards C G M_{c} -2
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



% Constructing a point H such that GH/GN=4
towards H G N 4
cmark_rt H
color 200 200 200
drawsegment G H
color 0 0 0



% Constructing a point O such that GO/GN=-2
towards O G N -2
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0



% Constructing a point E_{c} such that CE_{c}/CH=0.5
```

```
towards E_{c} C H 0.5
cmark_r E_{c}
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G243456} which is a foot of the point N on the line h_{c}
foot P_{\_G243456} N h_{c}
cmark_r P_{\_G243456}
color 200 200 200
drawline N P_{\_G243456}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G243456}
sim H_{c} P_{\_G243456} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
```

```
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points M_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points C and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving G=_G

Proving failed

4.1.2 Proving M_c=_M_c

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving G=_G

Proving failed

4.2.2 Proving M_c=_M_c

Proving failed

4.2.3 Proving N=_N

Proving failed

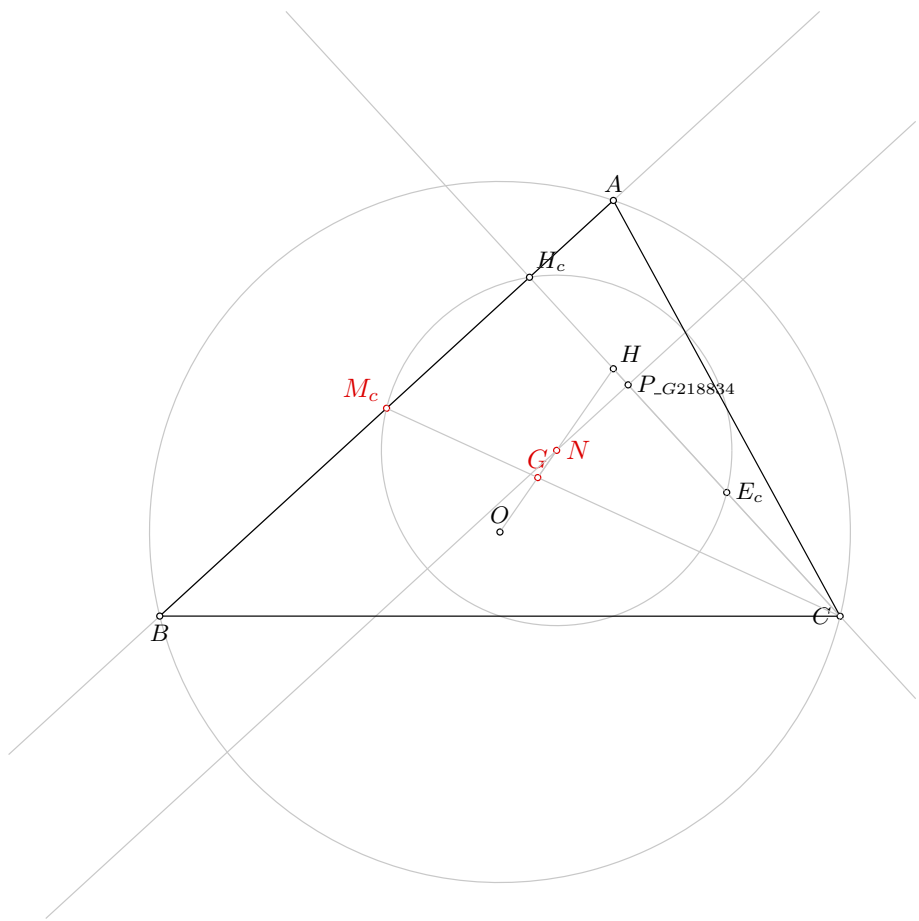

Figure 1: Illustration of the problem 1070

4.3 GCLC - Wu method

4.3.1 Proving G=_G

Proving failed

4.3.2 Proving M_c=_M_c

Status: The conjecture has not been proved nor disproved.

Space Complexity: The biggest polynomial obtained during proof process contained 874 terms.

Time Complexity: Time spent by the prover is 3.350 seconds.There are no ndg conditions.

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving G=_G

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1071

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1071: Given a point N, a point O and a point G, construct the triangle ABC.

2 Status

Problem is redundant.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Choose freely a point A (rule free);
3. Using the point A and the point G, construct a point M_a (rule W01); ;
4. Using the point N and the point O, construct a point H (rule W01); ;
5. Using the point A and the point H, construct a point E_a (rule W01); ;
6. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
7. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
8. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
9. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
10. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
11. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points M_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and H are not the same.

Rules used: [W01,W02,W04,W05,W06,free]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L19,L22,L55]

Solving time: 8.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point N 72.5 61.93
point O 65 51.14
point G 70 58.33

color 220 0 0
fontsize 9

cmark_r N
cmark_t O
cmark_t G
color 0 0 0
fontsize 8


% Constructing a line L_{\_G64150} which passes through point N and point O
line L_{\_G64150} N O

color 200 200 200
drawline L_{\_G64150}
color 0 0 0


% Constructing a point P_{\_G64251} with coordinates (0,0)
point P_{\_G64251} 0 0
cmark_r P_{\_G64251}

% Constructing a point P_{\_G64175} such that NP_{\_G64175}/NP_{\_G64251}=1
towards P_{\_G64175} N P_{\_G64251} 1
cmark_r P_{\_G64175}
color 200 200 200
drawsegment N P_{\_G64175}
color 0 0 0

% Constructing a point P_{\_G64220} such that NP_{\_G64220}/NP_{\_G64251}=3
towards P_{\_G64220} N P_{\_G64251} 3
cmark_r P_{\_G64220}
color 200 200 200
drawsegment N P_{\_G64220}
color 0 0 0

% Constructing a line L_{\_G64181} which passes through point O and point P_{\_G64220}
line L_{\_G64181} O P_{\_G64220}
```

```
color 200 200 200
drawline L_{\_G64181}
color 0 0 0


% Constructing a line L_{\_G64144} which contains the point P_{\_G64175} and is parallel to the
    line L_{\_G64181}
parallel L_{\_G64144} P_{\_G64175} L_{\_G64181}

color 200 200 200
drawline L_{\_G64144}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G64144} and line L_{\_G64150}
intersec G L_{\_G64144} L_{\_G64150}
cmark_t G



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
```

```
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G65328} which is a foot of the point N on the line h_{a}
foot P_{\_G65328} N h_{a}
cmark_r P_{\_G65328}
color 200 200 200
drawline N P_{\_G65328}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G65328}
sim H_{a} P_{\_G65328} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
```

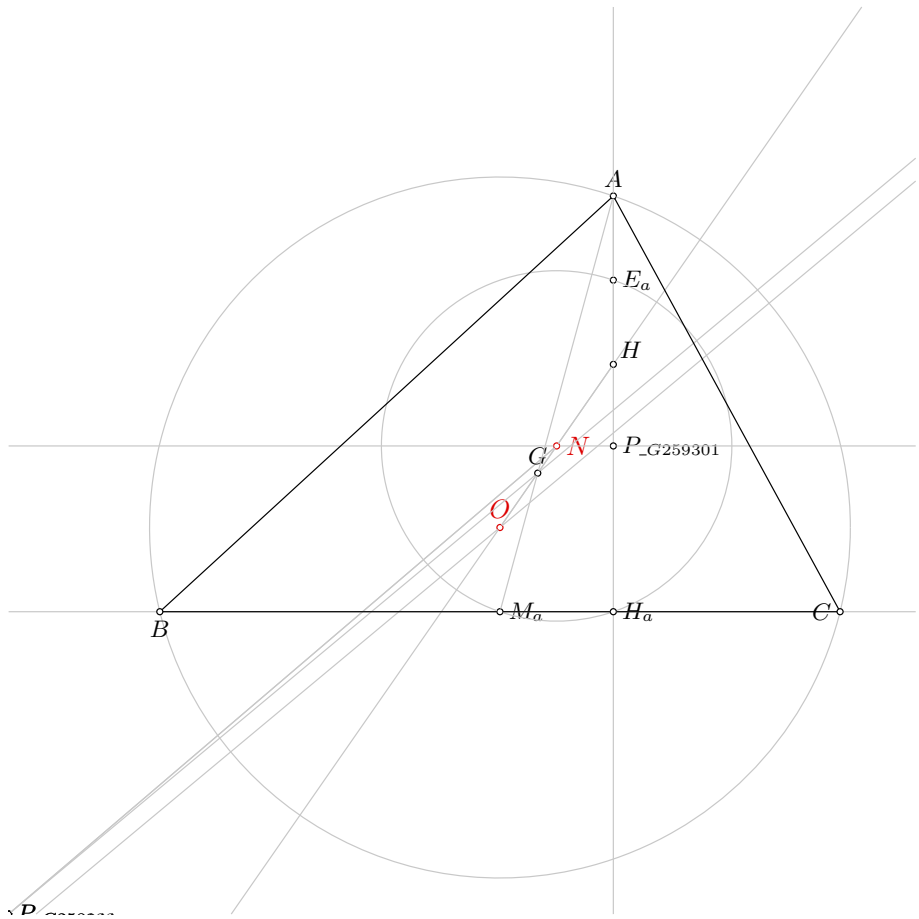

Figure 1: Illustration of the problem 1071

```
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points M_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving $N{=}\_N$

Proving failed

4.1.2 Proving $O{=}\_O$

Proving failed

4.1.3 Proving $G{=}\_G$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving $N{=}\_N$

Proving failed

4.2.2 Proving $O{=}\_O$

Proving failed

4.2.3 Proving $G{=}\_G$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $N{=}\_N$

Proving failed

4.3.2 Proving $O{=}\_O$

Proving failed

4.3.3 Proving $G{=}\_G$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $N{=}\_N$

Proving failed

4.4.2 Proving $O{=}\_O$

Proving failed

4.4.3 Proving $G{=}\_G$

Proving failed

Problem 1072

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1072: Given a point G, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1073

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1073: Given a point G, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1074

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1074: Given a point G, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1075

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1075: Given a point H, a point H_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point N, construct a point O (rule W01); ;
2. Using the point H and the point N, construct a point G (rule W01); ;
3. Using the point H and the point H_a, construct a line h_a (rule W02); % DET: points H and H_a are not the same;
4. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;
5. Using the circle $k(N, M_a)$, the line h_a, the point N and the point H_a, construct a point E_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points H_a and E_a must be different;
6. Using the point E_a and the point H, construct a point A (rule W01); ;
7. Using the point G and the point A, construct a point M_a (rule W01); ;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points H_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points H_a and E_a must be different; points H and H_a are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L16,L19,L22,L55]

Solving time: 4.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{a} 80 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_rt H
cmark_r H_{a}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G120721} which passes through point H and point N
line L_{\_G120721} H N

color 200 200 200
drawline L_{\_G120721}
color 0 0 0


% Constructing a point P_{\_G120822} with coordinates (0,0)
point P_{\_G120822} 0 0
cmark_r P_{\_G120822}

% Constructing a point P_{\_G120746} such that HP_{\_G120746}/HP_{\_G120822}=4
towards P_{\_G120746} H P_{\_G120822} 4
cmark_r P_{\_G120746}
color 200 200 200
drawsegment H P_{\_G120746}
color 0 0 0
```

```
% Constructing a point P_{\_G120791} such that HP_{\_G120791}/HP_{\_G120822}=3
towards P_{\_G120791} H P_{\_G120822} 3
cmark_r P_{\_G120791}
color 200 200 200
drawsegment H P_{\_G120791}
color 0 0 0

% Constructing a line L_{\_G120752} which passes through point N and point P_{\_G120791}
line L_{\_G120752} N P_{\_G120791}

color 200 200 200
drawline L_{\_G120752}
color 0 0 0


% Constructing a line L_{\_G120715} which contains the point P_{\_G120746} and is parallel to the
    line L_{\_G120752}
parallel L_{\_G120715} P_{\_G120746} L_{\_G120752}

color 200 200 200
drawline L_{\_G120715}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G120715} and line L_{\_G120721}
intersec G L_{\_G120715} L_{\_G120721}
cmark_t G


% DET: points H and H_{a} are not the same
% Constructing a line h_{a} which passes through point H and point H_{a}
line h_{a} H H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points H_{a} and E_{a} must be different
% Constructing a point P_{\_G121575} which is a foot of the point N on the line h_{a}
foot P_{\_G121575} N h_{a}
cmark_r P_{\_G121575}
color 200 200 200
drawline N P_{\_G121575}
color 0 0 0
```

```
% Constructing a point E_{a} which is an image of the point H_{a} in the symmetry to point/line P
    _{\_G121575}
sim E_{a} P_{\_G121575} H_{a}
cmark_r E_{a}



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point M_{a} such that GM_{a}/GA=-0.5
towards M_{a} G A -0.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

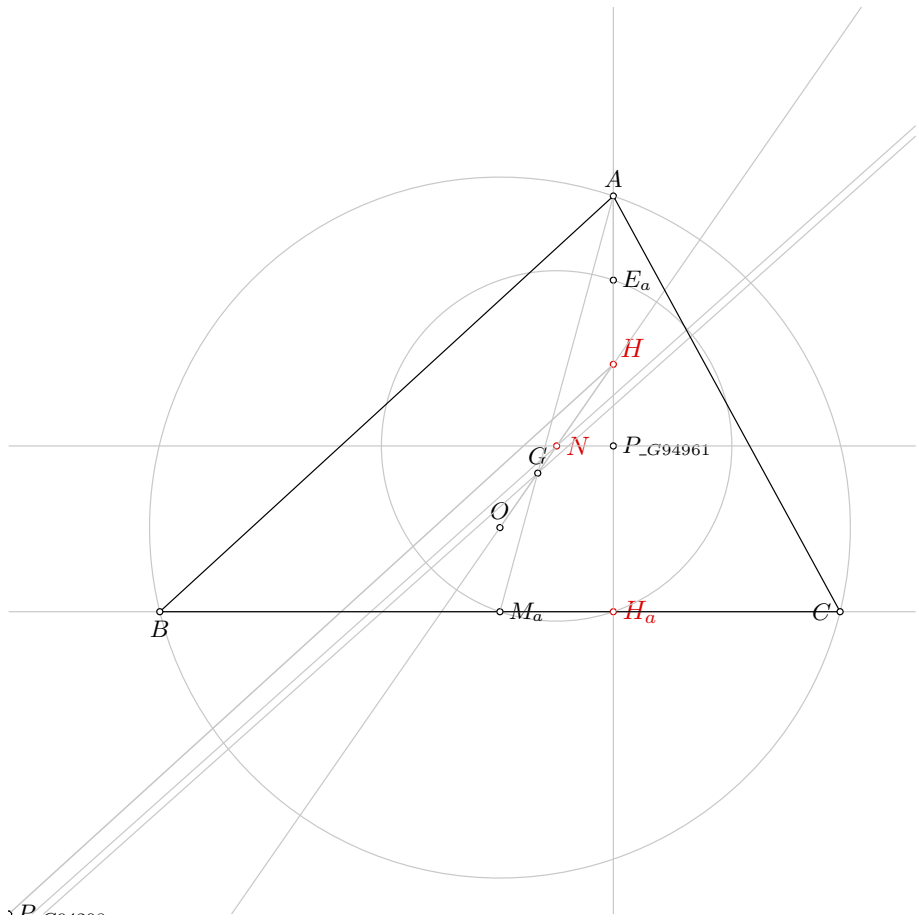

Figure 1: Illustration of the problem 1075

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points H_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points H_{a} and E_{a} must be
     different; points H and H_{a} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Proving failed

4.1.2 Proving H_a=_H_a

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving H_a=_H_a

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Proving failed

4.3.2 Proving H_a=_H_a

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving H_a=_H_a

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1076

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1076: Given a point H, a point H_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point N, construct a point O (rule W01); ;
2. Using the point H and the point N, construct a point G (rule W01); ;
3. Using the point H and the point H_b, construct a line h_b (rule W02); % DET: points H and H_b are not the same;
4. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;
5. Using the circle $k(N, M_a)$, the line h_b, the point N and the point H_b, construct a point E_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points H_b and E_b must be different;
6. Using the point E_b and the point H, construct a point B (rule W01); ;
7. Using the point G and the point B, construct a point M_b (rule W01); ;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points H_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points H_b and E_b must be different; points H and H_b are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L16,L20,L23,L56]

Solving time: 4.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{b} 89.36 77.83
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_rt H
cmark_l H_{b}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G159484} which passes through point H and point N
line L_{\_G159484} H N

color 200 200 200
drawline L_{\_G159484}
color 0 0 0


% Constructing a point P_{\_G159585} with coordinates (0,0)
point P_{\_G159585} 0 0
cmark_r P_{\_G159585}

% Constructing a point P_{\_G159509} such that HP_{\_G159509}/HP_{\_G159585}=4
towards P_{\_G159509} H P_{\_G159585} 4
cmark_r P_{\_G159509}
color 200 200 200
drawsegment H P_{\_G159509}
color 0 0 0
```

```
% Constructing a point P_{\_G159554} such that HP_{\_G159554}/HP_{\_G159585}=3
towards P_{\_G159554} H P_{\_G159585} 3
cmark_r P_{\_G159554}
color 200 200 200
drawsegment H P_{\_G159554}
color 0 0 0

% Constructing a line L_{\_G159515} which passes through point N and point P_{\_G159554}
line L_{\_G159515} N P_{\_G159554}

color 200 200 200
drawline L_{\_G159515}
color 0 0 0


% Constructing a line L_{\_G159478} which contains the point P_{\_G159509} and is parallel to the
    line L_{\_G159515}
parallel L_{\_G159478} P_{\_G159509} L_{\_G159515}

color 200 200 200
drawline L_{\_G159478}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G159478} and line L_{\_G159484}
intersec G L_{\_G159478} L_{\_G159484}
cmark_t G


% DET: points H and H_{b} are not the same
% Constructing a line h_{b} which passes through point H and point H_{b}
line h_{b} H H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points H_{b} and E_{b} must be different
% Constructing a point P_{\_G160338} which is a foot of the point N on the line h_{b}
foot P_{\_G160338} N h_{b}
cmark_r P_{\_G160338}
color 200 200 200
drawline N P_{\_G160338}
color 0 0 0
```

```
% Constructing a point E_{b} which is an image of the point H_{b} in the symmetry to point/line P
    _{\_G160338}
sim E_{b} P_{\_G160338} H_{b}
cmark_r E_{b}



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point M_{b} such that GM_{b}/GB=-0.5
towards M_{b} G B -0.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

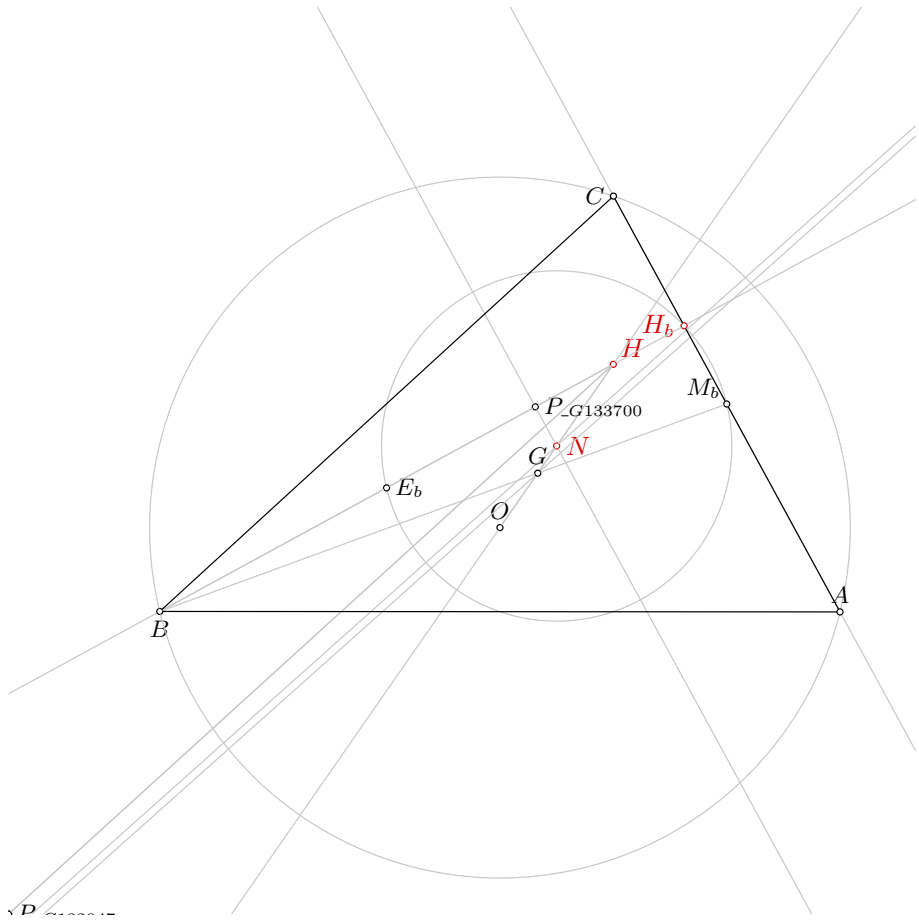

Figure 1: Illustration of the problem 1076

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points H_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points H_{b} and E_{b} must be
     different; points H and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Proving failed

4.1.2 Proving H_b=_H_b

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving H_b=_H_b

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Proving failed

4.3.2 Proving H_b=_H_b

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving H_b=_H_b

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1077

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1077: Given a point H, a point H_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point N, construct a point O (rule W01); ;
2. Using the point H and the point N, construct a point G (rule W01); ;
3. Using the point H and the point H_c, construct a line h_c (rule W02); % DET: points H and H_c are not the same;
4. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;
5. Using the circle $k(N, M_a)$, the line h_c, the point N and the point H_c, construct a point E_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points H_c and E_c must be different;
6. Using the point E_c and the point H, construct a point C (rule W01); ;
7. Using the point G and the point C, construct a point M_c (rule W01); ;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points H_c and E_c must be different; points H and H_c are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L16,L21,L24,L3,L57]

Solving time: 4.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point H_{c} 68.91 84.83
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_rt H
cmark_rt H_{c}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G199488} which passes through point H and point N
line L_{\_G199488} H N

color 200 200 200
drawline L_{\_G199488}
color 0 0 0


% Constructing a point P_{\_G199589} with coordinates (0,0)
point P_{\_G199589} 0 0
cmark_r P_{\_G199589}

% Constructing a point P_{\_G199513} such that HP_{\_G199513}/HP_{\_G199589}=4
towards P_{\_G199513} H P_{\_G199589} 4
cmark_r P_{\_G199513}
color 200 200 200
drawsegment H P_{\_G199513}
color 0 0 0
```

```
% Constructing a point P_{\_G199558} such that HP_{\_G199558}/HP_{\_G199589}=3
towards P_{\_G199558} H P_{\_G199589} 3
cmark_r P_{\_G199558}
color 200 200 200
drawsegment H P_{\_G199558}
color 0 0 0

% Constructing a line L_{\_G199519} which passes through point N and point P_{\_G199558}
line L_{\_G199519} N P_{\_G199558}

color 200 200 200
drawline L_{\_G199519}
color 0 0 0


% Constructing a line L_{\_G199482} which contains the point P_{\_G199513} and is parallel to the
    line L_{\_G199519}
parallel L_{\_G199482} P_{\_G199513} L_{\_G199519}

color 200 200 200
drawline L_{\_G199482}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G199482} and line L_{\_G199488}
intersec G L_{\_G199482} L_{\_G199488}
cmark_t G


% DET: points H and H_{c} are not the same
% Constructing a line h_{c} which passes through point H and point H_{c}
line h_{c} H H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points H_{c} and E_{c} must be different
% Constructing a point P_{\_G200342} which is a foot of the point N on the line h_{c}
foot P_{\_G200342} N h_{c}
cmark_r P_{\_G200342}
color 200 200 200
drawline N P_{\_G200342}
color 0 0 0
```

```
% Constructing a point E_{c} which is an image of the point H_{c} in the symmetry to point/line P
    _{\_G200342}
sim E_{c} P_{\_G200342} H_{c}
cmark_r E_{c}



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point M_{c} such that GM_{c}/GC=-0.5
towards M_{c} G C -0.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

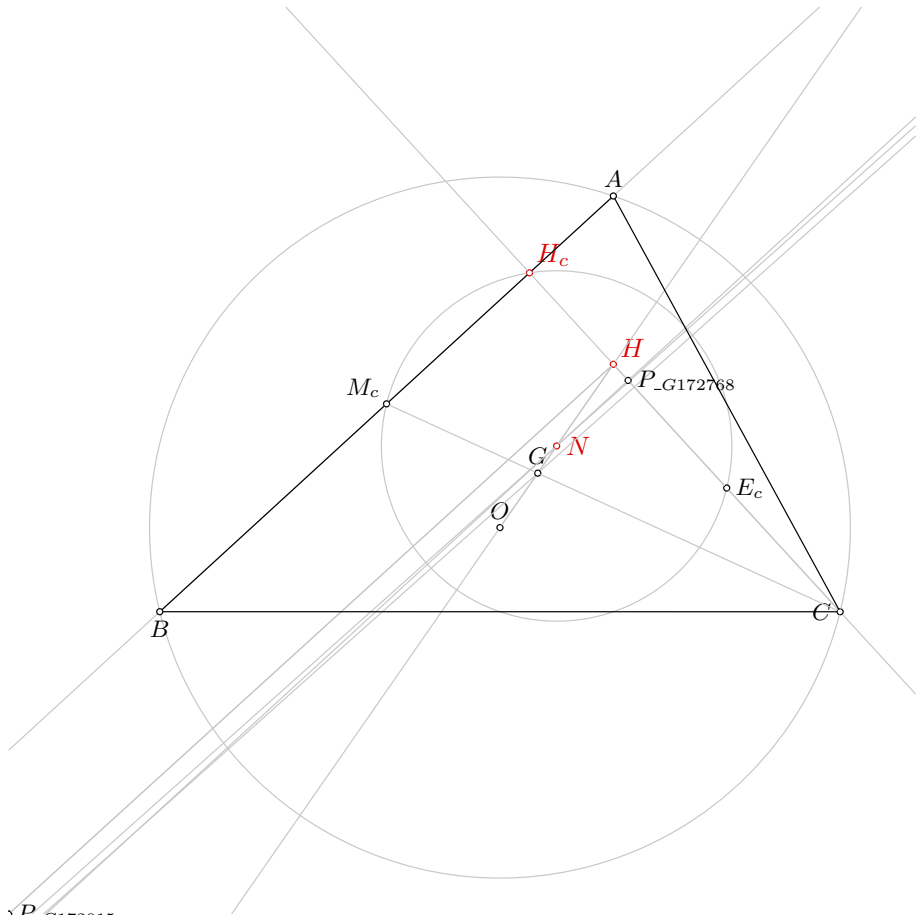

Figure 1: Illustration of the problem 1077

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points H_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points H_{c} and E_{c} must be
     different; points H and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Proving failed

4.1.2 Proving H_c=_H_c

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving H_c=_H_c

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Proving failed

4.3.2 Proving H_c=_H_c

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving H_c=_H_c

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1078

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1078: Given a point H, a point I and a point N, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1079

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1079: Given a point H, a point M_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point N, construct a point O (rule W01); ;
2. Using the point H and the point N, construct a point G (rule W01); ;
3. Using the point M_a and the point G, construct a point A (rule W01); ;
4. Using the point H and the point A, construct a point E_a (rule W01); ;
5. Using the point H and the point A, construct a line h_a (rule W02); % DET: points H and A are not the same;
6. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points M_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points H and A are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L16,L19,L22,L55]

Solving time: 8.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point M_{a} 65 40
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_rt H
cmark_r M_{a}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G244371} which passes through point H and point N
line L_{\_G244371} H N

color 200 200 200
drawline L_{\_G244371}
color 0 0 0


% Constructing a point P_{\_G244472} with coordinates (0,0)
point P_{\_G244472} 0 0
cmark_r P_{\_G244472}

% Constructing a point P_{\_G244396} such that HP_{\_G244396}/HP_{\_G244472}=4
towards P_{\_G244396} H P_{\_G244472} 4
cmark_r P_{\_G244396}
color 200 200 200
drawsegment H P_{\_G244396}
color 0 0 0
```

```
% Constructing a point P_{\_G244441} such that HP_{\_G244441}/HP_{\_G244472}=3
towards P_{\_G244441} H P_{\_G244472} 3
cmark_r P_{\_G244441}
color 200 200 200
drawsegment H P_{\_G244441}
color 0 0 0

% Constructing a line L_{\_G244402} which passes through point N and point P_{\_G244441}
line L_{\_G244402} N P_{\_G244441}

color 200 200 200
drawline L_{\_G244402}
color 0 0 0


% Constructing a line L_{\_G244365} which contains the point P_{\_G244396} and is parallel to the
    line L_{\_G244402}
parallel L_{\_G244365} P_{\_G244396} L_{\_G244402}

color 200 200 200
drawline L_{\_G244365}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G244365} and line L_{\_G244371}
intersec G L_{\_G244365} L_{\_G244371}
cmark_t G



% Constructing a point A such that M_{a}A/M_{a}G=3
towards A M_{a} G 3
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0



% Constructing a point E_{a} such that HE_{a}/HA=0.5
towards E_{a} H A 0.5
cmark_r E_{a}
color 200 200 200
drawsegment H A
color 0 0 0


% DET: points H and A are not the same
% Constructing a line h_{a} which passes through point H and point A
line h_{a} H A

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G245382} which is a foot of the point N on the line h_{a}
foot P_{\_G245382} N h_{a}
cmark_r P_{\_G245382}
color 200 200 200
drawline N P_{\_G245382}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G245382}
sim H_{a} P_{\_G245382} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

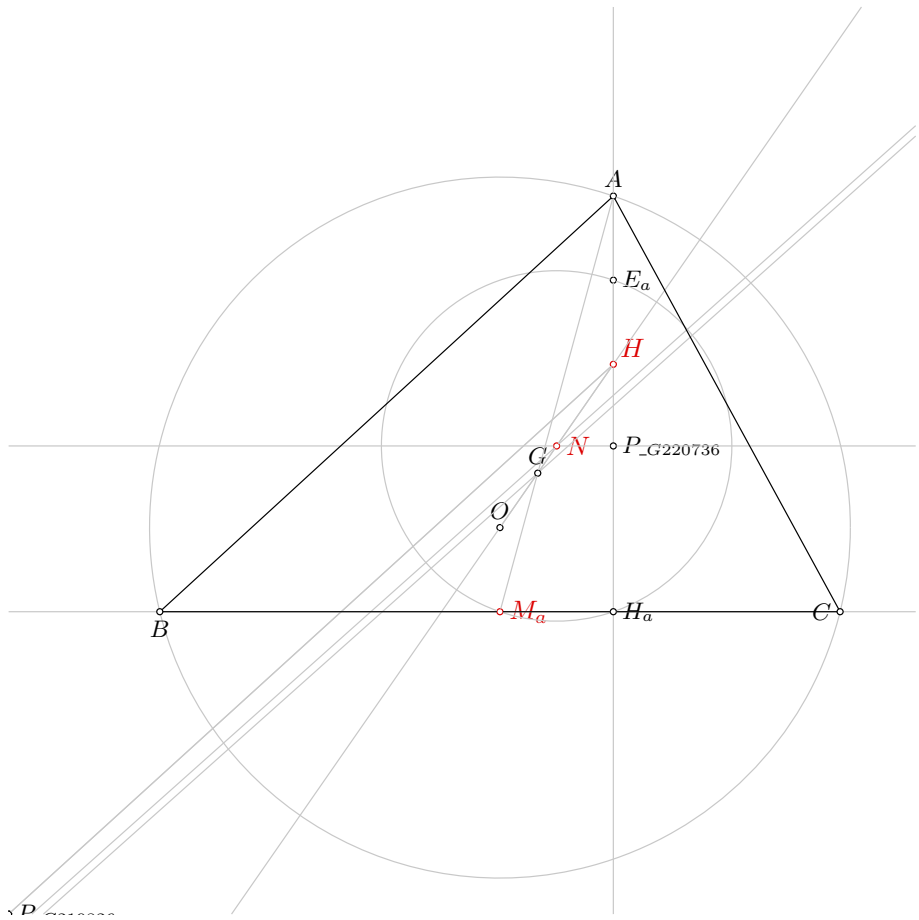

Figure 1: Illustration of the problem 1079

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points M_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points H and A are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Proving failed

4.1.2 Proving M_a=_M_a

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving M_a=_M_a

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Proving failed

4.3.2 Proving M_a=_M_a

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1080

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1080: Given a point H, a point M_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point N, construct a point O (rule W01); ;
2. Using the point H and the point N, construct a point G (rule W01); ;
3. Using the point M_b and the point G, construct a point B (rule W01); ;
4. Using the point H and the point B, construct a point E_b (rule W01); ;
5. Using the point H and the point B, construct a line h_b (rule W02); % DET: points H and B are not the same;
6. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points M_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points H and B are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L16,L17,L20,L23,L56]

Solving time: 8.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point M_{b} 95 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_rt H
cmark_lt M_{b}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G61988} which passes through point H and point N
line L_{\_G61988} H N

color 200 200 200
drawline L_{\_G61988}
color 0 0 0


% Constructing a point P_{\_G62089} with coordinates (0,0)
point P_{\_G62089} 0 0
cmark_r P_{\_G62089}

% Constructing a point P_{\_G62013} such that HP_{\_G62013}/HP_{\_G62089}=4
towards P_{\_G62013} H P_{\_G62089} 4
cmark_r P_{\_G62013}
color 200 200 200
drawsegment H P_{\_G62013}
color 0 0 0
```

```
% Constructing a point P_{\_G62058} such that HP_{\_G62058}/HP_{\_G62089}=3
towards P_{\_G62058} H P_{\_G62089} 3
cmark_r P_{\_G62058}
color 200 200 200
drawsegment H P_{\_G62058}
color 0 0 0

% Constructing a line L_{\_G62019} which passes through point N and point P_{\_G62058}
line L_{\_G62019} N P_{\_G62058}

color 200 200 200
drawline L_{\_G62019}
color 0 0 0


% Constructing a line L_{\_G61982} which contains the point P_{\_G62013} and is parallel to the
    line L_{\_G62019}
parallel L_{\_G61982} P_{\_G62013} L_{\_G62019}

color 200 200 200
drawline L_{\_G61982}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G61982} and line L_{\_G61988}
intersec G L_{\_G61982} L_{\_G61988}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



% Constructing a point E_{b} such that HE_{b}/HB=0.5
towards E_{b} H B 0.5
cmark_r E_{b}
color 200 200 200
drawsegment H B
color 0 0 0


% DET: points H and B are not the same
% Constructing a line h_{b} which passes through point H and point B
line h_{b} H B

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G62999} which is a foot of the point N on the line h_{b}
foot P_{\_G62999} N h_{b}
cmark_r P_{\_G62999}
color 200 200 200
drawline N P_{\_G62999}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G62999}
sim H_{b} P_{\_G62999} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

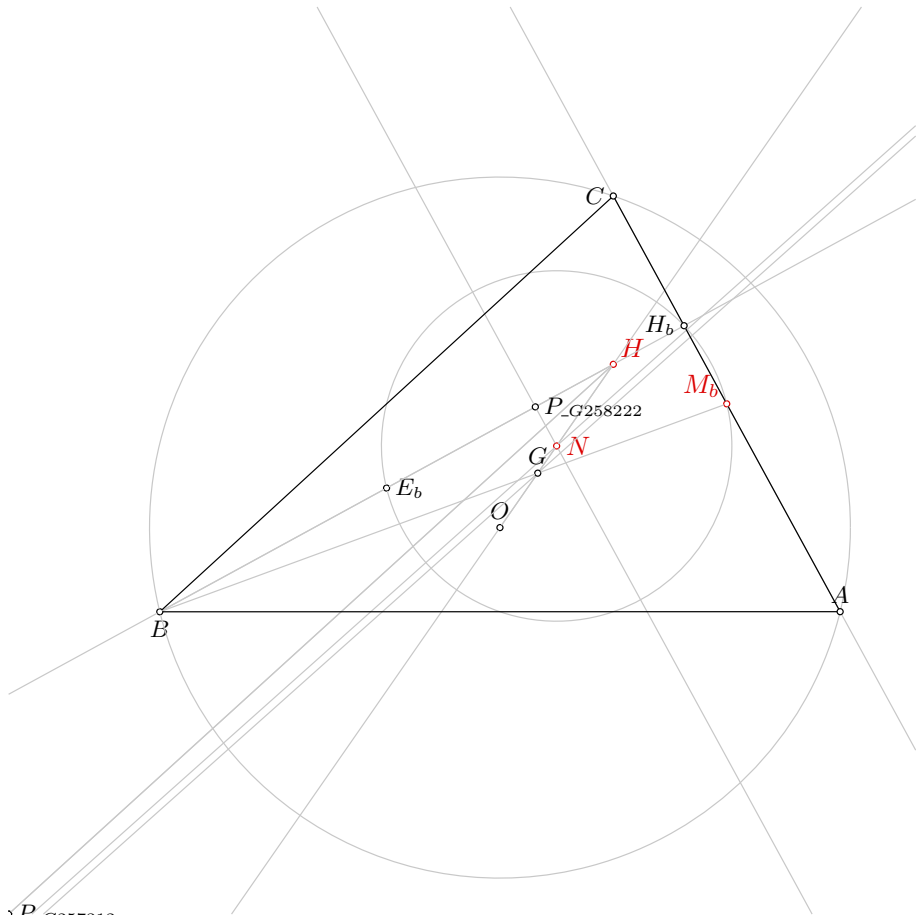

Figure 1: Illustration of the problem 1080

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points M_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points H and B are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Proving failed

4.1.2 Proving M_b=_M_b

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving M_b=_M_b

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Proving failed

4.3.2 Proving M_b=_M_b

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1081

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1081: Given a point H, a point M_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H and the point N, construct a point O (rule W01); ;
2. Using the point H and the point N, construct a point G (rule W01); ;
3. Using the point M_c and the point G, construct a point C (rule W01); ;
4. Using the point H and the point C, construct a point E_c (rule W01); ;
5. Using the point H and the point C, construct a line h_c (rule W02); % DET: points H and C are not the same;
6. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points M_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points H and C are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L16,L18,L21,L24,L3,L57]

Solving time: 8.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H 80 72.73
point M_{c} 50 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9

cmark_rt H
cmark_lt M_{c}
cmark_r N
color 0 0 0
fontsize 8


% Constructing a point O such that HO/HN=2
towards O H N 2
cmark_t O
color 200 200 200
drawsegment H O
color 0 0 0



% Constructing a line L_{\_G100220} which passes through point H and point N
line L_{\_G100220} H N

color 200 200 200
drawline L_{\_G100220}
color 0 0 0


% Constructing a point P_{\_G100321} with coordinates (0,0)
point P_{\_G100321} 0 0
cmark_r P_{\_G100321}

% Constructing a point P_{\_G100245} such that HP_{\_G100245}/HP_{\_G100321}=4
towards P_{\_G100245} H P_{\_G100321} 4
cmark_r P_{\_G100245}
color 200 200 200
drawsegment H P_{\_G100245}
color 0 0 0
```

```
% Constructing a point P_{\_G100290} such that HP_{\_G100290}/HP_{\_G100321}=3
towards P_{\_G100290} H P_{\_G100321} 3
cmark_r P_{\_G100290}
color 200 200 200
drawsegment H P_{\_G100290}
color 0 0 0

% Constructing a line L_{\_G100251} which passes through point N and point P_{\_G100290}
line L_{\_G100251} N P_{\_G100290}

color 200 200 200
drawline L_{\_G100251}
color 0 0 0


% Constructing a line L_{\_G100214} which contains the point P_{\_G100245} and is parallel to the
    line L_{\_G100251}
parallel L_{\_G100214} P_{\_G100245} L_{\_G100251}

color 200 200 200
drawline L_{\_G100214}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G100214} and line L_{\_G100220}
intersec G L_{\_G100214} L_{\_G100220}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



% Constructing a point E_{c} such that HE_{c}/HC=0.5
towards E_{c} H C 0.5
cmark_r E_{c}
color 200 200 200
drawsegment H C
color 0 0 0


% DET: points H and C are not the same
% Constructing a line h_{c} which passes through point H and point C
line h_{c} H C

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G101231} which is a foot of the point N on the line h_{c}
foot P_{\_G101231} N h_{c}
cmark_r P_{\_G101231}
color 200 200 200
drawline N P_{\_G101231}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G101231}
sim H_{c} P_{\_G101231} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

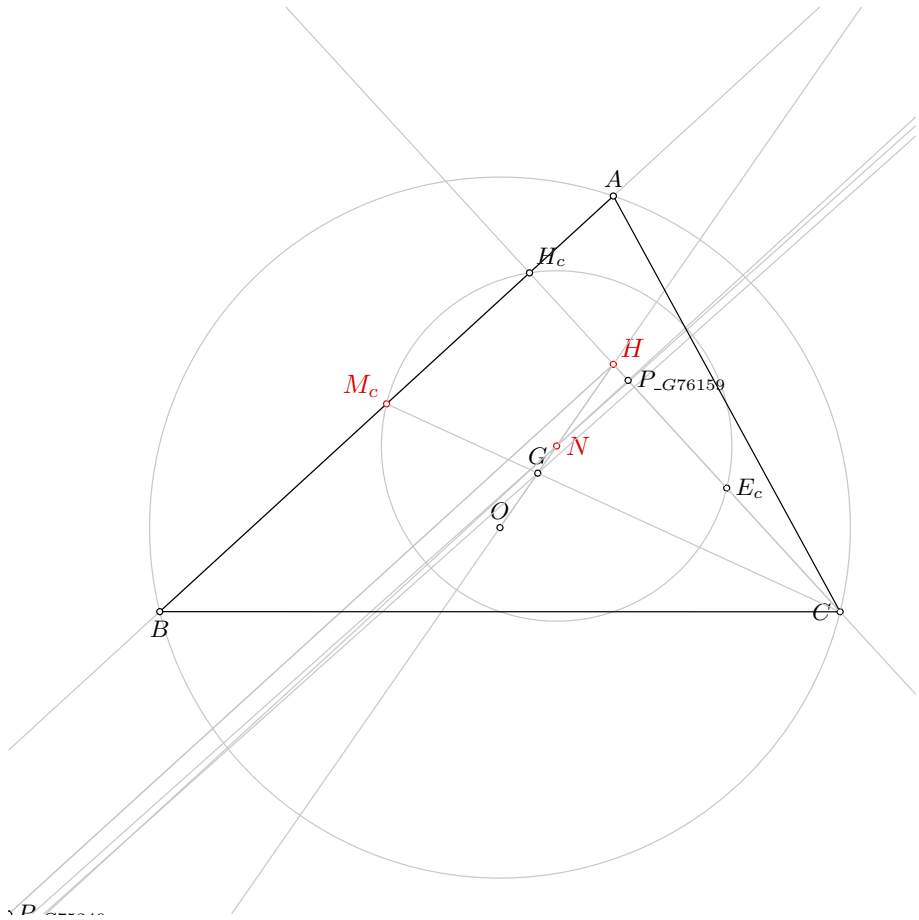

Figure 1: Illustration of the problem 1081

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points M_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points H and C are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H=_H

Proving failed

4.1.2 Proving M_c=_M_c

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H=_H

Proving failed

4.2.2 Proving M_c=_M_c

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H=_H

Proving failed

4.3.2 Proving M_c=_M_c

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H=_H

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1082

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1082: Given a point N, a point O and a point H, construct the triangle ABC.

2 Status

Problem is redundant.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point N and the point O, construct a point H (rule W01); ;
3. Choose freely a point A (rule free);
4. Using the point A and the point G, construct a point M_a (rule W01); ;
5. Using the point A and the point H, construct a point E_a (rule W01); ;
6. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
7. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
8. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
9. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
10. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
11. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; line h_a and circle $k(N, M_a)$ intersect; points M_a and N are not the same; points A and O are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and H are not the same.

Rules used: [W01,W02,W04,W05,W06,free]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L19,L22,L55]

Solving time: 8.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point N 72.5 61.93
point O 65 51.14
point H 80 72.73

color 220 0 0
fontsize 9

cmark_r N
cmark_t O
cmark_rt H
color 0 0 0
fontsize 8


% Constructing a line L_{\_G142490} which passes through point N and point O
line L_{\_G142490} N O

color 200 200 200
drawline L_{\_G142490}
color 0 0 0


% Constructing a point P_{\_G142591} with coordinates (0,0)
point P_{\_G142591} 0 0
cmark_r P_{\_G142591}

% Constructing a point P_{\_G142515} such that NP_{\_G142515}/NP_{\_G142591}=1
towards P_{\_G142515} N P_{\_G142591} 1
cmark_r P_{\_G142515}
color 200 200 200
drawsegment N P_{\_G142515}
color 0 0 0

% Constructing a point P_{\_G142560} such that NP_{\_G142560}/NP_{\_G142591}=3
towards P_{\_G142560} N P_{\_G142591} 3
cmark_r P_{\_G142560}
color 200 200 200
drawsegment N P_{\_G142560}
color 0 0 0

% Constructing a line L_{\_G142521} which passes through point O and point P_{\_G142560}
line L_{\_G142521} O P_{\_G142560}
```

```
color 200 200 200
drawline L_{\_G142521}
color 0 0 0


% Constructing a line L_{\_G142484} which contains the point P_{\_G142515} and is parallel to the
    line L_{\_G142521}
parallel L_{\_G142484} P_{\_G142515} L_{\_G142521}

color 200 200 200
drawline L_{\_G142484}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G142484} and line L_{\_G142490}
intersec G L_{\_G142484} L_{\_G142490}
cmark_t G



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point M_{a} such that AM_{a}/AG=1.5
towards M_{a} A G 1.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0



% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
```

```
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G143668} which is a foot of the point N on the line h_{a}
foot P_{\_G143668} N h_{a}
cmark_r P_{\_G143668}
color 200 200 200
drawline N P_{\_G143668}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G143668}
sim H_{a} P_{\_G143668} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
```

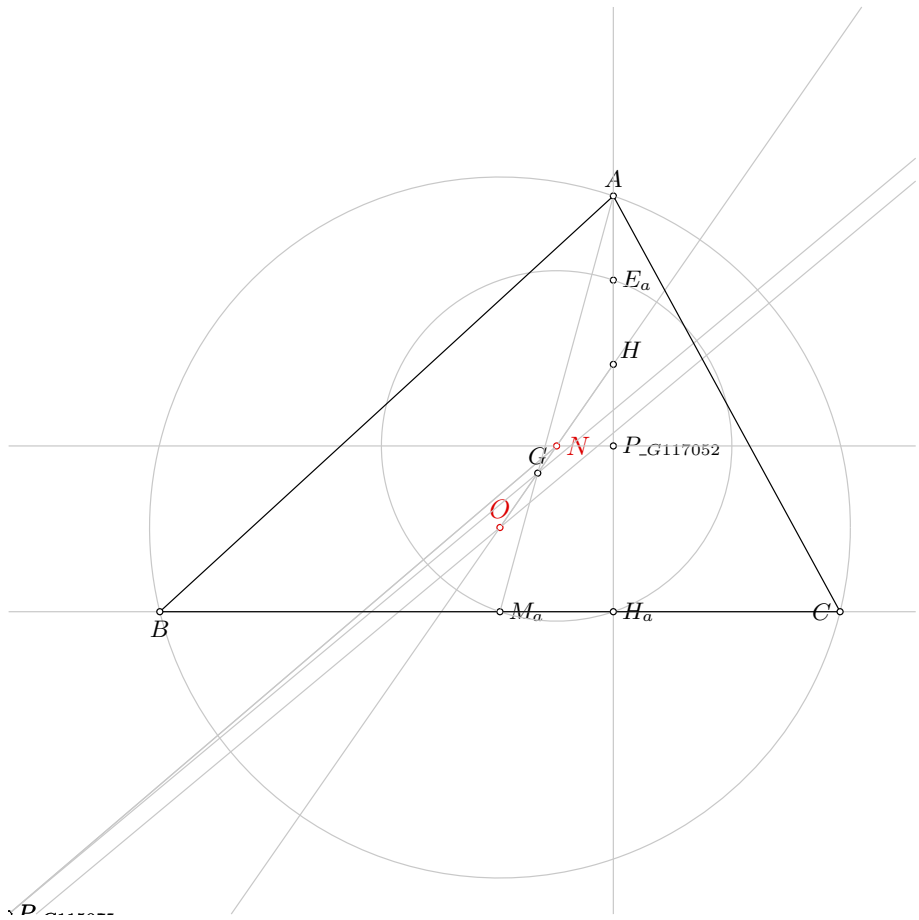

Figure 1: Illustration of the problem 1082

```
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; line h_{a} and circle k(N,M_{a})
    intersect; points M_{a} and N are not the same; points A and O are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving $N{=}\_N$

Proving failed

4.1.2 Proving $O{=}\_O$

Proving failed

4.1.3 Proving $H{=}\_H$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving $N{=}\_N$

Proving failed

4.2.2 Proving $O{=}\_O$

Proving failed

4.2.3 Proving $H{=}\_H$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving $N{=}\_N$

Proving failed

4.3.2 Proving $O{=}\_O$

Proving failed

4.3.3 Proving $H{=}\_H$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving $N{=}\_N$

Proving failed

4.4.2 Proving $O{=}\_O$

Proving failed

4.4.3 Proving $H{=}\_H$

Proving failed

Problem 1083

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1083: Given a point H, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1084

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1084: Given a point H, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1085

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1085: Given a point H, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1086

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1086: Given a point H_b, a point N and a point H_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;
2. Choose freely a point H_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point H_a and the point H_b, construct a line $m(H_aH_b)$ (rule W14); % DET: points H_a and H_b are not the same;
4. Using the circle $k(N, M_a)$ and the line $m(H_aH_b)$, construct a point M_c and a point E_c (rule W04); % NDG: line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect;
5. Choose freely a point A on the circle $k(M_c, A)$ (rule WOncircle);
6. Using the point A and the point M_c, construct a point B (rule W01); ;
7. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;
8. Using the point H_b and the point B, construct a line h_b (rule W02); % DET: points H_b and B are not the same;
9. Using the line h_a and the line h_b, construct a point H (rule W03); % NDG: lines h_a and h_b are not parallel % DET: lines h_a and h_b are not the same;
10. Using the point N and the point H, construct a point G (rule W01); ;
11. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: lines h_a and h_b are not parallel; line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect; points H_b and N are not the same.

Determination conditions: lines h_a and h_b are not the same; points H_b and B are not the same; points A and H_a are not the same; points H_a and H_b are not the same.

Rules used: [W01,W02,W03,W04,W06,W14,WOncircle1]

Lemmas used: [D20,D3,D32,D5,D6,D8,D9,GD02,GL01,GL03,GL04,L16,L18,L20,L24,L41,L42,L53,L54,L57]

Solving time: 58.0 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{b} 89.36 77.83
point N 72.5 61.93
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_l H_{b}
cmark_r N
cmark_r H_{a}
color 0 0 0
fontsize 8

% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{a} on the circle with center N through point H_{b}
oncircle H_{a} N H_{b}
cmark_r H_{a}
color 200 200 200
drawcircle N H_{b}
color 0 0 0


% DET: points H_{a} and H_{b} are not the same
% Constructing bisector m(H_{a}H_{b}) of the segment H_{a}H_{b}
med m(H_{a}H_{b}) H_{a} H_{b}

color 200 200 200
drawline m(H_{a}H_{b})
color 0 0 0

color 200 200 200
drawsegment H_{a} H_{b}
```

```
color 0 0 0

% NDG: line m(H_{a}H_{b}) and circle k(N,M_{a}) intersect
% Constructing points M_{c} and E_{c} which are in intersection of k(N,M_{a}) and m(H_{a}H_{b})
intersec2 M_{c} E_{c} k(N,M_{a}) m(H_{a}H_{b})
cmark_lt M_{c}
cmark_r E_{c}


% Choosing randomly a point A on the circle with center M_{c} through point H_{a}
oncircle A M_{c} H_{a}
cmark_t A
color 200 200 200
drawcircle M_{c} H_{a}
color 0 0 0


% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0

% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0


% DET: points H_{b} and B are not the same
% Constructing a line h_{b} which passes through point H_{b} and point B
line h_{b} H_{b} B

color 200 200 200
drawline h_{b}
color 0 0 0


% NDG: lines h_{a} and h_{b} are not parallel% DET: lines h_{a} and h_{b} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{b}
intersec H h_{a} h_{b}
cmark_rt H


% Constructing a line L_{\_G198116} which passes through point N and point H
```

```
line L_{\_G198116} N H

color 200 200 200
drawline L_{\_G198116}
color 0 0 0


% Constructing a point P_{\_G198217} with coordinates (0,0)
point P_{\_G198217} 0 0
cmark_r P_{\_G198217}

% Constructing a point P_{\_G198141} such that NP_{\_G198141}/NP_{\_G198217}=-1
towards P_{\_G198141} N P_{\_G198217} -1
cmark_r P_{\_G198141}
color 200 200 200
drawsegment P_{\_G198217} P_{\_G198141}
color 0 0 0

% Constructing a point P_{\_G198186} such that NP_{\_G198186}/NP_{\_G198217}=3
towards P_{\_G198186} N P_{\_G198217} 3
cmark_r P_{\_G198186}
color 200 200 200
drawsegment N P_{\_G198186}
color 0 0 0

% Constructing a line L_{\_G198147} which passes through point H and point P_{\_G198186}
line L_{\_G198147} H P_{\_G198186}

color 200 200 200
drawline L_{\_G198147}
color 0 0 0


% Constructing a line L_{\_G198110} which contains the point P_{\_G198141} and is parallel to the
    line L_{\_G198147}
parallel L_{\_G198110} P_{\_G198141} L_{\_G198147}

color 200 200 200
drawline L_{\_G198110}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G198110} and line L_{\_G198116}
intersec G L_{\_G198110} L_{\_G198116}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0
```

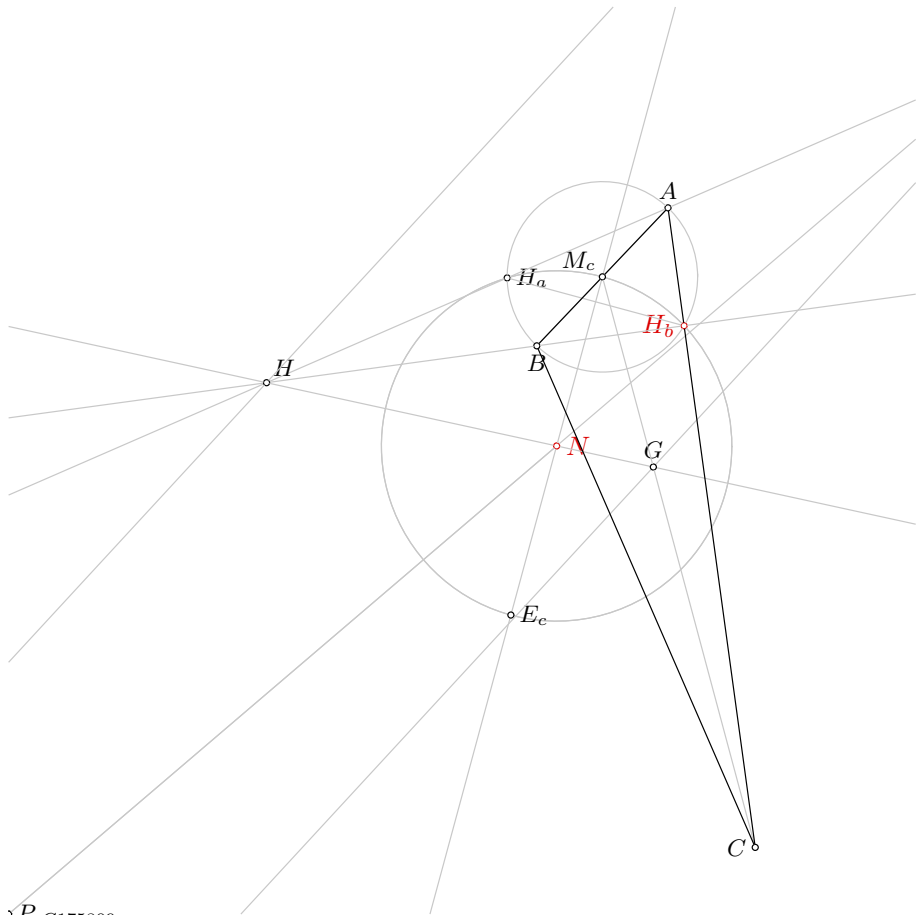

Figure 1: Illustration of the problem 1086

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{b} are not parallel; line m(H_{a}H_{b}) and circle
    k(N,M_{a}) intersect; points H_{b} and N are not the same
% Determination conditions: lines h_{a} and h_{b} are not the same; points H_{b} and B are not the
    same; points A and H_{a} are not the same; points H_{a} and H_{b} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_b=_H_b

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving H_a=_H_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_b=_H_b

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_b=_H_b

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_b=_H_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 1087

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1087: Given a point H_c, a point N and a point H_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;
2. Choose freely a point H_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point H_a and the point H_c, construct a line $m(H_aH_c)$ (rule W14); % DET: points H_a and H_c are not the same;
4. Using the circle $k(N, M_a)$ and the line $m(H_aH_c)$, construct a point M_b and a point E_b (rule W04); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect;
5. Choose freely a point A on the circle $k(M_b, C)$ (rule WOncircle);
6. Using the point A and the point M_b, construct a point C (rule W01); ;
7. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;
8. Using the point H_c and the point C, construct a line h_c (rule W02); % DET: points H_c and C are not the same;
9. Using the line h_a and the line h_c, construct a point H (rule W03); % NDG: lines h_a and h_c are not parallel % DET: lines h_a and h_c are not the same;
10. Using the point N and the point H, construct a point G (rule W01); ;
11. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: lines h_a and h_c are not parallel; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: lines h_a and h_c are not the same; points H_c and C are not the same; points A and H_a are not the same; points H_a and H_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W14,WOncircle1]

Lemmas used: [D10,D22,D3,D32,D5,D7,D8,GD02,GL01,GL03,GL04,L16,L17,L21,L23,L3,L44,L45,L50,L51,L56

Solving time: 57.8 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{c} 68.91 84.83
point N 72.5 61.93
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_rt H_{c}
cmark_r N
cmark_r H_{a}
color 0 0 0
fontsize 8

% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{a} on the circle with center N through point H_{c}
oncircle H_{a} N H_{c}
cmark_r H_{a}
color 200 200 200
drawcircle N H_{c}
color 0 0 0


% DET: points H_{a} and H_{c} are not the same
% Constructing bisector m(H_{a}H_{c}) of the segment H_{a}H_{c}
med m(H_{a}H_{c}) H_{a} H_{c}

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0

color 200 200 200
drawsegment H_{a} H_{c}
```

```
color 0 0 0

% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect
% Constructing points M_{b} and E_{b} which are in intersection of k(N,M_{a}) and m(H_{a}H_{c})
intersec2 M_{b} E_{b} k(N,M_{a}) m(H_{a}H_{c})
cmark_lt M_{b}
cmark_r E_{b}


% Choosing randomly a point A on the circle with center M_{b} through point H_{a}
oncircle A M_{b} H_{a}
cmark_t A
color 200 200 200
drawcircle M_{b} H_{a}
color 0 0 0


% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0

% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0


% DET: points H_{c} and C are not the same
% Constructing a line h_{c} which passes through point H_{c} and point C
line h_{c} H_{c} C

color 200 200 200
drawline h_{c}
color 0 0 0


% NDG: lines h_{a} and h_{c} are not parallel% DET: lines h_{a} and h_{c} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{c}
intersec H h_{a} h_{c}
cmark_rt H


% Constructing a line L_{\_G235889} which passes through point N and point H
```

```
line L_{\_G235889} N H

color 200 200 200
drawline L_{\_G235889}
color 0 0 0


% Constructing a point P_{\_G235990} with coordinates (0,0)
point P_{\_G235990} 0 0
cmark_r P_{\_G235990}

% Constructing a point P_{\_G235914} such that NP_{\_G235914}/NP_{\_G235990}=-1
towards P_{\_G235914} N P_{\_G235990} -1
cmark_r P_{\_G235914}
color 200 200 200
drawsegment P_{\_G235990} P_{\_G235914}
color 0 0 0

% Constructing a point P_{\_G235959} such that NP_{\_G235959}/NP_{\_G235990}=3
towards P_{\_G235959} N P_{\_G235990} 3
cmark_r P_{\_G235959}
color 200 200 200
drawsegment N P_{\_G235959}
color 0 0 0

% Constructing a line L_{\_G235920} which passes through point H and point P_{\_G235959}
line L_{\_G235920} H P_{\_G235959}

color 200 200 200
drawline L_{\_G235920}
color 0 0 0


% Constructing a line L_{\_G235883} which contains the point P_{\_G235914} and is parallel to the
    line L_{\_G235920}
parallel L_{\_G235883} P_{\_G235914} L_{\_G235920}

color 200 200 200
drawline L_{\_G235883}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G235883} and line L_{\_G235889}
intersec G L_{\_G235883} L_{\_G235889}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0
```

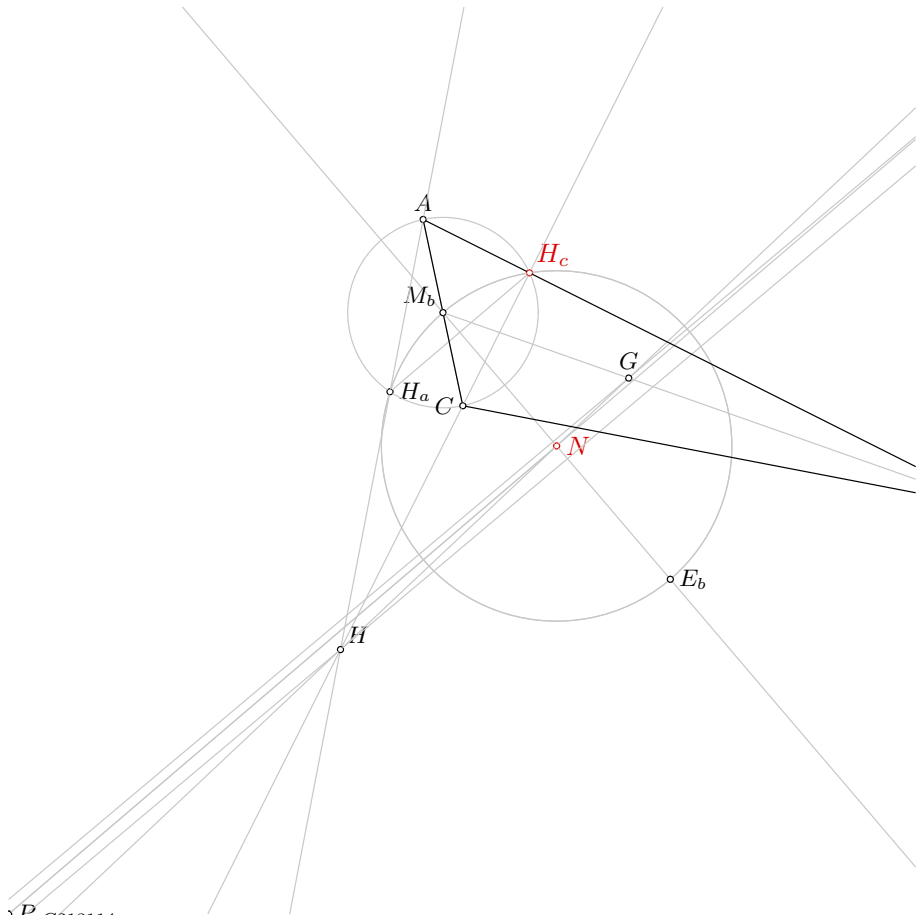

Figure 1: Illustration of the problem 1087

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{c} are not parallel; line m(H_{a}H_{c}) and circle
    k(N,M_{a}) intersect; points H_{c} and N are not the same
% Determination conditions: lines h_{a} and h_{c} are not the same; points H_{c} and C are not the
    same; points A and H_{a} are not the same; points H_{a} and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_c=_H_c

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving H_a=_H_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_c=_H_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_c=_H_c

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_c=_H_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 1088

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1088: Given a point H_a, a point I and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;

2. Using the point I, the circle $k(N, M_a)$, the point N and the point H_a, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

3. Using the circle $k(I, P_a)$, the point H_a and the point I, construct a line $y1$ and a line a (rule W12); % NDG: point H_a is outside the circle $k(I, P_a)$;

4. Using the circle $k(N, M_a)$, the line a, the point N and the point H_a, construct a point M_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points H_a and M_a must be different;

5. Using the point M_a and the point I, construct a line IM_a (rule W02); % DET: points M_a and I are not the same;

6. Using the point N and the point M_a, construct a line $m(H_bH_c)$ (rule W02); % DET: points N and M_a are not the same;

7. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;

8. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;

9. Using the point I and the point M_a, construct a circle $k_over(I, M_a)$ (rule W09); % NDG: points I and M_a are not the same;

10. Using the circle $k_over(I, M_a)$ and the circle $k(I, P_a)$, construct a point A_{fi} and a point P_a (rule W07); % NDG: circles $k_over(I, M_a)$ and $k(I, P_a)$ intersect % DET: circles $k_over(I, M_a)$ and $k(I, P_a)$ are not the same;

11. Using the point P_a and the point M_a, construct a point $P`_a$ (rule W01); ;

12. Using the point M_a and the line a, construct a line m_a (rule W10b); ;

13. Using the point $P`_a$ and the line $IM_a$, construct a line $AP`_a$ (rule W16); ;

14. Using the line $AP`_a$ and the line $h_a$, construct a point $A$ (rule W03); % NDG: lines $AP`_a$ and h_a are not parallel % DET: lines $AP`_a$ and h_a are not the same;

15. Using the point I and the point A, construct a line s_a (rule W02); % DET: points I and A are not the same;

16. Using the line m_a and the line s_a, construct a point N_a (rule W03); % NDG: lines m_a and s_a are not parallel % DET: lines m_a and s_a are not the same;

17. Using the point I and the point N_a, construct a circle $k(N_a, C)$ (rule W06); % NDG: points I and N_a are not the same;

18. Using the circle $k(N_a, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(N_a, C)$ intersect.

Non-degenerate conditions: line a and circle $k(N_a, C)$ intersect; points I and N_a are not the same; lines m_a and s_a are not parallel; lines $AP`_a$ and h_a are not parallel; circles $k_over(I, M_a)$ and $k(I, P_a)$ intersect; points I and M_a are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; line a and circle $k(N, M_a)$ intersect; point H_a is outside the circle $k(I, P_a)$; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points H_a and N are not the same.

Determination conditions: lines m_a and s_a are not the same; points I and A are not the same; lines $AP`_a$ and h_a are not the same; circles $k_over(I, M_a)$ and $k(I, P_a)$ are not the same; points E_a and H_a are not the same; points M_a and E_a must be different; points N and M_a are not the same; points M_a and I are not the same; points H_a and M_a must be different.

Rules used: [W01,W02,W03,W04,W05,W05a,W06,W07,W09,W10b,W12,W16,W22]

Lemmas used: [D11,D2,D21,D27,D28,D3,D32,D47,D5,D65,D8,D88,GD01,GD02,GL01,GL03,GL09,L119,L19,L

Solving time: 41.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{a} 80 40
point I 74.37 61.15
point N 72.5 61.93

color 220 0 0
```

```
fontsize 9

cmark_r H_{a}
cmark_b I
cmark_r N
color 0 0 0
fontsize 8

% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G76914] from point N to point H_{a}
distance V[_G76914] N H_{a}


% Calculating distance V[_G76938] from point N to point I
distance V[_G76938] N I


% Calculating value V[_G76959] using formula V[_G76914]/V[_G76938]
expression V[_G76959] { V[_G76914]/V[_G76938] }


% Constructing a point P_{\_G76990} such that NP_{\_G76990}/NI=V[_G76914]/V[_G76938]
towards P_{\_G76990} N I V[_G76959]
cmark_r P_{\_G76990}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    76990}
circle k(I,P_{a}) I P_{\_G76990}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: point H_{a} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G77363} of the segment H_{a}I
midpoint P_{\_G77363} H_{a} I
cmark_r P_{\_G77363}

% Constructing a circle C_{\_G77366} whose center is at point P_{\_G77363} and which passes through
     point H_{a}
circle C_{\_G77366} P_{\_G77363} H_{a}

color 200 200 200
drawcircle C_{\_G77366}
```

```
color 0 0 0


% Constructing points P_{\_G77369} and P_{\_G77372} which are in intersection of C_{\_G77366} and k
    (I,P_{a})
intersec2 P_{\_G77369} P_{\_G77372} C_{\_G77366} k(I,P_{a})
cmark_r P_{\_G77369}
cmark_r P_{\_G77372}

% Constructing a line y1 which passes through point H_{a} and point P_{\_G77369}
line y1 H_{a} P_{\_G77369}

color 200 200 200
drawline y1
color 0 0 0


% Constructing a line a which passes through point H_{a} and point P_{\_G77372}
line a H_{a} P_{\_G77372}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(N,M_{a}) intersect% DET: points H_{a} and M_{a} must be different
% Constructing a point P_{\_G77706} which is a foot of the point N on the line a
foot P_{\_G77706} N a
cmark_r P_{\_G77706}
color 200 200 200
drawline N P_{\_G77706}
color 0 0 0

% Constructing a point M_{a} which is an image of the point H_{a} in the symmetry to point/line P
    _{\_G77706}
sim M_{a} P_{\_G77706} H_{a}
cmark_r M_{a}


% DET: points M_{a} and I are not the same
% Constructing a line IM_{a} which passes through point M_{a} and point I
line IM_{a} M_{a} I

color 200 200 200
drawline IM_{a}
color 0 0 0



% DET: points N and M_{a} are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point N and point M_{a}
line m(H_{b}H_{c}) N M_{a}

color 200 200 200
drawline m(H_{b}H_{c})
```

```
color 0 0 0


% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points I and M_{a} are not the same
% Constructing midpoint P_{\_G78174} of the segment IM_{a}
midpoint P_{\_G78174} I M_{a}
cmark_r P_{\_G78174}

% Constructing a circle k_over(I,M_{a}) whose center is at point P_{\_G78174} and which passes
    through point I
circle k_over(I,M_{a}) P_{\_G78174} I

color 200 200 200
drawcircle k_over(I,M_{a})
color 0 0 0



% NDG: circles k_over(I,M_{a}) and k(I,P_{a}) intersect% DET: circles k_over(I,M_{a}) and k(I,P_{a
    }) are not the same
% Constructing points A_{fi} and P_{a} which are in intersection of k_over(I,M_{a}) and k(I,P_{a})
intersec2 A_{fi} P_{a} k_over(I,M_{a}) k(I,P_{a})
cmark_r A_{fi}
cmark_r P_{a}



% Constructing a point P‘_{a} such that P_{a}P‘_{a}/P_{a}M_{a}=2
towards P‘_{a} P_{a} M_{a} 2
cmark_r P‘_{a}
color 200 200 200
drawsegment P_{a} P‘_{a}
color 0 0 0



% Constructing a line m_{a} which is perpendicular to line a and which passes through point M_{a}
perp m_{a} M_{a} a
```

```
color 200 200 200
drawline m_{a}
color 0 0 0



% Constructing a line AP‘_{a} which contains the point P‘_{a} and is parallel to the line IM_{a}
parallel AP‘_{a} P‘_{a} IM_{a}

color 200 200 200
drawline AP‘_{a}
color 0 0 0



% NDG: lines AP‘_{a} and h_{a} are not parallel% DET: lines AP‘_{a} and h_{a} are not the same
% Constructing a point A which belongs to line AP‘_{a} and line h_{a}
intersec A AP‘_{a} h_{a}
cmark_t A


% DET: points I and A are not the same
% Constructing a line s_{a} which passes through point I and point A
line s_{a} I A

color 200 200 200
drawline s_{a}
color 0 0 0



% NDG: lines m_{a} and s_{a} are not parallel% DET: lines m_{a} and s_{a} are not the same
% Constructing a point N_{a} which belongs to line m_{a} and line s_{a}
intersec N_{a} m_{a} s_{a}
cmark_b N_{a}


% NDG: points I and N_{a} are not the same
% Constructing a circle k(N_{a},C) whose center is at point N_{a} and which passes through point I
circle k(N_{a},C) N_{a} I

color 200 200 200
drawcircle k(N_{a},C)
color 0 0 0



% NDG: line a and circle k(N_{a},C) intersect
% Constructing points C and B which are in intersection of k(N_{a},C) and a
intersec2 C B k(N_{a},C) a
cmark_l C
cmark_b B
```

Figure 1: Illustration of the problem 1088

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(N_{a},C) intersect; points I and N_{a} are not the
     same; lines m_{a} and s_{a} are not parallel; lines AP‘_{a} and h_{a} are not parallel;
    circles k_over(I,M_{a}) and k(I,P_{a}) intersect; points I and M_{a} are not the same; line m(H
    _{b}H_{c}) and circle k(N,M_{a}) intersect; line a and circle k(N,M_{a}) intersect; point H_{a}
     is outside the circle k(I,P_{a}); point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points H_{a} and N are not the same
% Determination conditions: lines m_{a} and s_{a} are not the same; points I and A are not the same
    ; lines AP‘_{a} and h_{a} are not the same; circles k_over(I,M_{a}) and k(I,P_{a}) are not the
    same; points E_{a} and H_{a} are not the same; points M_{a} and E_{a} must be different; points
     N and M_{a} are not the same; points M_{a} and I are not the same; points H_{a} and M_{a} must
     be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_a=_H_a

Proving failed

4.1.2 Proving I=_I

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_a=_H_a

Proving failed

4.2.2 Proving I=_I

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_a=_H_a

Proving failed

4.3.2 Proving I=_I

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_a=_H_a

Proving failed

4.4.2 Proving I=_I

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1089

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1089: Given a point M_a, a point N and a point H_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;
2. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
3. Choose freely a point H_a on the circle $k(N, M_a)$ (rule WOncircle);
4. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
5. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;
6. Using the point E_a and the point H_a, construct a line h_a (rule W02); % DET: points E_a and H_a are not the same;
7. Choose freely a point A on the line h_a (rule WOnline1) ;
8. Using the point A and the point M_a, construct a point G (rule W01); ;
9. Using the point N and the point G, construct a point O (rule W01); ;
10. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
11. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points M_a and N are not the same.

Determination conditions: points E_a and H_a are not the same; points M_a and E_a must be different; points H_a and M_a are not the same; points M_a and N are not the same.

Rules used: [W01,W02,W04,W05a,W06,WOncircle1,WOnline1]

Lemmas used: [D21,D26,D28,D3,D32,D5,D8,GD01,GD02,GL01,GL03,GL09,L11,L12,L15,L20,L21,L22,L38,L39

Solving time: 571.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{a} 65 40
point N 72.5 61.93
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_r M_{a}
cmark_r N
cmark_r H_{a}
color 0 0 0
fontsize 8

% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% Choosing randomly a point H_{a} on the circle with center N through point M_{a}
oncircle H_{a} N M_{a}
cmark_r H_{a}
color 200 200 200
drawcircle N M_{a}
color 0 0 0
```

```
% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% DET: points E_{a} and H_{a} are not the same
% Constructing a line h_{a} which passes through point E_{a} and point H_{a}
line h_{a} E_{a} H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Choosing randomly a point A on the line H_{a}E_{a}
online A H_{a} E_{a}
cmark_t A
color 200 200 200
drawline H_{a} E_{a}
color 0 0 0



% Constructing a line L_{\_G114874} which passes through point A and point M_{a}
line L_{\_G114874} A M_{a}

color 200 200 200
drawline L_{\_G114874}
color 0 0 0


% Constructing a point P_{\_G114975} with coordinates (0,0)
point P_{\_G114975} 0 0
cmark_r P_{\_G114975}

% Constructing a point P_{\_G114899} such that AP_{\_G114899}/AP_{\_G114975}=2
towards P_{\_G114899} A P_{\_G114975} 2
cmark_r P_{\_G114899}
color 200 200 200
drawsegment A P_{\_G114899}
color 0 0 0
```

```
% Constructing a point P_{\_G114944} such that AP_{\_G114944}/AP_{\_G114975}=3
towards P_{\_G114944} A P_{\_G114975} 3
cmark_r P_{\_G114944}
color 200 200 200
drawsegment A P_{\_G114944}
color 0 0 0

% Constructing a line L_{\_G114905} which passes through point M_{a} and point P_{\_G114944}
line L_{\_G114905} M_{a} P_{\_G114944}

color 200 200 200
drawline L_{\_G114905}
color 0 0 0


% Constructing a line L_{\_G114868} which contains the point P_{\_G114899} and is parallel to the
    line L_{\_G114905}
parallel L_{\_G114868} P_{\_G114899} L_{\_G114905}

color 200 200 200
drawline L_{\_G114868}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G114868} and line L_{\_G114874}
intersec G L_{\_G114868} L_{\_G114874}
cmark_t G



% Constructing a point O such that NO/NG=3
towards O N G 3
cmark_t O
color 200 200 200
drawsegment N O
color 0 0 0


% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B
```

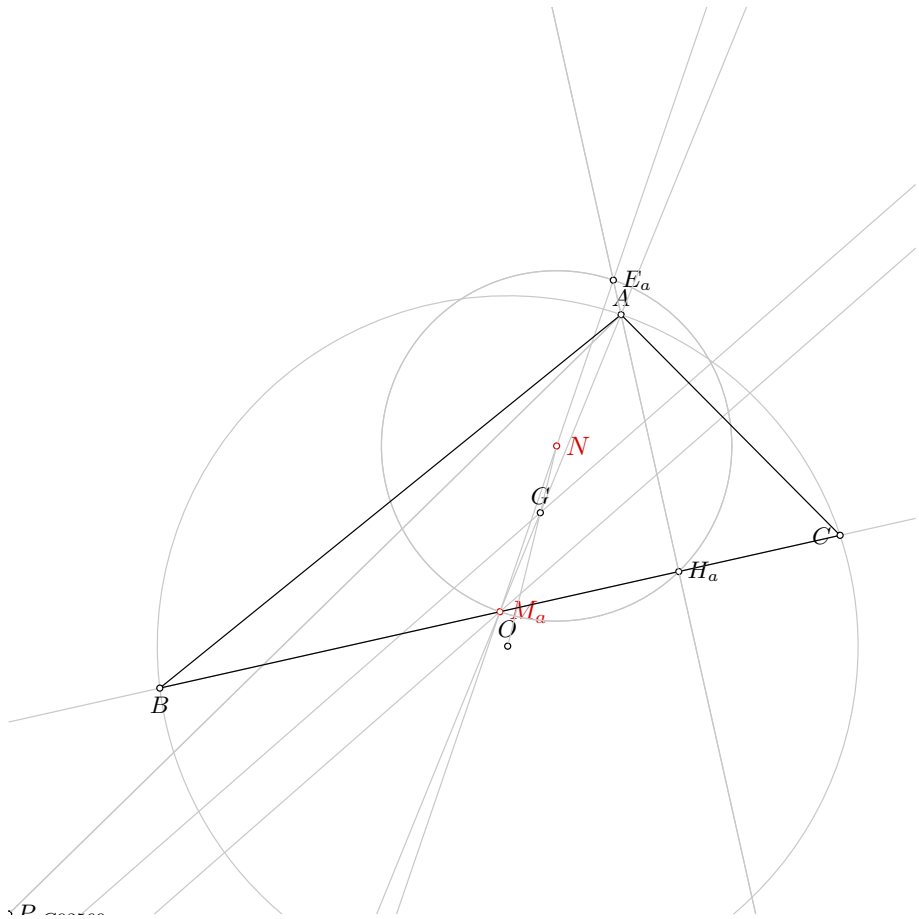

Figure 1: Illustration of the problem 1089

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect; points M_{a} and N are not the same
% Determination conditions: points E_{a} and H_{a} are not the same; points M_{a} and E_{a} must be
     different; points H_{a} and M_{a} are not the same; points M_{a} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_a=_M_a

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving H_a=_H_a

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_a=_M_a

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving H_a=_H_a

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_a=_M_a

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving H_a=_H_a

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_a=_M_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving H_a=_H_a

Proving failed

Problem 1090

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1090: Given a point M_b, a point N and a point H_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
2. Choose freely a point H_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point H_a and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points H_a and M_b are not the same;
4. Using the circle $k(N, M_a)$, the circle $k(M_b, C)$, the point H_a, the point N and the point M_b, construct a point H_c (rule W08); % NDG: circles $k(N, M_a)$ and $k(M_b, C)$ intersect % DET: circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points H_a and H_c must be different;
5. Choose freely a point A on the circle $k(M_b, C)$ (rule WOncircle);
6. Using the point A and the point M_b, construct a point C (rule W01); ;
7. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;
8. Using the point H_c and the point C, construct a line h_c (rule W02); % DET: points H_c and C are not the same;
9. Using the line h_a and the line h_c, construct a point H (rule W03); % NDG: lines h_a and h_c are not parallel % DET: lines h_a and h_c are not the same;
10. Using the point N and the point H, construct a point G (rule W01); ;
11. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: lines h_a and h_c are not parallel; circles $k(N, M_a)$ and $k(M_b, C)$ intersect; points H_a and M_b are not the same; points M_b and N are not the same.

Determination conditions: lines h_a and h_c are not the same; points H_c and C are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points H_a and H_c must be different.

Rules used: [W01,W02,W03,W06,W08,WOncircle1]

Lemmas used: [D10,D22,D3,D32,D5,D7,D8,GD02,GL03,GL04,L16,L17,L19,L21,L3,L44,L45,L56]

Solving time: 58.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{b} 95 67.5
point N 72.5 61.93
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_lt M_{b}
cmark_r N
cmark_r H_{a}
color 0 0 0
fontsize 8

% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{a} on the circle with center N through point M_{b}
oncircle H_{a} N M_{b}
cmark_r H_{a}
color 200 200 200
drawcircle N M_{b}
color 0 0 0


% NDG: points H_{a} and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point H
    _{a}
circle k(M_{b},C) M_{b} H_{a}

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0
```

```
% NDG: circles k(N,M_{a}) and k(M_{b},C) intersect% DET: circles k(N,M_{a}) and k(M_{b},C) are not
    the same; points H_{a} and H_{c} must be different
% Constructing a line L_{\_G152292} which passes through point N and point M_{b}
line L_{\_G152292} N M_{b}

color 200 200 200
drawline L_{\_G152292}
color 0 0 0


% Constructing a point H_{c} which is an image of the point H_{a} in the symmetry to point/line L
    _{\_G152292}
sim H_{c} L_{\_G152292} H_{a}
cmark_rt H_{c}



% Choosing randomly a point A on the circle with center M_{b} through point H_{a}
oncircle A M_{b} H_{a}
cmark_t A
color 200 200 200
drawcircle M_{b} H_{a}
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% DET: points H_{c} and C are not the same
% Constructing a line h_{c} which passes through point H_{c} and point C
line h_{c} H_{c} C

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: lines h_{a} and h_{c} are not parallel% DET: lines h_{a} and h_{c} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{c}
intersec H h_{a} h_{c}
cmark_rt H



% Constructing a line L_{\_G152676} which passes through point N and point H
line L_{\_G152676} N H

color 200 200 200
drawline L_{\_G152676}
color 0 0 0


% Constructing a point P_{\_G152777} with coordinates (0,0)
point P_{\_G152777} 0 0
cmark_r P_{\_G152777}

% Constructing a point P_{\_G152701} such that NP_{\_G152701}/NP_{\_G152777}=-1
towards P_{\_G152701} N P_{\_G152777} -1
cmark_r P_{\_G152701}
color 200 200 200
drawsegment P_{\_G152777} P_{\_G152701}
color 0 0 0

% Constructing a point P_{\_G152746} such that NP_{\_G152746}/NP_{\_G152777}=3
towards P_{\_G152746} N P_{\_G152777} 3
cmark_r P_{\_G152746}
color 200 200 200
drawsegment N P_{\_G152746}
color 0 0 0

% Constructing a line L_{\_G152707} which passes through point H and point P_{\_G152746}
line L_{\_G152707} H P_{\_G152746}

color 200 200 200
drawline L_{\_G152707}
color 0 0 0


% Constructing a line L_{\_G152670} which contains the point P_{\_G152701} and is parallel to the
    line L_{\_G152707}
parallel L_{\_G152670} P_{\_G152701} L_{\_G152707}

color 200 200 200
drawline L_{\_G152670}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G152670} and line L_{\_G152676}
intersec G L_{\_G152670} L_{\_G152676}
cmark_t G
```

```
% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{c} are not parallel; circles k(N,M_{a}) and k(M_{b
    },C) intersect; points H_{a} and M_{b} are not the same; points M_{b} and N are not the same
% Determination conditions: lines h_{a} and h_{c} are not the same; points H_{c} and C are not the
    same; points A and H_{a} are not the same; circles k(N,M_{a}) and k(M_{b},C) are not the same;
    points H_{a} and H_{c} must be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_b=$\_M_b$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.124 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving H_a=$\_H_a$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_b=$\_M_b$

NDG conditions are:

$S_{AH_cC} \neq S_{H_aH_cC}$ i.e., lines AH_a and H_cC are not parallel (construction based assumption)

$S_{P\_G132290NH} \neq S_{P^0_{L\_G132259}NH}$ i.e., lines $P_{\_G132290}P^0_{L\_G132259}$ and NH are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

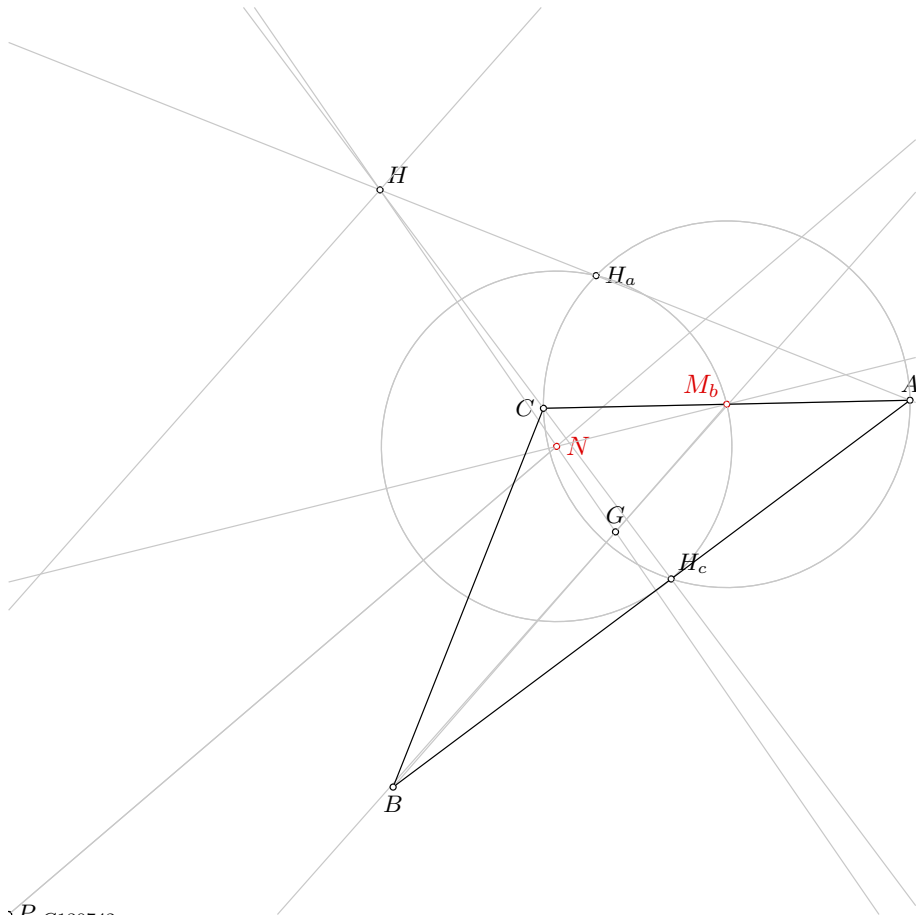

Figure 1: Illustration of the problem 1090

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)
$S_{BAF^3_{\_h_a}} \neq S_{CAF^3_{\_h_a}}$ i.e., lines BC and $AF^3_{\_h_a}$ are not parallel (construction based assumption)
Total number of proof steps: 42
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving H_a=$\_H_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_b=$\_M_b$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.070 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving H_a=$\_H_a$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_b=$\_M_b$

Proving failed

4.4.2 Proving N=$\_N$

Proving failed

4.4.3 Proving H_a=$\_H_a$

Proving failed

Problem 1091

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1091: Given a point M_c, a point N and a point H_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
2. Choose freely a point H_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point H_a and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points H_a and M_c are not the same;
4. Using the circle $k(N, M_a)$, the circle $k(M_c, A)$, the point H_a, the point N and the point M_c, construct a point H_b (rule W08); % NDG: circles $k(N, M_a)$ and $k(M_c, A)$ intersect % DET: circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points H_a and H_b must be different;
5. Choose freely a point A on the circle $k(M_c, A)$ (rule WOncircle);
6. Using the point A and the point M_c, construct a point B (rule W01); ;
7. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;
8. Using the point H_b and the point B, construct a line h_b (rule W02); % DET: points H_b and B are not the same;
9. Using the line h_a and the line h_b, construct a point H (rule W03); % NDG: lines h_a and h_b are not parallel % DET: lines h_a and h_b are not the same;
10. Using the point N and the point H, construct a point G (rule W01); ;
11. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: lines h_a and h_b are not parallel; circles $k(N, M_a)$ and $k(M_c, A)$ intersect; points H_a and M_c are not the same; points M_c and N are not the same.

Determination conditions: lines h_a and h_b are not the same; points H_b and B are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points H_a and H_b must be different.

Rules used: [W01,W02,W03,W06,W08,WOncircle1]

Lemmas used: [D20,D3,D32,D5,D6,D8,D9,GD02,GL03,GL04,L16,L18,L19,L20,L41,L42,L57]

Solving time: 57.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{c} 50 67.5
point N 72.5 61.93
point H_{a} 80 40

color 220 0 0
fontsize 9

cmark_lt M_{c}
cmark_r N
cmark_r H_{a}
color 0 0 0
fontsize 8

% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{a} on the circle with center N through point M_{c}
oncircle H_{a} N M_{c}
cmark_r H_{a}
color 200 200 200
drawcircle N M_{c}
color 0 0 0


% NDG: points H_{a} and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point H
    _{a}
circle k(M_{c},A) M_{c} H_{a}

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0
```

```
% NDG: circles k(N,M_{a}) and k(M_{c},A) intersect% DET: circles k(N,M_{a}) and k(M_{c},A) are not
    the same; points H_{a} and H_{b} must be different
% Constructing a line L_{\_G190215} which passes through point N and point M_{c}
line L_{\_G190215} N M_{c}

color 200 200 200
drawline L_{\_G190215}
color 0 0 0


% Constructing a point H_{b} which is an image of the point H_{a} in the symmetry to point/line L
    _{\_G190215}
sim H_{b} L_{\_G190215} H_{a}
cmark_l H_{b}



% Choosing randomly a point A on the circle with center M_{c} through point H_{a}
oncircle A M_{c} H_{a}
cmark_t A
color 200 200 200
drawcircle M_{c} H_{a}
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% DET: points H_{b} and B are not the same
% Constructing a line h_{b} which passes through point H_{b} and point B
line h_{b} H_{b} B

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: lines h_{a} and h_{b} are not parallel% DET: lines h_{a} and h_{b} are not the same
% Constructing a point H which belongs to line h_{a} and line h_{b}
intersec H h_{a} h_{b}
cmark_rt H



% Constructing a line L_{\_G190599} which passes through point N and point H
line L_{\_G190599} N H

color 200 200 200
drawline L_{\_G190599}
color 0 0 0


% Constructing a point P_{\_G190700} with coordinates (0,0)
point P_{\_G190700} 0 0
cmark_r P_{\_G190700}

% Constructing a point P_{\_G190624} such that NP_{\_G190624}/NP_{\_G190700}=-1
towards P_{\_G190624} N P_{\_G190700} -1
cmark_r P_{\_G190624}
color 200 200 200
drawsegment P_{\_G190700} P_{\_G190624}
color 0 0 0

% Constructing a point P_{\_G190669} such that NP_{\_G190669}/NP_{\_G190700}=3
towards P_{\_G190669} N P_{\_G190700} 3
cmark_r P_{\_G190669}
color 200 200 200
drawsegment N P_{\_G190669}
color 0 0 0

% Constructing a line L_{\_G190630} which passes through point H and point P_{\_G190669}
line L_{\_G190630} H P_{\_G190669}

color 200 200 200
drawline L_{\_G190630}
color 0 0 0


% Constructing a line L_{\_G190593} which contains the point P_{\_G190624} and is parallel to the
    line L_{\_G190630}
parallel L_{\_G190593} P_{\_G190624} L_{\_G190630}

color 200 200 200
drawline L_{\_G190593}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G190593} and line L_{\_G190599}
intersec G L_{\_G190593} L_{\_G190599}
cmark_t G
```

```
% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{a} and h_{b} are not parallel; circles k(N,M_{a}) and k(M_{c
    },A) intersect; points H_{a} and M_{c} are not the same; points M_{c} and N are not the same
% Determination conditions: lines h_{a} and h_{b} are not the same; points H_{b} and B are not the
    same; points A and H_{a} are not the same; circles k(N,M_{a}) and k(M_{c},A) are not the same;
    points H_{a} and H_{b} must be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.118 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving H_a=$\_H_a$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_c=$\_M_c$

NDG conditions are:

$S_{AH_bB} \neq S_{H_aH_bB}$ i.e., lines AH_a and H_bB are not parallel (construction based assumption)

$S_{P\_G170006NH} \neq S_{P^0_{L\_G169975}NH}$ i.e., lines $P\_G170006P^0_{L\_G169975}$ and NH are not parallel (construction based assumption)

$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)

$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)

$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)

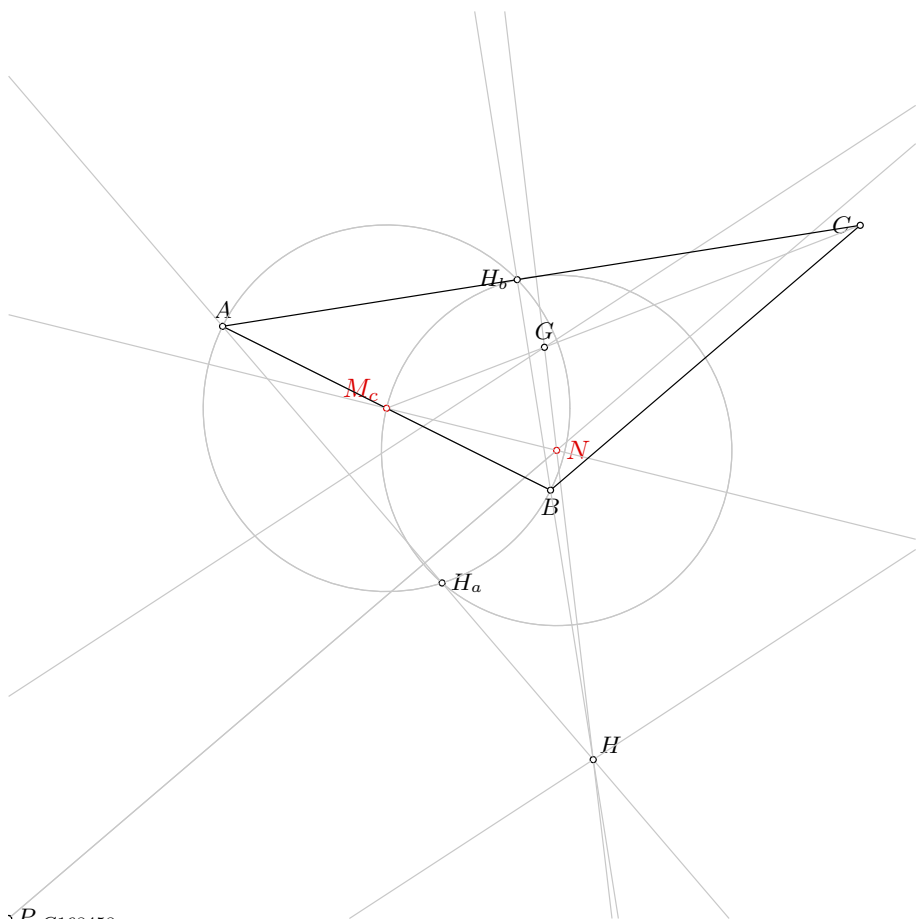

Figure 1: Illustration of the problem 1091

$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^4_{\_h_b}} \neq S_{F^3_{\_h_a}BF^4_{\_h_b}}$ i.e., lines $AF^3_{\_h_a}$ and $BF^4_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^2_{\_m_b}} \neq S_{F^1_{\_m_a}\_M_bF^2_{\_m_b}}$ i.e., lines $\_M_aF^1_{\_m_a}$ and $\_M_bF^2_{\_m_b}$ are not parallel (construction based assumption)
$S_{BAF^3_{\_h_a}} \neq S_{CAF^3_{\_h_a}}$ i.e., lines BC and $AF^3_{\_h_a}$ are not parallel (construction based assumption)
Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving H_a=$\_H_a$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.080 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving H_a=$\_H_a$

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_c=$\_M_c$

Proving failed

4.4.2 Proving N=$\_N$

Proving failed

4.4.3 Proving H_a=$\_H_a$

Proving failed

Problem 1092

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1092: Given a point H_a, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point N and the point O, construct a point H (rule W01); ;
3. Using the point H_a and the point H, construct a line h_a (rule W02); % DET: points H_a and H are not the same;
4. Using the point H_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_a and N are not the same;
5. Using the circle $k(N, M_a)$, the line h_a, the point N and the point H_a, construct a point E_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points H_a and E_a must be different;
6. Using the point E_a and the point H, construct a point A (rule W01); ;
7. Using the point G and the point A, construct a point M_a (rule W01); ;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points H_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points H_a and E_a must be different; points H_a and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L19,L22,L55]

Solving time: 5.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{a} 80 40
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r H_{a}
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G232378} which passes through point N and point O
line L_{\_G232378} N O

color 200 200 200
drawline L_{\_G232378}
color 0 0 0


% Constructing a point P_{\_G232479} with coordinates (0,0)
point P_{\_G232479} 0 0
cmark_r P_{\_G232479}

% Constructing a point P_{\_G232403} such that NP_{\_G232403}/NP_{\_G232479}=1
towards P_{\_G232403} N P_{\_G232479} 1
cmark_r P_{\_G232403}
color 200 200 200
drawsegment N P_{\_G232403}
color 0 0 0

% Constructing a point P_{\_G232448} such that NP_{\_G232448}/NP_{\_G232479}=3
towards P_{\_G232448} N P_{\_G232479} 3
cmark_r P_{\_G232448}
color 200 200 200
drawsegment N P_{\_G232448}
color 0 0 0

% Constructing a line L_{\_G232409} which passes through point O and point P_{\_G232448}
line L_{\_G232409} O P_{\_G232448}
```

```
color 200 200 200
drawline L_{\_G232409}
color 0 0 0


% Constructing a line L_{\_G232372} which contains the point P_{\_G232403} and is parallel to the
    line L_{\_G232409}
parallel L_{\_G232372} P_{\_G232403} L_{\_G232409}

color 200 200 200
drawline L_{\_G232372}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G232372} and line L_{\_G232378}
intersec G L_{\_G232372} L_{\_G232378}
cmark_t G



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0


% DET: points H_{a} and H are not the same
% Constructing a line h_{a} which passes through point H_{a} and point H
line h_{a} H_{a} H

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: points H_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{a}
circle k(N,M_{a}) N H_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points H_{a} and E_{a} must be different
% Constructing a point P_{\_G233306} which is a foot of the point N on the line h_{a}
foot P_{\_G233306} N h_{a}
cmark_r P_{\_G233306}
color 200 200 200
drawline N P_{\_G233306}
color 0 0 0
```

```
% Constructing a point E_{a} which is an image of the point H_{a} in the symmetry to point/line P
    _{\_G233306}
sim E_{a} P_{\_G233306} H_{a}
cmark_r E_{a}



% Constructing a point A such that E_{a}A/E_{a}H=-1
towards A E_{a} H -1
cmark_t A
color 200 200 200
drawsegment H A
color 0 0 0



% Constructing a point M_{a} such that GM_{a}/GA=-0.5
towards M_{a} G A -0.5
cmark_r M_{a}
color 200 200 200
drawsegment A M_{a}
color 0 0 0


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

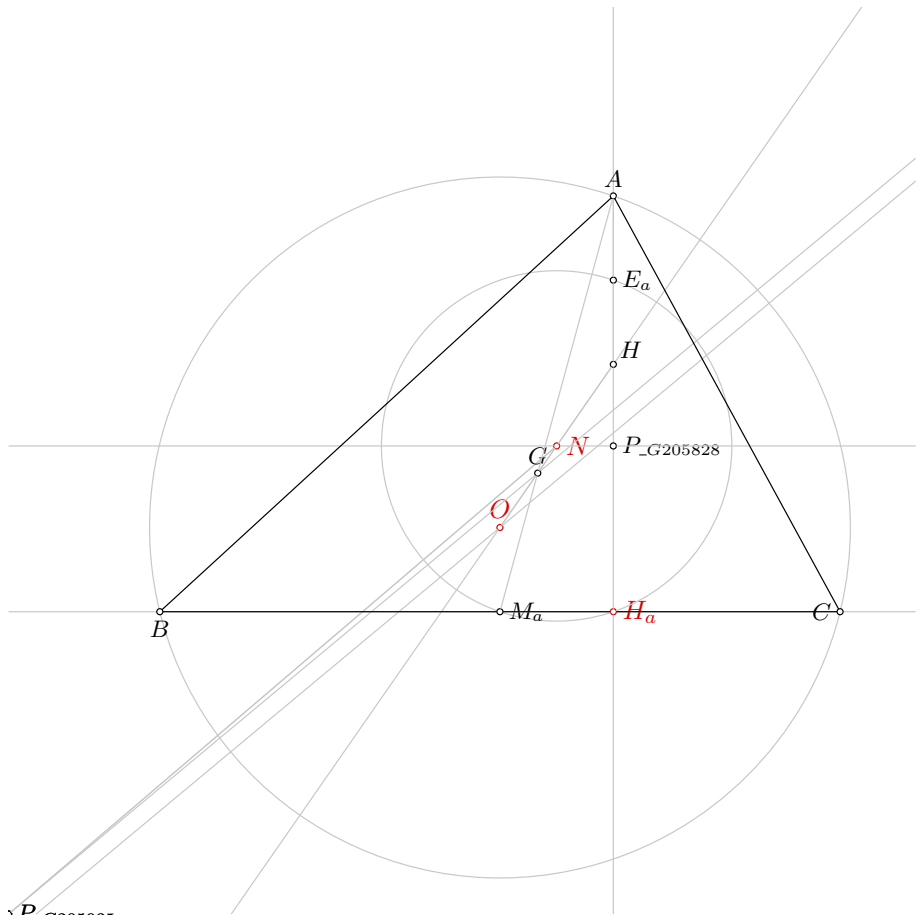

Figure 1: Illustration of the problem 1092

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points H_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points H_{a} and E_{a} must be
     different; points H_{a} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_a=_H_a

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_a=_H_a

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_a=_H_a

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_a=_H_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 1093

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1093: Given a point H_a, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1094

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1094: Given a point H_a, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1095

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1095: Given a point H_a, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1096

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1096: Given a point H_c, a point N and a point H_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;
2. Choose freely a point H_b on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point H_b and the point H_c, construct a line $m(H_bH_c)$ (rule W14); % DET: points H_b and H_c are not the same;
4. Using the circle $k(N, M_a)$ and the line $m(H_bH_c)$, construct a point M_a and a point E_a (rule W04); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect;
5. Choose freely a point A on the circle $k(E_a, A)$ (rule WOncircle);
6. Using the point A and the point E_a, construct a point H (rule W01); ;
7. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
8. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
9. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same;
10. Using the point M_a and the point C, construct a point B (rule W01); .

Non-degenerate conditions: lines b and h_c are not parallel; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: lines b and h_c are not the same; points H_c and H are not the same; points A and H_b are not the same; points H_b and H_c are not the same.

Rules used: [W01,W02,W03,W04,W06,W14,WOncircle1]

Lemmas used: [D10,D21,D28,D32,D6,D7,GD01,GD02,GL01,GL03,GL04,L21,L22,L3,L38,L39,L47,L48]

Solving time: 59.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{c} 68.91 84.83
point N 72.5 61.93
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_rt H_{c}
cmark_r N
cmark_l H_{b}
color 0 0 0
fontsize 8

% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{b} on the circle with center N through point H_{c}
oncircle H_{b} N H_{c}
cmark_l H_{b}
color 200 200 200
drawcircle N H_{c}
color 0 0 0


% DET: points H_{b} and H_{c} are not the same
% Constructing bisector m(H_{b}H_{c}) of the segment H_{b}H_{c}
med m(H_{b}H_{c}) H_{b} H_{c}

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0

color 200 200 200
drawsegment H_{b} H_{c}
```

```
color 0 0 0

% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect
% Constructing points M_{a} and E_{a} which are in intersection of k(N,M_{a}) and m(H_{b}H_{c})
intersec2 M_{a} E_{a} k(N,M_{a}) m(H_{b}H_{c})
cmark_r M_{a}
cmark_r E_{a}


% Choosing randomly a point A on the circle with center E_{a} through point H_{b}
oncircle A E_{a} H_{b}
cmark_t A
color 200 200 200
drawcircle E_{a} H_{b}
color 0 0 0


% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
drawsegment A H
color 0 0 0

% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0


% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C


% Constructing a point B such that M_{a}B/M_{a}C=-1
```

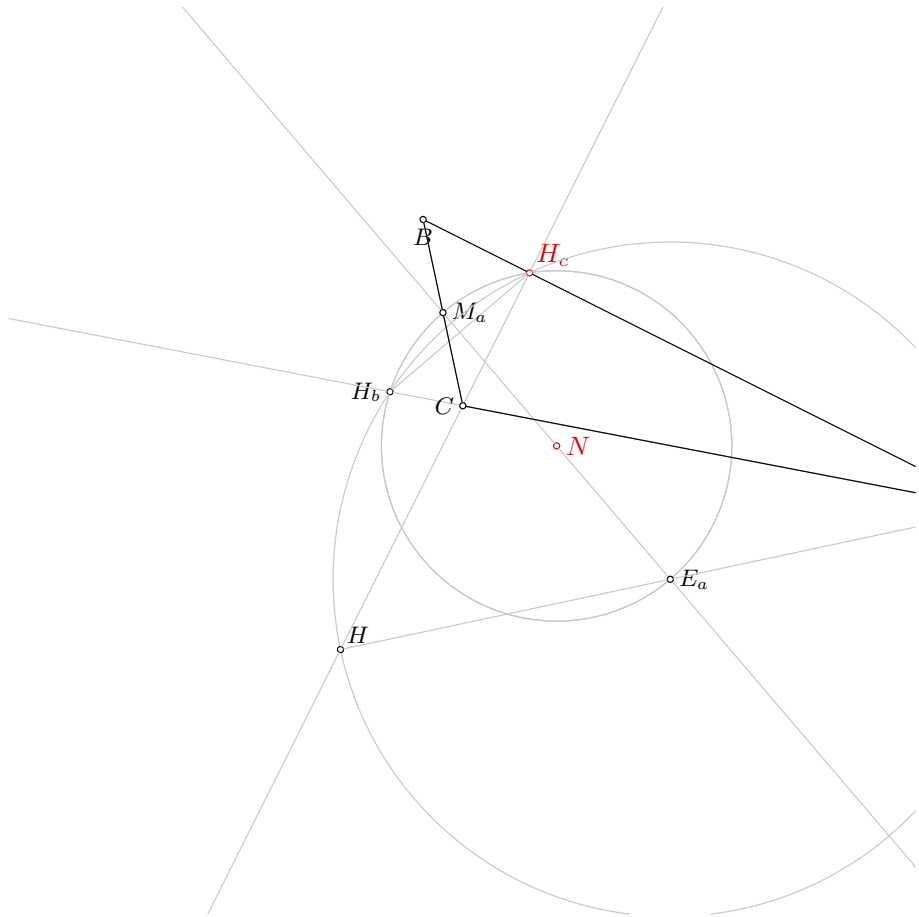

Figure 1: Illustration of the problem 1096

```
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; line m(H_{b}H_{c}) and circle k(N,
    M_{a}) intersect; points H_{c} and N are not the same
% Determination conditions: lines b and h_{c} are not the same; points H_{c} and H are not the same
    ; points A and H_{b} are not the same; points H_{b} and H_{c} are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_c=_H_c

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_c=_H_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_c=_H_c

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_c=_H_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 1097

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1097: Given a point H_b, a point I and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;

2. Using the point I, the circle $k(N, M_a)$, the point N and the point H_b, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

3. Using the circle $k(I, P_a)$, the point H_b and the point I, construct a line $y2$ and a line b (rule W12); % NDG: point H_b is outside the circle $k(I, P_a)$;

4. Using the circle $k(N, M_a)$, the line b, the point N and the point H_b, construct a point M_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points H_b and M_b must be different;

5. Using the point M_b and the point I, construct a line IM_b (rule W02); % DET: points M_b and I are not the same;

6. Using the point N and the point M_b, construct a line $m(H_aH_c)$ (rule W02); % DET: points N and M_b are not the same;

7. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point M_b, construct a point E_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_b and E_b must be different;

8. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;

9. Using the point I and the point M_b, construct a circle $k_over(I, M_b)$ (rule W09); % NDG: points I and M_b are not the same;

10. Using the circle $k_over(I, M_b)$ and the circle $k(I, P_a)$, construct a point B_{fi} and a point P_b (rule W07); % NDG: circles $k_over(I, M_b)$ and $k(I, P_a)$ intersect % DET: circles $k_over(I, M_b)$ and $k(I, P_a)$ are not the same;

11. Using the point P_b and the point M_b, construct a point $P`_b$ (rule W01); ;

12. Using the point M_b and the line b, construct a line m_b (rule W10b); ;

13. Using the point $P`_b$ and the line $IM_b$, construct a line $BP`_b$ (rule W16); ;

14. Using the line $BP`_b$ and the line $h_b$, construct a point $B$ (rule W03); % NDG: lines $BP`_b$ and h_b are not parallel % DET: lines $BP`_b$ and h_b are not the same;

15. Using the point I and the point B, construct a line s_b (rule W02); % DET: points I and B are not the same;

16. Using the line m_b and the line s_b, construct a point N_b (rule W03); % NDG: lines m_b and s_b are not parallel % DET: lines m_b and s_b are not the same;

17. Using the point I and the point N_b, construct a circle $k(N_b, A)$ (rule W06); % NDG: points I and N_b are not the same;

18. Using the circle $k(N_b, A)$ and the line b, construct a point A and a point C (rule W04); % NDG: line b and circle $k(N_b, A)$ intersect.

Non-degenerate conditions: line b and circle $k(N_b, A)$ intersect; points I and N_b are not the same; lines m_b and s_b are not parallel; lines $BP`_b$ and h_b are not parallel; circles $k_over(I, M_b)$ and $k(I, P_a)$ intersect; points I and M_b are not the same; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; line b and circle $k(N, M_a)$ intersect; point H_b is outside the circle $k(I, P_a)$; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points H_b and N are not the same.

Determination conditions: lines m_b and s_b are not the same; points I and B are not the same; lines $BP`_b$ and h_b are not the same; circles $k_over(I, M_b)$ and $k(I, P_a)$ are not the same; points E_b and H_b are not the same; points M_b and E_b must be different; points N and M_b are not the same; points M_b and I are not the same; points H_b and M_b must be different.

Rules used: [W01,W02,W03,W04,W05,W05a,W06,W07,W09,W10b,W12,W16,W22]

Lemmas used: [D12,D2,D22,D27,D29,D3,D32,D48,D6,D66,D89,D9,GD01,GD02,GL01,GL03,GL09,L119,L13,L

Solving time: 41.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{b} 89.36 77.83
point I 74.37 61.15
point N 72.5 61.93

color 220 0 0
```

```
fontsize 9

cmark_l H_{b}
cmark_b I
cmark_r N
color 0 0 0
fontsize 8

% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G124541] from point N to point H_{b}
distance V[_G124541] N H_{b}


% Calculating distance V[_G124565] from point N to point I
distance V[_G124565] N I


% Calculating value V[_G124586] using formula V[_G124541]/V[_G124565]
expression V[_G124586] { V[_G124541]/V[_G124565] }


% Constructing a point P_{\_G124617} such that NP_{\_G124617}/NI=V[_G124541]/V[_G124565]
towards P_{\_G124617} N I V[_G124586]
cmark_r P_{\_G124617}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    124617}
circle k(I,P_{a}) I P_{\_G124617}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: point H_{b} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G124991} of the segment H_{b}I
midpoint P_{\_G124991} H_{b} I
cmark_r P_{\_G124991}

% Constructing a circle C_{\_G124994} whose center is at point P_{\_G124991} and which passes
    through point H_{b}
circle C_{\_G124994} P_{\_G124991} H_{b}

color 200 200 200
drawcircle C_{\_G124994}
```

```
color 0 0 0


% Constructing points P_{\_G124997} and P_{\_G125000} which are in intersection of C_{\_G124994}
    and k(I,P_{a})
intersec2 P_{\_G124997} P_{\_G125000} C_{\_G124994} k(I,P_{a})
cmark_r P_{\_G124997}
cmark_r P_{\_G125000}

% Constructing a line y2 which passes through point H_{b} and point P_{\_G124997}
line y2 H_{b} P_{\_G124997}

color 200 200 200
drawline y2
color 0 0 0


% Constructing a line b which passes through point H_{b} and point P_{\_G125000}
line b H_{b} P_{\_G125000}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(N,M_{a}) intersect% DET: points H_{b} and M_{b} must be different
% Constructing a point P_{\_G125334} which is a foot of the point N on the line b
foot P_{\_G125334} N b
cmark_r P_{\_G125334}
color 200 200 200
drawline N P_{\_G125334}
color 0 0 0

% Constructing a point M_{b} which is an image of the point H_{b} in the symmetry to point/line P
    _{\_G125334}
sim M_{b} P_{\_G125334} H_{b}
cmark_lt M_{b}


% DET: points M_{b} and I are not the same
% Constructing a line IM_{b} which passes through point M_{b} and point I
line IM_{b} M_{b} I

color 200 200 200
drawline IM_{b}
color 0 0 0



% DET: points N and M_{b} are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point N and point M_{b}
line m(H_{a}H_{c}) N M_{b}

color 200 200 200
drawline m(H_{a}H_{c})
```

```
color 0 0 0


% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{b} and E_{b} must be
    different
% Constructing a point E_{b} which is an image of the point M_{b} in the symmetry to point/line N
sim E_{b} N M_{b}
cmark_r E_{b}


% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points I and M_{b} are not the same
% Constructing midpoint P_{\_G125802} of the segment IM_{b}
midpoint P_{\_G125802} I M_{b}
cmark_r P_{\_G125802}

% Constructing a circle k_over(I,M_{b}) whose center is at point P_{\_G125802} and which passes
    through point I
circle k_over(I,M_{b}) P_{\_G125802} I

color 200 200 200
drawcircle k_over(I,M_{b})
color 0 0 0



% NDG: circles k_over(I,M_{b}) and k(I,P_{a}) intersect% DET: circles k_over(I,M_{b}) and k(I,P_{a
    }) are not the same
% Constructing points B_{fi} and P_{b} which are in intersection of k_over(I,M_{b}) and k(I,P_{a})
intersec2 B_{fi} P_{b} k_over(I,M_{b}) k(I,P_{a})
cmark_r B_{fi}
cmark_r P_{b}



% Constructing a point P‘_{b} such that P_{b}P‘_{b}/P_{b}M_{b}=2
towards P‘_{b} P_{b} M_{b} 2
cmark_r P‘_{b}
color 200 200 200
drawsegment P_{b} P‘_{b}
color 0 0 0



% Constructing a line m_{b} which is perpendicular to line b and which passes through point M_{b}
perp m_{b} M_{b} b
```

```
color 200 200 200
drawline m_{b}
color 0 0 0



% Constructing a line BP‘_{b} which contains the point P‘_{b} and is parallel to the line IM_{b}
parallel BP‘_{b} P‘_{b} IM_{b}

color 200 200 200
drawline BP‘_{b}
color 0 0 0



% NDG: lines BP‘_{b} and h_{b} are not parallel% DET: lines BP‘_{b} and h_{b} are not the same
% Constructing a point B which belongs to line BP‘_{b} and line h_{b}
intersec B BP‘_{b} h_{b}
cmark_b B


% DET: points I and B are not the same
% Constructing a line s_{b} which passes through point I and point B
line s_{b} I B

color 200 200 200
drawline s_{b}
color 0 0 0



% NDG: lines m_{b} and s_{b} are not parallel% DET: lines m_{b} and s_{b} are not the same
% Constructing a point N_{b} which belongs to line m_{b} and line s_{b}
intersec N_{b} m_{b} s_{b}
cmark_rb N_{b}


% NDG: points I and N_{b} are not the same
% Constructing a circle k(N_{b},A) whose center is at point N_{b} and which passes through point I
circle k(N_{b},A) N_{b} I

color 200 200 200
drawcircle k(N_{b},A)
color 0 0 0



% NDG: line b and circle k(N_{b},A) intersect
% Constructing points A and C which are in intersection of k(N_{b},A) and b
intersec2 A C k(N_{b},A) b
cmark_t A
cmark_l C
```

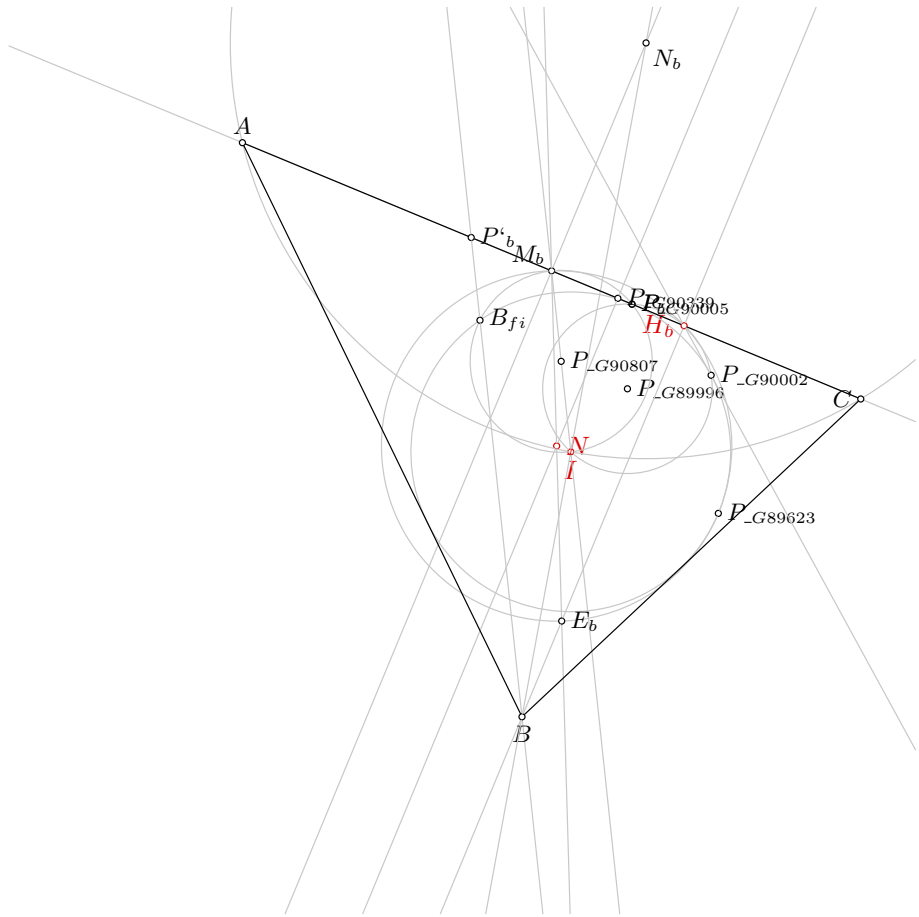

Figure 1: Illustration of the problem 1097

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(N_{b},A) intersect; points I and N_{b} are not the
     same; lines m_{b} and s_{b} are not parallel; lines BP'_{b} and h_{b} are not parallel;
    circles k_over(I,M_{b}) and k(I,P_{a}) intersect; points I and M_{b} are not the same; line m(H
    _{a}H_{c}) and circle k(N,M_{a}) intersect; line b and circle k(N,M_{a}) intersect; point H_{b}
     is outside the circle k(I,P_{a}); point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points H_{b} and N are not the same
% Determination conditions: lines m_{b} and s_{b} are not the same; points I and B are not the same
    ; lines BP'_{b} and h_{b} are not the same; circles k_over(I,M_{b}) and k(I,P_{a}) are not the
    same; points E_{b} and H_{b} are not the same; points M_{b} and E_{b} must be different; points
     N and M_{b} are not the same; points M_{b} and I are not the same; points H_{b} and M_{b} must
     be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_b=_H_b

Proving failed

4.1.2 Proving I=_I

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_b=_H_b

Proving failed

4.2.2 Proving I=_I

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_b=_H_b

Proving failed

4.3.2 Proving I=_I

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_b=_H_b

Proving failed

4.4.2 Proving I=_I

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 1098

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1098: Given a point M_a, a point N and a point H_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;
2. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
3. Choose freely a point H_b on the circle $k(N, M_a)$ (rule WOncircle);
4. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;
5. Using the point H_b and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points H_b and M_a are not the same;
6. Using the circle $k(N, M_a)$, the circle $k(M_a, B)$, the point H_b, the point N and the point M_a, construct a point H_c (rule W08); % NDG: circles $k(N, M_a)$ and $k(M_a, B)$ intersect % DET: circles $k(N, M_a)$ and $k(M_a, B)$ are not the same; points H_b and H_c must be different;
7. Choose freely a point A on the circle $k(E_a, A)$ (rule WOncircle);
8. Using the point A and the point E_a, construct a point H (rule W01); ;
9. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
10. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;

11. Using the line b and the line h_c, construct a point C (rule W03); % NDG: lines b and h_c are not parallel % DET: lines b and h_c are not the same;

12. Using the point M_a and the point C, construct a point B (rule W01); .

Non-degenerate conditions: lines b and h_c are not parallel; circles $k(N, M_a)$ and $k(M_a, B)$ intersect; points H_b and M_a are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points M_a and N are not the same.

Determination conditions: lines b and h_c are not the same; points H_c and H are not the same; points A and H_b are not the same; circles $k(N, M_a)$ and $k(M_a, B)$ are not the same; points H_b and H_c must be different; points M_a and E_a must be different; points M_a and N are not the same.

Rules used: [W01,W02,W03,W05a,W06,W08,WOncircle1]

Lemmas used: [D10,D21,D28,D32,D6,D7,GD01,GD02,GL01,GL03,GL04,L20,L21,L22,L3,L38,L39,L47,L48]

Solving time: 59.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{a} 65 40
point N 72.5 61.93
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_r M_{a}
cmark_r N
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% Choosing randomly a point H_{b} on the circle with center N through point M_{a}
oncircle H_{b} N M_{a}
cmark_l H_{b}
color 200 200 200
drawcircle N M_{a}
color 0 0 0


% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% NDG: points H_{b} and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point H
    _{b}
circle k(M_{a},B) M_{a} H_{b}

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{a},B) intersect% DET: circles k(N,M_{a}) and k(M_{a},B) are not
    the same; points H_{b} and H_{c} must be different
% Constructing a line L_{\_G163597} which passes through point N and point M_{a}
line L_{\_G163597} N M_{a}

color 200 200 200
drawline L_{\_G163597}
color 0 0 0


% Constructing a point H_{c} which is an image of the point H_{b} in the symmetry to point/line L
    _{\_G163597}
sim H_{c} L_{\_G163597} H_{b}
cmark_rt H_{c}



% Choosing randomly a point A on the circle with center E_{a} through point H_{b}
oncircle A E_{a} H_{b}
cmark_t A
color 200 200 200
drawcircle E_{a} H_{b}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
```

```
drawsegment A H
color 0 0 0


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: lines b and h_{c} are not parallel% DET: lines b and h_{c} are not the same
% Constructing a point C which belongs to line b and line h_{c}
intersec C b h_{c}
cmark_l C



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and h_{c} are not parallel; circles k(N,M_{a}) and k(M_{a},B)
    intersect; points H_{b} and M_{a} are not the same; line m(H_{b}H_{c}) and circle k(N,M_{a})
    intersect; points M_{a} and N are not the same
% Determination conditions: lines b and h_{c} are not the same; points H_{c} and H are not the same
    ; points A and H_{b} are not the same; circles k(N,M_{a}) and k(M_{a},B) are not the same;
    points H_{b} and H_{c} must be different; points M_{a} and E_{a} must be different; points M_{a
    } and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

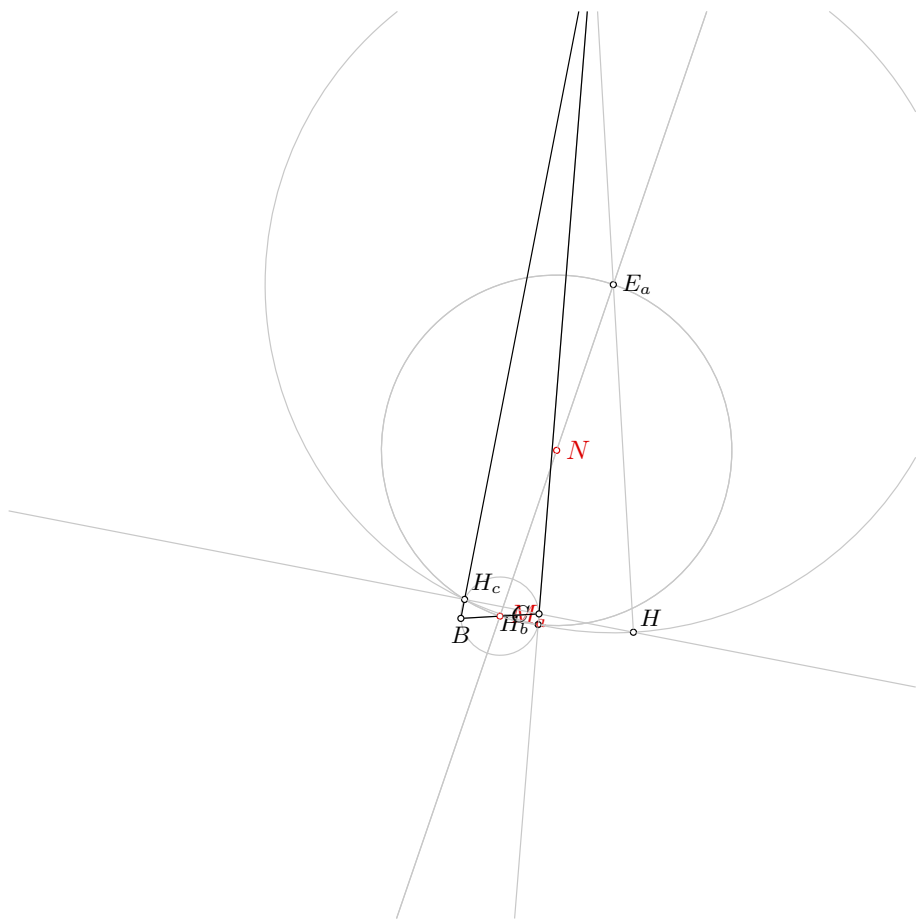

Figure 1: Illustration of the problem 1098

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_a=$\_M_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.201 seconds.

NDG conditions Line through points H_b and A is not parallel with line through points H_c and H
Points H_b and A are not identical

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving H_b=$\_H_b$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_a=$\_M_a$

NDG conditions are:

$S_{AH_cH} \neq S_{H_bH_cH}$ i.e., lines AH_b and H_cH are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{CBF^3_{\_h_b}}$ i.e., lines AC and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving H_b=$\_H_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_a=$\_M_a$

Proving failed

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_a=_M_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 1099

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1099: Given a point M_b, a point N and a point H_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points M_b and N are not the same;
2. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
3. Choose freely a point H_b on the circle $k(N, M_a)$ (rule WOncircle);
4. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
5. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point M_b, construct a point E_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_b and E_b must be different;
6. Using the point E_b and the point H_b, construct a line h_b (rule W02); % DET: points E_b and H_b are not the same;
7. Choose freely a point A on the line b (rule WOnline1) ;
8. Using the point A and the point M_b, construct a point C (rule W01); ;
9. Using the point A and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points A and M_b are not the same;
10. Using the circle $k(N, M_a)$ and the circle $k(M_b, C)$, construct a point H_a and a point H_c (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_b, C)$ intersect % DET: circles $k(N, M_a)$ and $k(M_b, C)$ are not the same;

11. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

12. Using the line h_b and the line h_a, construct a point H (rule W03); % NDG: lines h_b and h_a are not parallel % DET: lines h_b and h_a are not the same;

13. Using the point N and the point H, construct a point G (rule W01); ;

14. Using the point M_b and the point G, construct a point B (rule W01); .

Non-degenerate conditions: lines h_b and h_a are not parallel; circles $k(N, M_a)$ and $k(M_b, C)$ intersect; points A and M_b are not the same; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points M_b and N are not the same.

Determination conditions: lines h_b and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points E_b and H_b are not the same; points M_b and E_b must be different; points H_b and M_b are not the same; points M_b and N are not the same.

Rules used: [W01,W02,W03,W05a,W06,W07,WOncircle1,WOnline1]

Lemmas used: [D22,D29,D3,D32,D5,D6,D8,D9,GD01,GD02,GL01,GL03,GL04,GL09,L16,L17,L19,L21,L23,L43

Solving time: 569.9 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{b} 95 67.5
point N 72.5 61.93
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_lt M_{b}
cmark_r N
cmark_l H_{b}
color 0 0 0
fontsize 8

% DET: points M_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point M_{b} and point N
line m(H_{a}H_{c}) M_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
```

```
color 0 0 0



% Choosing randomly a point H_{b} on the circle with center N through point M_{b}
oncircle H_{b} N M_{b}
cmark_l H_{b}
color 200 200 200
drawcircle N M_{b}
color 0 0 0


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{b} and E_{b} must be
    different
% Constructing a point E_{b} which is an image of the point M_{b} in the symmetry to point/line N
sim E_{b} N M_{b}
cmark_r E_{b}


% DET: points E_{b} and H_{b} are not the same
% Constructing a line h_{b} which passes through point E_{b} and point H_{b}
line h_{b} E_{b} H_{b}

color 200 200 200
drawline h_{b}
color 0 0 0



% Choosing randomly a point A on the line H_{b}M_{b}
online A H_{b} M_{b}
cmark_t A
color 200 200 200
drawline H_{b} M_{b}
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0
```

```
% NDG: points A and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point A
circle k(M_{b},C) M_{b} A

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{b},C) intersect% DET: circles k(N,M_{a}) and k(M_{b},C) are not
    the same
% Constructing points H_{a} and H_{c} which are in intersection of k(N,M_{a}) and k(M_{b},C)
intersec2 H_{a} H_{c} k(N,M_{a}) k(M_{b},C)
cmark_r H_{a}
cmark_rt H_{c}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{b} and h_{a} are not parallel% DET: lines h_{b} and h_{a} are not the same
% Constructing a point H which belongs to line h_{b} and line h_{a}
intersec H h_{b} h_{a}
cmark_rt H



% Constructing a line L_{\_G206131} which passes through point N and point H
line L_{\_G206131} N H

color 200 200 200
drawline L_{\_G206131}
color 0 0 0


% Constructing a point P_{\_G206232} with coordinates (0,0)
point P_{\_G206232} 0 0
cmark_r P_{\_G206232}

% Constructing a point P_{\_G206156} such that NP_{\_G206156}/NP_{\_G206232}=-1
towards P_{\_G206156} N P_{\_G206232} -1
cmark_r P_{\_G206156}
color 200 200 200
drawsegment P_{\_G206232} P_{\_G206156}
color 0 0 0
```

```
% Constructing a point P_{\_G206201} such that NP_{\_G206201}/NP_{\_G206232}=3
towards P_{\_G206201} N P_{\_G206232} 3
cmark_r P_{\_G206201}
color 200 200 200
drawsegment N P_{\_G206201}
color 0 0 0

% Constructing a line L_{\_G206162} which passes through point H and point P_{\_G206201}
line L_{\_G206162} H P_{\_G206201}

color 200 200 200
drawline L_{\_G206162}
color 0 0 0


% Constructing a line L_{\_G206125} which contains the point P_{\_G206156} and is parallel to the
    line L_{\_G206162}
parallel L_{\_G206125} P_{\_G206156} L_{\_G206162}

color 200 200 200
drawline L_{\_G206125}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G206125} and line L_{\_G206131}
intersec G L_{\_G206125} L_{\_G206131}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{b} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{b
    },C) intersect; points A and M_{b} are not the same; line m(H_{a}H_{c}) and circle k(N,M_{a})
    intersect; points M_{b} and N are not the same
% Determination conditions: lines h_{b} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{b},C) are not the same; points E_{b} and H_{b} are not the
    same; points M_{b} and E_{b} must be different; points H_{b} and M_{b} are not the same; points
     M_{b} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

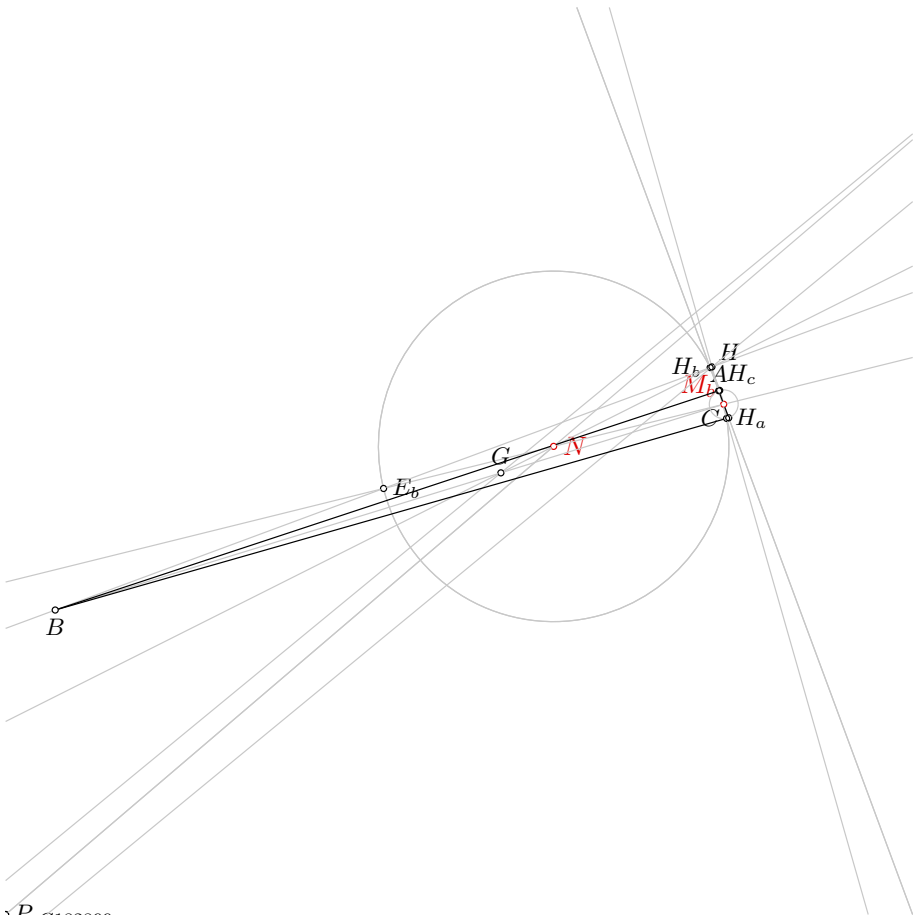

Figure 1: Illustration of the problem 1099

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.114 seconds.

NDG conditions Points M_b and H_b are not identical

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving H_b=_H_b

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_b=_M_b

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving H_b=_H_b

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.070 seconds.There are no ndg conditions.

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_b=_M_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 1100

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1100: Given a point M_c, a point N and a point H_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
2. Choose freely a point H_b on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point H_b and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points H_b and M_c are not the same;
4. Using the circle $k(N, M_a)$, the circle $k(M_c, A)$, the point H_b, the point N and the point M_c, construct a point H_a (rule W08); % NDG: circles $k(N, M_a)$ and $k(M_c, A)$ intersect % DET: circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points H_b and H_a must be different;
5. Choose freely a point A on the circle $k(M_c, A)$ (rule WOncircle);
6. Using the point A and the point M_c, construct a point B (rule W01); ;
7. Using the point A and the point H_b, construct a line b (rule W02); % DET: points A and H_b are not the same;
8. Using the point H_a and the point B, construct a line a (rule W02); % DET: points H_a and B are not the same;
9. Using the line b and the line a, construct a point C (rule W03); % NDG: lines b and a are not parallel % DET: lines b and a are not the same.

Non-degenerate conditions: lines b and a are not parallel; circles $k(N, M_a)$ and $k(M_c, A)$ intersect; points H_b and M_c are not the same; points M_c and N are not the same.

Determination conditions: lines b and a are not the same; points H_a and B are not the same; points A and H_b are not the same; circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points H_b and H_a must be different.

Rules used: [W01,W02,W03,W06,W08,WOncircle1]

Lemmas used: [D20,D32,D5,D6,GD01,GD02,GL03,L18,L19,L20,L41,L42]

Solving time: 57.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{c} 50 67.5
point N 72.5 61.93
point H_{b} 89.36 77.83

color 220 0 0
fontsize 9

cmark_lt M_{c}
cmark_r N
cmark_l H_{b}
color 0 0 0
fontsize 8

% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{b} on the circle with center N through point M_{c}
oncircle H_{b} N M_{c}
cmark_l H_{b}
color 200 200 200
drawcircle N M_{c}
color 0 0 0


% NDG: points H_{b} and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point H
    _{b}
circle k(M_{c},A) M_{c} H_{b}

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0
```

```
% NDG: circles k(N,M_{a}) and k(M_{c},A) intersect% DET: circles k(N,M_{a}) and k(M_{c},A) are not
    the same; points H_{b} and H_{a} must be different
% Constructing a line L_{\_G238759} which passes through point N and point M_{c}
line L_{\_G238759} N M_{c}

color 200 200 200
drawline L_{\_G238759}
color 0 0 0


% Constructing a point H_{a} which is an image of the point H_{b} in the symmetry to point/line L
    _{\_G238759}
sim H_{a} L_{\_G238759} H_{b}
cmark_r H_{a}



% Choosing randomly a point A on the circle with center M_{c} through point H_{b}
oncircle A M_{c} H_{b}
cmark_t A
color 200 200 200
drawcircle M_{c} H_{b}
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0


% DET: points A and H_{b} are not the same
% Constructing a line b which passes through point A and point H_{b}
line b A H_{b}

color 200 200 200
drawline b
color 0 0 0



% DET: points H_{a} and B are not the same
% Constructing a line a which passes through point H_{a} and point B
line a H_{a} B

color 200 200 200
drawline a
color 0 0 0



% NDG: lines b and a are not parallel% DET: lines b and a are not the same
% Constructing a point C which belongs to line b and line a
```

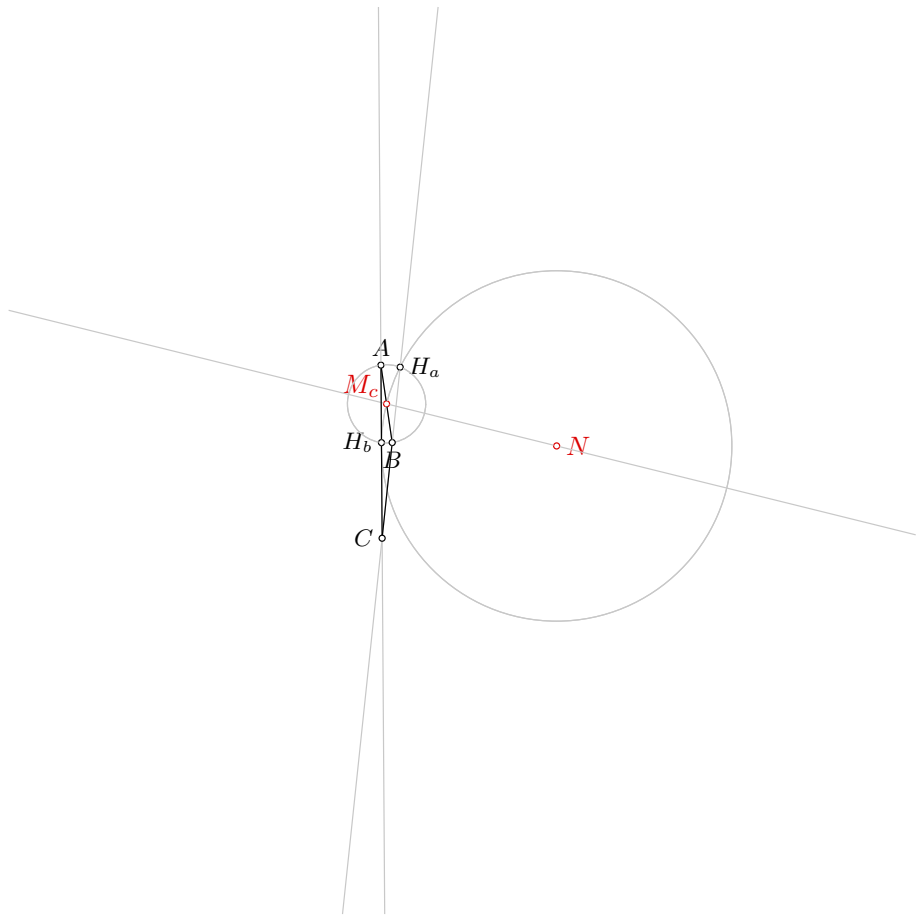

Figure 1: Illustration of the problem 1100

```
intersec C b a
cmark_l C



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines b and a are not parallel; circles k(N,M_{a}) and k(M_{c},A)
    intersect; points H_{b} and M_{c} are not the same; points M_{c} and N are not the same
% Determination conditions: lines b and a are not the same; points H_{a} and B are not the same;
    points A and H_{b} are not the same; circles k(N,M_{a}) and k(M_{c},A) are not the same; points
     H_{b} and H_{a} must be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_c=$\_M_c$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.117 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving H_b=$\_H_b$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_c=$\_M_c$

NDG conditions are:

$S_{AH_aB} \neq S_{H_bH_aB}$ i.e., lines AH_b and H_aB are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{CBF^3_{\_h_b}}$ i.e., lines AC and $BF^3_{\_h_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving H_b=$\_H_b$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.050 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving H_b=_H_b

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_c=_M_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving H_b=_H_b

Proving failed

Problem 1101

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1101: Given a point H_b, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point N and the point O, construct a point H (rule W01); ;
3. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;
4. Using the point H_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_b and N are not the same;
5. Using the circle $k(N, M_a)$, the line h_b, the point N and the point H_b, construct a point E_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points H_b and E_b must be different;
6. Using the point E_b and the point H, construct a point B (rule W01); ;
7. Using the point G and the point B, construct a point M_b (rule W01); ;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points H_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points H_b and E_b must be different; points H_b and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L15,L20,L23,L56]

Solving time: 5.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{b} 89.36 77.83
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_l H_{b}
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G62350} which passes through point N and point O
line L_{\_G62350} N O

color 200 200 200
drawline L_{\_G62350}
color 0 0 0


% Constructing a point P_{\_G62451} with coordinates (0,0)
point P_{\_G62451} 0 0
cmark_r P_{\_G62451}

% Constructing a point P_{\_G62375} such that NP_{\_G62375}/NP_{\_G62451}=1
towards P_{\_G62375} N P_{\_G62451} 1
cmark_r P_{\_G62375}
color 200 200 200
drawsegment N P_{\_G62375}
color 0 0 0

% Constructing a point P_{\_G62420} such that NP_{\_G62420}/NP_{\_G62451}=3
towards P_{\_G62420} N P_{\_G62451} 3
cmark_r P_{\_G62420}
color 200 200 200
drawsegment N P_{\_G62420}
color 0 0 0

% Constructing a line L_{\_G62381} which passes through point O and point P_{\_G62420}
line L_{\_G62381} O P_{\_G62420}
```

```
color 200 200 200
drawline L_{\_G62381}
color 0 0 0


% Constructing a line L_{\_G62344} which contains the point P_{\_G62375} and is parallel to the
    line L_{\_G62381}
parallel L_{\_G62344} P_{\_G62375} L_{\_G62381}

color 200 200 200
drawline L_{\_G62344}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G62344} and line L_{\_G62350}
intersec G L_{\_G62344} L_{\_G62350}
cmark_t G



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0


% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: points H_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{b}
circle k(N,M_{a}) N H_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points H_{b} and E_{b} must be different
% Constructing a point P_{\_G63278} which is a foot of the point N on the line h_{b}
foot P_{\_G63278} N h_{b}
cmark_r P_{\_G63278}
color 200 200 200
drawline N P_{\_G63278}
color 0 0 0
```

```
% Constructing a point E_{b} which is an image of the point H_{b} in the symmetry to point/line P
    _{\_G63278}
sim E_{b} P_{\_G63278} H_{b}
cmark_r E_{b}



% Constructing a point B such that E_{b}B/E_{b}H=-1
towards B E_{b} H -1
cmark_b B
color 200 200 200
drawsegment H B
color 0 0 0



% Constructing a point M_{b} such that GM_{b}/GB=-0.5
towards M_{b} G B -0.5
cmark_lt M_{b}
color 200 200 200
drawsegment B M_{b}
color 0 0 0


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

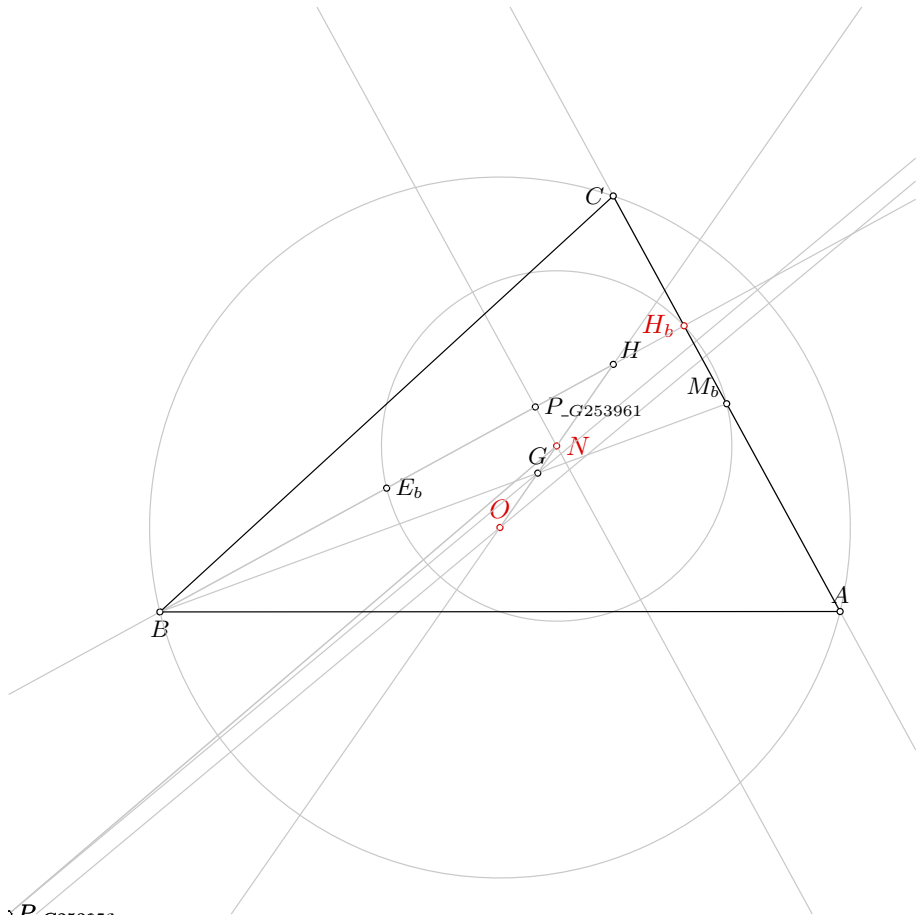

Figure 1: Illustration of the problem 1101

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points H_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points H_{b} and E_{b} must be
     different; points H_{b} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_b=_H_b

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving O=_O

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_b=_H_b

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_b=_H_b

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_b=_H_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 1102

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1102: Given a point H_b, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1103

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1103: Given a point H_b, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1104

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1104: Given a point H_b, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1105

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1105: Given a point H_c, a point I and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;

2. Using the point I, the circle $k(N, M_a)$, the point N and the point H_c, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

3. Using the circle $k(I, P_a)$, the point H_c and the point I, construct a line $y3$ and a line c (rule W12); % NDG: point H_c is outside the circle $k(I, P_a)$;

4. Using the circle $k(N, M_a)$, the line c, the point N and the point H_c, construct a point M_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points H_c and M_c must be different;

5. Using the point M_c and the point I, construct a line IM_c (rule W02); % DET: points M_c and I are not the same;

6. Using the point N and the point M_c, construct a line $m(H_aH_b)$ (rule W02); % DET: points N and M_c are not the same;

7. Using the circle $k(N, M_a)$, the line $m(H_aH_b)$, the point N and the point M_c, construct a point E_c (rule W05a); % NDG: line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect % DET: points M_c and E_c must be different;

8. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;

9. Using the point I and the point M_c, construct a circle $k_over(I, M_c)$ (rule W09); % NDG: points I and M_c are not the same;

10. Using the circle $k_over(I, M_c)$ and the circle $k(I, P_a)$, construct a point C_{fi} and a point P_c (rule W07); % NDG: circles $k_over(I, M_c)$ and $k(I, P_a)$ intersect % DET: circles $k_over(I, M_c)$ and $k(I, P_a)$ are not the same;

11. Using the point P_c and the point M_c, construct a point $P`_c$ (rule W01); ;

12. Using the point M_c and the line c, construct a line m_c (rule W10b); ;

13. Using the point $P`_c$ and the line $IM_c$, construct a line $CP`_c$ (rule W16); ;

14. Using the line $CP`_c$ and the line $h_c$, construct a point $C$ (rule W03); % NDG: lines $CP`_c$ and h_c are not parallel % DET: lines $CP`_c$ and h_c are not the same;

15. Using the point I and the point C, construct a line s_c (rule W02); % DET: points I and C are not the same;

16. Using the line m_c and the line s_c, construct a point N_c (rule W03); % NDG: lines m_c and s_c are not parallel % DET: lines m_c and s_c are not the same;

17. Using the point I and the point N_c, construct a circle $k(N_c, B)$ (rule W06); % NDG: points I and N_c are not the same;

18. Using the circle $k(N_c, B)$ and the line c, construct a point B and a point A (rule W04); % NDG: line c and circle $k(N_c, B)$ intersect.

Non-degenerate conditions: line c and circle $k(N_c, B)$ intersect; points I and N_c are not the same; lines m_c and s_c are not parallel; lines $CP`_c$ and h_c are not parallel; circles $k_over(I, M_c)$ and $k(I, P_a)$ intersect; points I and M_c are not the same; line $m(H_aH_b)$ and circle $k(N, M_a)$ intersect; line c and circle $k(N, M_a)$ intersect; point H_c is outside the circle $k(I, P_a)$; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points H_c and N are not the same.

Determination conditions: lines m_c and s_c are not the same; points I and C are not the same; lines $CP`_c$ and h_c are not the same; circles $k_over(I, M_c)$ and $k(I, P_a)$ are not the same; points E_c and H_c are not the same; points M_c and E_c must be different; points N and M_c are not the same; points M_c and I are not the same; points H_c and M_c must be different.

Rules used: [W01,W02,W03,W04,W05,W05a,W06,W07,W09,W10b,W12,W16,W22]

Lemmas used: [D10,D13,D20,D27,D30,D32,D49,D67,D7,D90,GD01,GD02,GL01,GL03,GL09,L119,L14,L18,L19

Solving time: 41.6 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{c} 68.91 84.83
point I 74.37 61.15
point N 72.5 61.93

color 220 0 0
```

```
fontsize 9

cmark_rt H_{c}
cmark_b I
cmark_r N
color 0 0 0
fontsize 8

% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G139297] from point N to point H_{c}
distance V[_G139297] N H_{c}


% Calculating distance V[_G139321] from point N to point I
distance V[_G139321] N I


% Calculating value V[_G139342] using formula V[_G139297]/V[_G139321]
expression V[_G139342] { V[_G139297]/V[_G139321] }


% Constructing a point P_{\_G139373} such that NP_{\_G139373}/NI=V[_G139297]/V[_G139321]
towards P_{\_G139373} N I V[_G139342]
cmark_r P_{\_G139373}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    139373}
circle k(I,P_{a}) I P_{\_G139373}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: point H_{c} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G139747} of the segment H_{c}I
midpoint P_{\_G139747} H_{c} I
cmark_r P_{\_G139747}

% Constructing a circle C_{\_G139750} whose center is at point P_{\_G139747} and which passes
    through point H_{c}
circle C_{\_G139750} P_{\_G139747} H_{c}

color 200 200 200
drawcircle C_{\_G139750}
```

```
color 0 0 0


% Constructing points P_{\_G139753} and P_{\_G139756} which are in intersection of C_{\_G139750}
    and k(I,P_{a})
intersec2 P_{\_G139753} P_{\_G139756} C_{\_G139750} k(I,P_{a})
cmark_r P_{\_G139753}
cmark_r P_{\_G139756}

% Constructing a line y3 which passes through point H_{c} and point P_{\_G139753}
line y3 H_{c} P_{\_G139753}

color 200 200 200
drawline y3
color 0 0 0


% Constructing a line c which passes through point H_{c} and point P_{\_G139756}
line c H_{c} P_{\_G139756}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(N,M_{a}) intersect% DET: points H_{c} and M_{c} must be different
% Constructing a point P_{\_G140090} which is a foot of the point N on the line c
foot P_{\_G140090} N c
cmark_r P_{\_G140090}
color 200 200 200
drawline N P_{\_G140090}
color 0 0 0

% Constructing a point M_{c} which is an image of the point H_{c} in the symmetry to point/line P
    _{\_G140090}
sim M_{c} P_{\_G140090} H_{c}
cmark_lt M_{c}


% DET: points M_{c} and I are not the same
% Constructing a line IM_{c} which passes through point M_{c} and point I
line IM_{c} M_{c} I

color 200 200 200
drawline IM_{c}
color 0 0 0



% DET: points N and M_{c} are not the same
% Constructing a line m(H_{a}H_{b}) which passes through point N and point M_{c}
line m(H_{a}H_{b}) N M_{c}

color 200 200 200
drawline m(H_{a}H_{b})
```

```
color 0 0 0


% NDG: line m(H_{a}H_{b}) and circle k(N,M_{a}) intersect% DET: points M_{c} and E_{c} must be
    different
% Constructing a point E_{c} which is an image of the point M_{c} in the symmetry to point/line N
sim E_{c} N M_{c}
cmark_r E_{c}


% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points I and M_{c} are not the same
% Constructing midpoint P_{\_G140558} of the segment IM_{c}
midpoint P_{\_G140558} I M_{c}
cmark_r P_{\_G140558}

% Constructing a circle k_over(I,M_{c}) whose center is at point P_{\_G140558} and which passes
    through point I
circle k_over(I,M_{c}) P_{\_G140558} I

color 200 200 200
drawcircle k_over(I,M_{c})
color 0 0 0



% NDG: circles k_over(I,M_{c}) and k(I,P_{a}) intersect% DET: circles k_over(I,M_{c}) and k(I,P_{a
    }) are not the same
% Constructing points C_{fi} and P_{c} which are in intersection of k_over(I,M_{c}) and k(I,P_{a})
intersec2 C_{fi} P_{c} k_over(I,M_{c}) k(I,P_{a})
cmark_r C_{fi}
cmark_r P_{c}



% Constructing a point P‘_{c} such that P_{c}P‘_{c}/P_{c}M_{c}=2
towards P‘_{c} P_{c} M_{c} 2
cmark_r P‘_{c}
color 200 200 200
drawsegment P_{c} P‘_{c}
color 0 0 0



% Constructing a line m_{c} which is perpendicular to line c and which passes through point M_{c}
perp m_{c} M_{c} c
```

```
color 200 200 200
drawline m_{c}
color 0 0 0



% Constructing a line CP‘_{c} which contains the point P‘_{c} and is parallel to the line IM_{c}
parallel CP‘_{c} P‘_{c} IM_{c}

color 200 200 200
drawline CP‘_{c}
color 0 0 0



% NDG: lines CP‘_{c} and h_{c} are not parallel% DET: lines CP‘_{c} and h_{c} are not the same
% Constructing a point C which belongs to line CP‘_{c} and line h_{c}
intersec C CP‘_{c} h_{c}
cmark_l C


% DET: points I and C are not the same
% Constructing a line s_{c} which passes through point I and point C
line s_{c} I C

color 200 200 200
drawline s_{c}
color 0 0 0



% NDG: lines m_{c} and s_{c} are not parallel% DET: lines m_{c} and s_{c} are not the same
% Constructing a point N_{c} which belongs to line m_{c} and line s_{c}
intersec N_{c} m_{c} s_{c}
cmark_b N_{c}


% NDG: points I and N_{c} are not the same
% Constructing a circle k(N_{c},B) whose center is at point N_{c} and which passes through point I
circle k(N_{c},B) N_{c} I

color 200 200 200
drawcircle k(N_{c},B)
color 0 0 0



% NDG: line c and circle k(N_{c},B) intersect
% Constructing points B and A which are in intersection of k(N_{c},B) and c
intersec2 B A k(N_{c},B) c
cmark_b B
cmark_t A
```

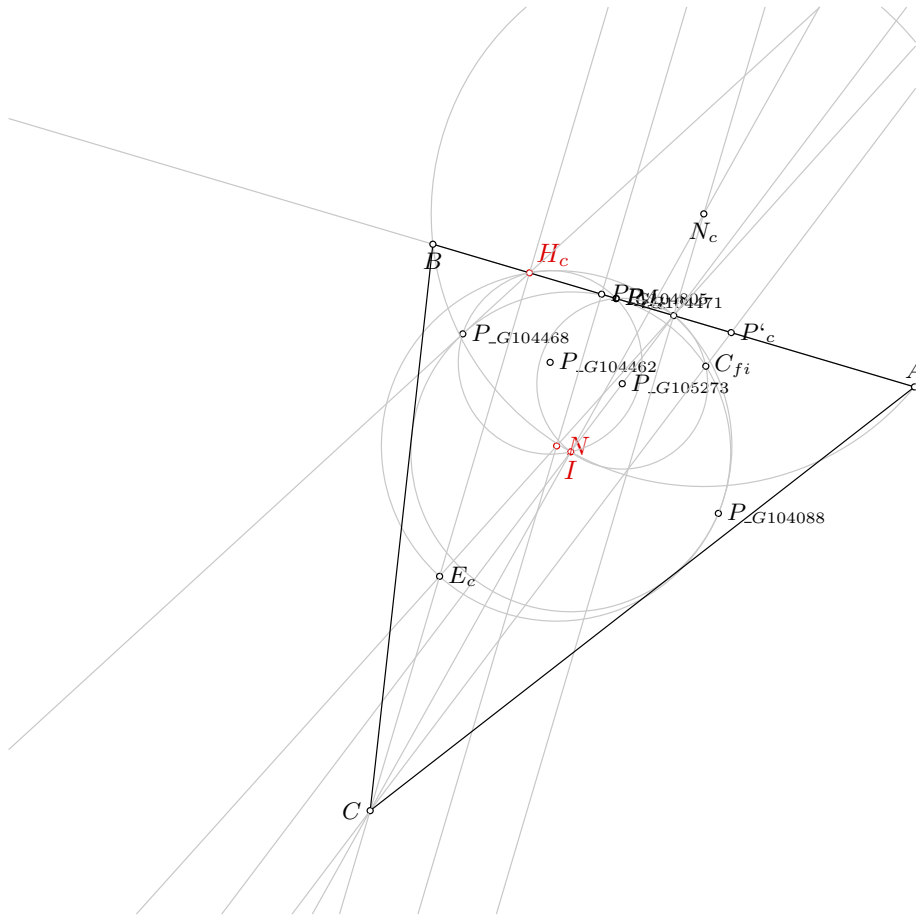

Figure 1: Illustration of the problem 1105

```
drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(N_{c},B) intersect; points I and N_{c} are not the
     same; lines m_{c} and s_{c} are not parallel; lines CP'_{c} and h_{c} are not parallel;
    circles k_over(I,M_{c}) and k(I,P_{a}) intersect; points I and M_{c} are not the same; line m(H
    _{a}H_{b}) and circle k(N,M_{a}) intersect; line c and circle k(N,M_{a}) intersect; point H_{c}
     is outside the circle k(I,P_{a}); point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points H_{c} and N are not the same
% Determination conditions: lines m_{c} and s_{c} are not the same; points I and C are not the same
    ; lines CP'_{c} and h_{c} are not the same; circles k_over(I,M_{c}) and k(I,P_{a}) are not the
    same; points E_{c} and H_{c} are not the same; points M_{c} and E_{c} must be different; points
     N and M_{c} are not the same; points M_{c} and I are not the same; points H_{c} and M_{c} must
     be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_c=_H_c

Proving failed

4.1.2 Proving I=_I

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving H_c=_H_c

Proving failed

4.2.2 Proving I=_I

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_c=_H_c

Proving failed

4.3.2 Proving I=_I

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_c=_H_c

Proving failed

4.4.2 Proving I=_I

Proving failed

4.4.3 Proving $N{=}\_N$

Proving failed

Problem 1106

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1106: Given a point M_a, a point N and a point H_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;
2. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
3. Choose freely a point H_c on the circle $k(N, M_a)$ (rule WOncircle);
4. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;
5. Using the point H_c and the point M_a, construct a circle $k(M_a, B)$ (rule W06); % NDG: points H_c and M_a are not the same;
6. Using the circle $k(N, M_a)$, the circle $k(M_a, B)$, the point H_c, the point N and the point M_a, construct a point H_b (rule W08); % NDG: circles $k(N, M_a)$ and $k(M_a, B)$ intersect % DET: circles $k(N, M_a)$ and $k(M_a, B)$ are not the same; points H_c and H_b must be different;
7. Choose freely a point A on the circle $k(E_a, A)$ (rule WOncircle);
8. Using the point A and the point E_a, construct a point H (rule W01); ;
9. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;
10. Using the point H_b and the point H, construct a line h_b (rule W02); % DET: points H_b and H are not the same;

11. Using the line c and the line h_b, construct a point B (rule W03); % NDG: lines c and h_b are not parallel % DET: lines c and h_b are not the same;

12. Using the point M_a and the point B, construct a point C (rule W01); .

Non-degenerate conditions: lines c and h_b are not parallel; circles $k(N, M_a)$ and $k(M_a, B)$ intersect; points H_c and M_a are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points M_a and N are not the same.

Determination conditions: lines c and h_b are not the same; points H_b and H are not the same; points A and H_c are not the same; circles $k(N, M_a)$ and $k(M_a, B)$ are not the same; points H_c and H_b must be different; points M_a and E_a must be different; points M_a and N are not the same.

Rules used: [W01,W02,W03,W05a,W06,W08,WOncircle1]

Lemmas used: [D21,D28,D3,D32,D6,D7,D9,GD01,GD02,GL01,GL03,GL04,L20,L21,L22,L38,L39,L47,L48]

Solving time: 59.7 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{a} 65 40
point N 72.5 61.93
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_r M_{a}
cmark_r N
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0
```

```
% Choosing randomly a point H_{c} on the circle with center N through point M_{a}
oncircle H_{c} N M_{a}
cmark_rt H_{c}
color 200 200 200
drawcircle N M_{a}
color 0 0 0


% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% NDG: points H_{c} and M_{a} are not the same
% Constructing a circle k(M_{a},B) whose center is at point M_{a} and which passes through point H
    _{c}
circle k(M_{a},B) M_{a} H_{c}

color 200 200 200
drawcircle k(M_{a},B)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{a},B) intersect% DET: circles k(N,M_{a}) and k(M_{a},B) are not
    the same; points H_{c} and H_{b} must be different
% Constructing a line L_{\_G180912} which passes through point N and point M_{a}
line L_{\_G180912} N M_{a}

color 200 200 200
drawline L_{\_G180912}
color 0 0 0


% Constructing a point H_{b} which is an image of the point H_{c} in the symmetry to point/line L
    _{\_G180912}
sim H_{b} L_{\_G180912} H_{c}
cmark_l H_{b}



% Choosing randomly a point A on the circle with center E_{a} through point H_{c}
oncircle A E_{a} H_{c}
cmark_t A
color 200 200 200
drawcircle E_{a} H_{c}
color 0 0 0



% Constructing a point H such that AH/AE_{a}=2
towards H A E_{a} 2
cmark_rt H
color 200 200 200
```

```
drawsegment A H
color 0 0 0


% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% DET: points H_{b} and H are not the same
% Constructing a line h_{b} which passes through point H_{b} and point H
line h_{b} H_{b} H

color 200 200 200
drawline h_{b}
color 0 0 0



% NDG: lines c and h_{b} are not parallel% DET: lines c and h_{b} are not the same
% Constructing a point B which belongs to line c and line h_{b}
intersec B c h_{b}
cmark_b B



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and h_{b} are not parallel; circles k(N,M_{a}) and k(M_{a},B)
    intersect; points H_{c} and M_{a} are not the same; line m(H_{b}H_{c}) and circle k(N,M_{a})
    intersect; points M_{a} and N are not the same
% Determination conditions: lines c and h_{b} are not the same; points H_{b} and H are not the same
    ; points A and H_{c} are not the same; circles k(N,M_{a}) and k(M_{a},B) are not the same;
    points H_{c} and H_{b} must be different; points M_{a} and E_{a} must be different; points M_{a
    } and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

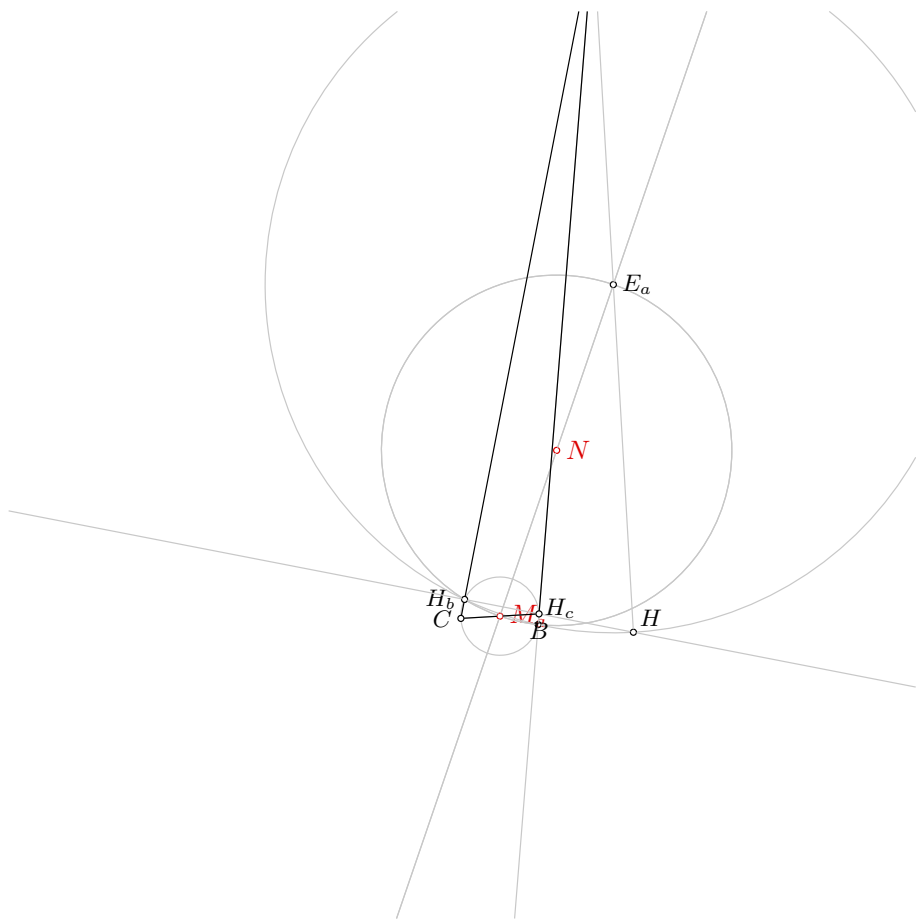

Figure 1: Illustration of the problem 1106

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_a=$\_M_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 11 terms.

Time Complexity: Time spent by the prover is 0.196 seconds.

NDG conditions Line through points H_b and H is not parallel with line through points A and H_c

Points A, H_c and $P_{\_G171685}$ are not collinear

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving H_c=$\_H_c$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_a=$\_M_a$

NDG conditions are:

$S_{AH_bH} \neq S_{H_cH_bH}$ i.e., lines AH_c and H_bH are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^4_{\_h_c}} \neq S_{BCF^4_{\_h_c}}$ i.e., lines AB and $CF^4_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving H_c=$\_H_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_a=$\_M_a$

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving H_c=_H_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_a=_M_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 1107

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1107: Given a point M_b, a point N and a point H_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
2. Choose freely a point H_c on the circle $k(N, M_a)$ (rule WOncircle);
3. Using the point H_c and the point M_b, construct a circle $k(M_b, C)$ (rule W06); % NDG: points H_c and M_b are not the same;
4. Using the circle $k(N, M_a)$, the circle $k(M_b, C)$, the point H_c, the point N and the point M_b, construct a point H_a (rule W08); % NDG: circles $k(N, M_a)$ and $k(M_b, C)$ intersect % DET: circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points H_c and H_a must be different;
5. Choose freely a point A on the circle $k(M_b, C)$ (rule WOncircle);
6. Using the point A and the point M_b, construct a point C (rule W01); ;
7. Using the point A and the point H_c, construct a line c (rule W02); % DET: points A and H_c are not the same;
8. Using the point H_a and the point C, construct a line a (rule W02); % DET: points H_a and C are not the same;
9. Using the line c and the line a, construct a point B (rule W03); % NDG: lines c and a are not parallel % DET: lines c and a are not the same.

Non-degenerate conditions: lines c and a are not parallel; circles $k(N, M_a)$ and $k(M_b, C)$ intersect; points H_c and M_b are not the same; points M_b and N are not the same.

Determination conditions: lines c and a are not the same; points H_a and C are not the same; points A and H_c are not the same; circles $k(N, M_a)$ and $k(M_b, C)$ are not the same; points H_c and H_a must be different.

Rules used: [W01,W02,W03,W06,W08,WOncircle1]

Lemmas used: [D22,D32,D5,D7,GD01,GD02,GL03,GL04,L17,L19,L21,L44,L45]

Solving time: 57.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{b} 95 67.5
point N 72.5 61.93
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_lt M_{b}
cmark_r N
cmark_rt H_{c}
color 0 0 0
fontsize 8

% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point H_{c} on the circle with center N through point M_{b}
oncircle H_{c} N M_{b}
cmark_rt H_{c}
color 200 200 200
drawcircle N M_{b}
color 0 0 0


% NDG: points H_{c} and M_{b} are not the same
% Constructing a circle k(M_{b},C) whose center is at point M_{b} and which passes through point H
    _{c}
circle k(M_{b},C) M_{b} H_{c}

color 200 200 200
drawcircle k(M_{b},C)
color 0 0 0
```

```
% NDG: circles k(N,M_{a}) and k(M_{b},C) intersect% DET: circles k(N,M_{a}) and k(M_{b},C) are not
    the same; points H_{c} and H_{a} must be different
% Constructing a line L_{\_G216066} which passes through point N and point M_{b}
line L_{\_G216066} N M_{b}

color 200 200 200
drawline L_{\_G216066}
color 0 0 0


% Constructing a point H_{a} which is an image of the point H_{c} in the symmetry to point/line L
    _{\_G216066}
sim H_{a} L_{\_G216066} H_{c}
cmark_r H_{a}



% Choosing randomly a point A on the circle with center M_{b} through point H_{c}
oncircle A M_{b} H_{c}
cmark_t A
color 200 200 200
drawcircle M_{b} H_{c}
color 0 0 0



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0


% DET: points A and H_{c} are not the same
% Constructing a line c which passes through point A and point H_{c}
line c A H_{c}

color 200 200 200
drawline c
color 0 0 0



% DET: points H_{a} and C are not the same
% Constructing a line a which passes through point H_{a} and point C
line a H_{a} C

color 200 200 200
drawline a
color 0 0 0



% NDG: lines c and a are not parallel% DET: lines c and a are not the same
% Constructing a point B which belongs to line c and line a
```

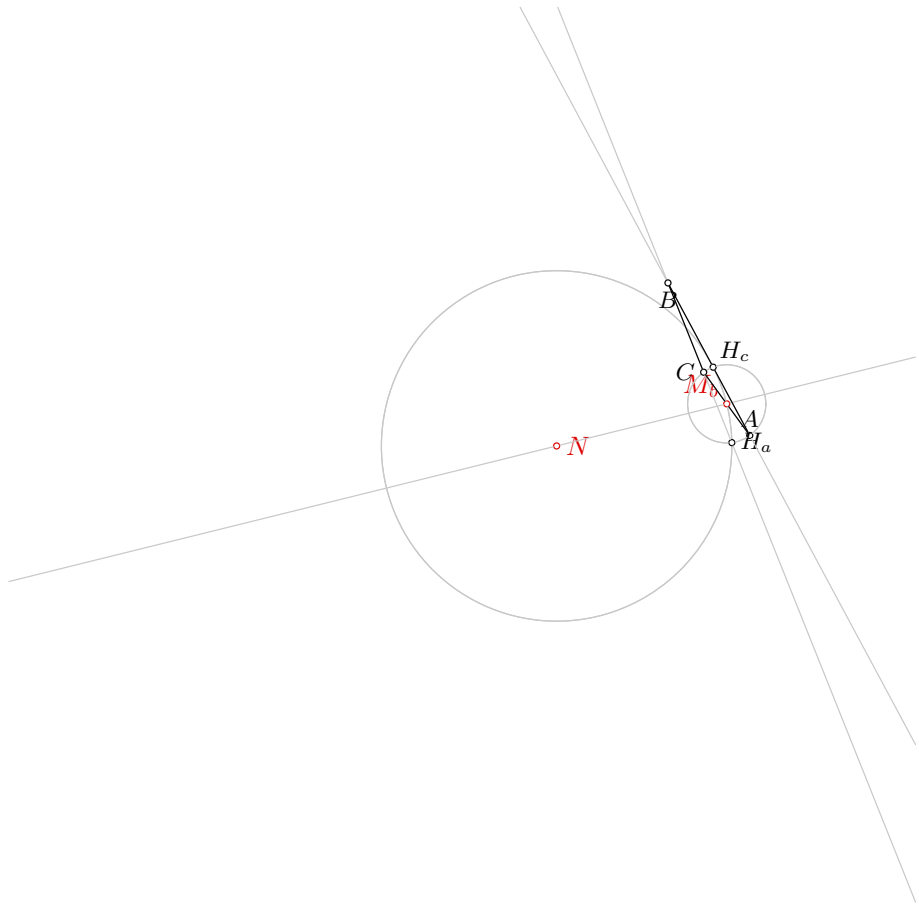

Figure 1: Illustration of the problem 1107

```
intersec B c a
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines c and a are not parallel; circles k(N,M_{a}) and k(M_{b},C)
    intersect; points H_{c} and M_{b} are not the same; points M_{b} and N are not the same
% Determination conditions: lines c and a are not the same; points H_{a} and C are not the same;
    points A and H_{c} are not the same; circles k(N,M_{a}) and k(M_{b},C) are not the same; points
     H_{c} and H_{a} must be different
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_b=$\_M_b$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.136 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving H_c=$\_H_c$

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_b=$\_M_b$

NDG conditions are:

$S_{AH_aC} \neq S_{H_cH_aC}$ i.e., lines AH_c and H_aC are not parallel (construction based assumption)
$S_{\_M_aBC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_bAC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a}BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a\_M_bF^1_{\_m_b}} \neq S_{F^0_{\_m_a}\_M_bF^1_{\_m_b}}$ i.e., lines $\_M_aF^0_{\_m_a}$ and $\_M_bF^1_{\_m_b}$ are not parallel (construction based assumption)
$S_{CAB} \neq 0$ i.e., points C, A and B are not collinear (foot is not the point itself; construction based assumption)
$S_{ACF^4_{\_h_c}} \neq S_{BCF^4_{\_h_c}}$ i.e., lines AB and $CF^4_{\_h_c}$ are not parallel (construction based assumption)

Total number of proof steps: 42
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving H_c=$\_H_c$

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_b=$\_M_b$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving H_c=_H_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 868 terms.

Time Complexity: Time spent by the prover is 1.020 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving M_b=_M_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 1108

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1108: Given a point M_c, a point N and a point H_c, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points M_c and N are not the same;
2. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
3. Choose freely a point H_c on the circle $k(N, M_a)$ (rule WOncircle);
4. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
5. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point M_c, construct a point E_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points M_c and E_c must be different;
6. Using the point E_c and the point H_c, construct a line h_c (rule W02); % DET: points E_c and H_c are not the same;
7. Choose freely a point A on the line c (rule WOnline1) ;
8. Using the point A and the point M_c, construct a point B (rule W01); ;
9. Using the point A and the point M_c, construct a circle $k(M_c, A)$ (rule W06); % NDG: points A and M_c are not the same;
10. Using the circle $k(N, M_a)$ and the circle $k(M_c, A)$, construct a point H_a and a point H_b (rule W07); % NDG: circles $k(N, M_a)$ and $k(M_c, A)$ intersect % DET: circles $k(N, M_a)$ and $k(M_c, A)$ are not the same;

11. Using the point A and the point H_a, construct a line h_a (rule W02); % DET: points A and H_a are not the same;

12. Using the line h_c and the line h_a, construct a point H (rule W03); % NDG: lines h_c and h_a are not parallel % DET: lines h_c and h_a are not the same;

13. Using the point N and the point H, construct a point G (rule W01); ;

14. Using the point M_c and the point G, construct a point C (rule W01); .

Non-degenerate conditions: lines h_c and h_a are not parallel; circles $k(N, M_a)$ and $k(M_c, A)$ intersect; points A and M_c are not the same; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points M_c and N are not the same.

Determination conditions: lines h_c and h_a are not the same; points A and H_a are not the same; circles $k(N, M_a)$ and $k(M_c, A)$ are not the same; points E_c and H_c are not the same; points M_c and E_c must be different; points H_c and M_c are not the same; points M_c and N are not the same.

Rules used: [W01,W02,W03,W05a,W06,W07,WOncircle1,WOnline1]

Lemmas used: [D10,D20,D3,D30,D32,D5,D7,D8,GD01,GD02,GL01,GL03,GL04,GL09,L16,L18,L19,L20,L24,L3

Solving time: 568.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{c} 50 67.5
point N 72.5 61.93
point H_{c} 68.91 84.83

color 220 0 0
fontsize 9

cmark_lt M_{c}
cmark_r N
cmark_rt H_{c}
color 0 0 0
fontsize 8

% DET: points M_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point M_{c} and point N
line m(H_{b}H_{a}) M_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
```

```
color 0 0 0



% Choosing randomly a point H_{c} on the circle with center N through point M_{c}
oncircle H_{c} N M_{c}
cmark_rt H_{c}
color 200 200 200
drawcircle N M_{c}
color 0 0 0


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points M_{c} and E_{c} must be
    different
% Constructing a point E_{c} which is an image of the point M_{c} in the symmetry to point/line N
sim E_{c} N M_{c}
cmark_r E_{c}


% DET: points E_{c} and H_{c} are not the same
% Constructing a line h_{c} which passes through point E_{c} and point H_{c}
line h_{c} E_{c} H_{c}

color 200 200 200
drawline h_{c}
color 0 0 0



% Choosing randomly a point A on the line H_{c}M_{c}
online A H_{c} M_{c}
cmark_t A
color 200 200 200
drawline H_{c} M_{c}
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0
```

```
% NDG: points A and M_{c} are not the same
% Constructing a circle k(M_{c},A) whose center is at point M_{c} and which passes through point A
circle k(M_{c},A) M_{c} A

color 200 200 200
drawcircle k(M_{c},A)
color 0 0 0



% NDG: circles k(N,M_{a}) and k(M_{c},A) intersect% DET: circles k(N,M_{a}) and k(M_{c},A) are not
    the same
% Constructing points H_{a} and H_{b} which are in intersection of k(N,M_{a}) and k(M_{c},A)
intersec2 H_{a} H_{b} k(N,M_{a}) k(M_{c},A)
cmark_r H_{a}
cmark_l H_{b}


% DET: points A and H_{a} are not the same
% Constructing a line h_{a} which passes through point A and point H_{a}
line h_{a} A H_{a}

color 200 200 200
drawline h_{a}
color 0 0 0



% NDG: lines h_{c} and h_{a} are not parallel% DET: lines h_{c} and h_{a} are not the same
% Constructing a point H which belongs to line h_{c} and line h_{a}
intersec H h_{c} h_{a}
cmark_rt H



% Constructing a line L_{\_G46118} which passes through point N and point H
line L_{\_G46118} N H

color 200 200 200
drawline L_{\_G46118}
color 0 0 0


% Constructing a point P_{\_G46219} with coordinates (0,0)
point P_{\_G46219} 0 0
cmark_r P_{\_G46219}

% Constructing a point P_{\_G46143} such that NP_{\_G46143}/NP_{\_G46219}=-1
towards P_{\_G46143} N P_{\_G46219} -1
cmark_r P_{\_G46143}
color 200 200 200
drawsegment P_{\_G46219} P_{\_G46143}
color 0 0 0
```

```
% Constructing a point P_{\_G46188} such that NP_{\_G46188}/NP_{\_G46219}=3
towards P_{\_G46188} N P_{\_G46219} 3
cmark_r P_{\_G46188}
color 200 200 200
drawsegment N P_{\_G46188}
color 0 0 0

% Constructing a line L_{\_G46149} which passes through point H and point P_{\_G46188}
line L_{\_G46149} H P_{\_G46188}

color 200 200 200
drawline L_{\_G46149}
color 0 0 0


% Constructing a line L_{\_G46112} which contains the point P_{\_G46143} and is parallel to the
    line L_{\_G46149}
parallel L_{\_G46112} P_{\_G46143} L_{\_G46149}

color 200 200 200
drawline L_{\_G46112}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G46112} and line L_{\_G46118}
intersec G L_{\_G46112} L_{\_G46118}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: lines h_{c} and h_{a} are not parallel; circles k(N,M_{a}) and k(M_{c
    },A) intersect; points A and M_{c} are not the same; line m(H_{b}H_{a}) and circle k(N,M_{a})
    intersect; points M_{c} and N are not the same
% Determination conditions: lines h_{c} and h_{a} are not the same; points A and H_{a} are not the
    same; circles k(N,M_{a}) and k(M_{c},A) are not the same; points E_{c} and H_{c} are not the
    same; points M_{c} and E_{c} must be different; points H_{c} and M_{c} are not the same; points
     M_{c} and N are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

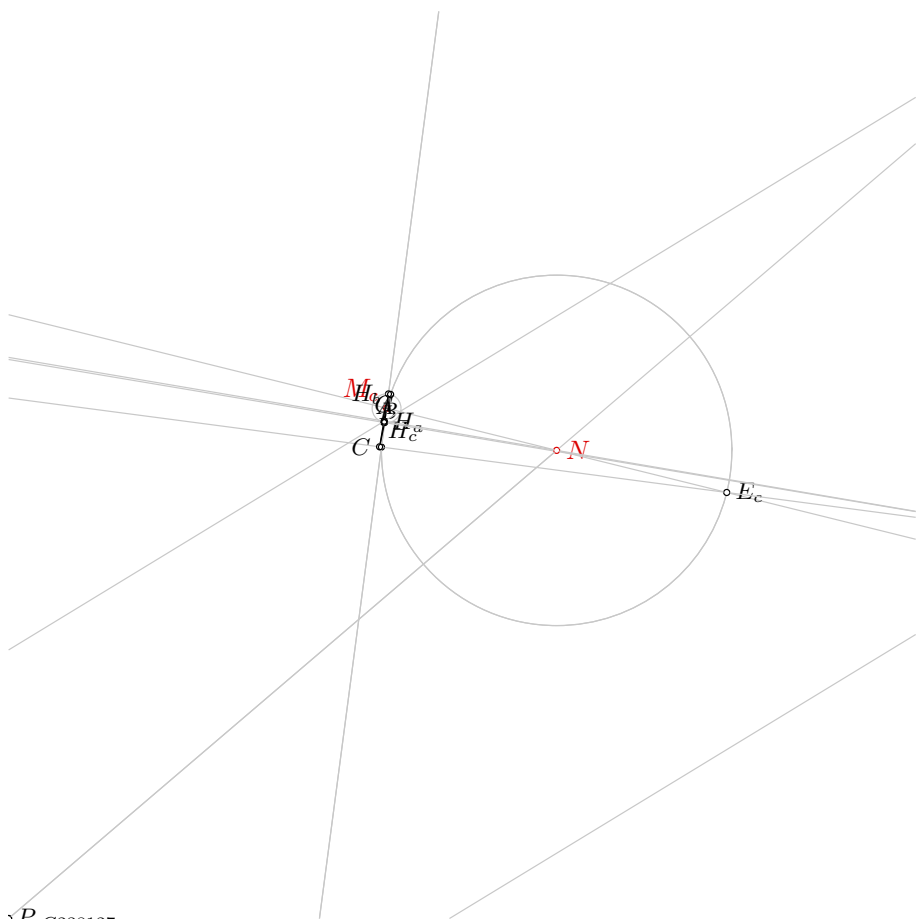

Figure 1: Illustration of the problem 1108

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 6 terms.

Time Complexity: Time spent by the prover is 0.112 seconds.

NDG conditions Points H_c and M_c are not identical

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving H_c=_H_c

Proving failed

4.2 GCLC - Area method

4.2.1 Proving M_c=_M_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving H_c=_H_c

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_c=_M_c

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.070 seconds.There are no ndg conditions.

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving H_c=_H_c

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_c=_M_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving H_c=_H_c

Proving failed

Problem 1109

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1109: Given a point H_c, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point N and the point O, construct a point H (rule W01); ;
3. Using the point H_c and the point H, construct a line h_c (rule W02); % DET: points H_c and H are not the same;
4. Using the point H_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points H_c and N are not the same;
5. Using the circle $k(N, M_a)$, the line h_c, the point N and the point H_c, construct a point E_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points H_c and E_c must be different;
6. Using the point E_c and the point H, construct a point C (rule W01); ;
7. Using the point G and the point C, construct a point M_c (rule W01); ;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points H_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points H_c and E_c must be different; points H_c and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L15,L21,L24,L3,L57]

Solving time: 5.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point H_{c} 68.91 84.83
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_rt H_{c}
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G88896} which passes through point N and point O
line L_{\_G88896} N O

color 200 200 200
drawline L_{\_G88896}
color 0 0 0


% Constructing a point P_{\_G88997} with coordinates (0,0)
point P_{\_G88997} 0 0
cmark_r P_{\_G88997}

% Constructing a point P_{\_G88921} such that NP_{\_G88921}/NP_{\_G88997}=1
towards P_{\_G88921} N P_{\_G88997} 1
cmark_r P_{\_G88921}
color 200 200 200
drawsegment N P_{\_G88921}
color 0 0 0

% Constructing a point P_{\_G88966} such that NP_{\_G88966}/NP_{\_G88997}=3
towards P_{\_G88966} N P_{\_G88997} 3
cmark_r P_{\_G88966}
color 200 200 200
drawsegment N P_{\_G88966}
color 0 0 0

% Constructing a line L_{\_G88927} which passes through point O and point P_{\_G88966}
line L_{\_G88927} O P_{\_G88966}
```

```
color 200 200 200
drawline L_{\_G88927}
color 0 0 0


% Constructing a line L_{\_G88890} which contains the point P_{\_G88921} and is parallel to the
    line L_{\_G88927}
parallel L_{\_G88890} P_{\_G88921} L_{\_G88927}

color 200 200 200
drawline L_{\_G88890}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G88890} and line L_{\_G88896}
intersec G L_{\_G88890} L_{\_G88896}
cmark_t G



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0


% DET: points H_{c} and H are not the same
% Constructing a line h_{c} which passes through point H_{c} and point H
line h_{c} H_{c} H

color 200 200 200
drawline h_{c}
color 0 0 0



% NDG: points H_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point H_{c}
circle k(N,M_{a}) N H_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points H_{c} and E_{c} must be different
% Constructing a point P_{\_G89824} which is a foot of the point N on the line h_{c}
foot P_{\_G89824} N h_{c}
cmark_r P_{\_G89824}
color 200 200 200
drawline N P_{\_G89824}
color 0 0 0
```

```
% Constructing a point E_{c} which is an image of the point H_{c} in the symmetry to point/line P
    _{\_G89824}
sim E_{c} P_{\_G89824} H_{c}
cmark_r E_{c}



% Constructing a point C such that E_{c}C/E_{c}H=-1
towards C E_{c} H -1
cmark_l C
color 200 200 200
drawsegment H C
color 0 0 0



% Constructing a point M_{c} such that GM_{c}/GC=-0.5
towards M_{c} G C -0.5
cmark_lt M_{c}
color 200 200 200
drawsegment C M_{c}
color 0 0 0


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

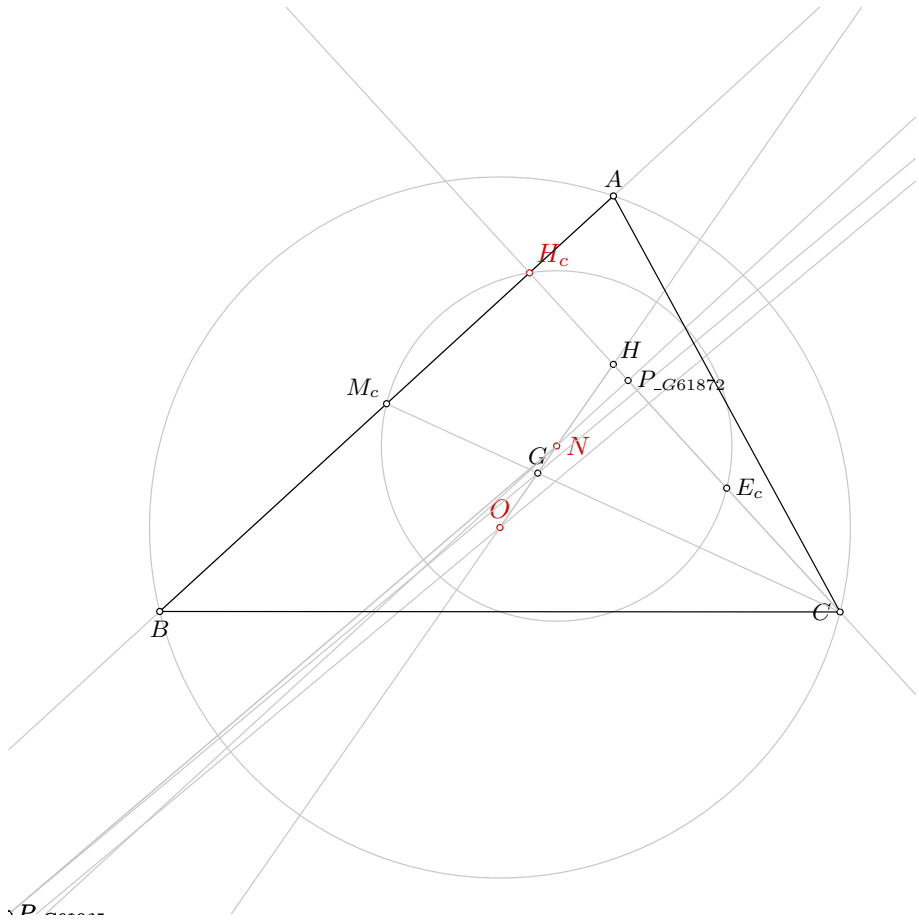

Figure 1: Illustration of the problem 1109

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points H_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points H_{c} and E_{c} must be
     different; points H_{c} and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving H_c=_H_c

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving O=_O

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3990 terms.

Time Complexity: Time spent by the prover is 9.077 seconds.

NDG conditions Points P_{G84194}, N and O are not collinear

Line through points H_c and N is not parallel with line through points P_{G84194} and O

Points H_c and H are not identical

Points H_c, N and H are not collinear

Points P_{G84695}, C and G are not collinear

Line through points H_c and N is not parallel with line through points C and P_{G84695}

Points H_c and M_c are not identical

Points H_c and M_c are not identical

Points A, B and C are not collinear

Line through points H_c and B is not perpendicular to line through points B and N

4.2 GCLC - Area method

4.2.1 Proving H_c=_H_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving H_c=_H_c

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving H_c=_H_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving O=_O

Proving failed

Problem 1110

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1110: Given a point H_c, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1111

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1111: Given a point H_c, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1112

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1112: Given a point H_c, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1113

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1113: Given a point I, a point M_a and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point I and the point M_a, construct a line IM_a (rule W02); % DET: points I and M_a are not the same;

2. Using the point M_a and the point N, construct a line $m(H_bH_c)$ (rule W02); % DET: points M_a and N are not the same;

3. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;

4. Using the circle $k(N, M_a)$, the line $m(H_bH_c)$, the point N and the point M_a, construct a point E_a (rule W05a); % NDG: line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_a and E_a must be different;

5. Using the point I and the point M_a, construct a circle $k_over(I, M_a)$ (rule W09); % NDG: points I and M_a are not the same;

6. Using the point I, the circle $k(N, M_a)$, the point N and the point M_a, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

7. Using the circle $k(I, P_a)$ and the circle $k_over(I, M_a)$, construct a point P_a and a point A_{fi} (rule W07); % NDG: circles $k(I, P_a)$ and $k_over(I, M_a)$ intersect % DET: circles $k(I, P_a)$ and $k_over(I, M_a)$ are not the same;

8. Using the point P_a and the point M_a, construct a point $P‘_a$ (rule W01); ;

9. Using the circle $k(I, P_a)$, the point M_a and the point I, construct a line $x1$ and a line a (rule W12); % NDG: point M_a is outside the circle $k(I, P_a)$;

10. Using the circle $k(N, M_a)$, the line a, the point N and the point M_a, construct a point H_a (rule W05); % NDG: line a and circle $k(N, M_a)$ intersect % DET: points M_a and H_a must be different;

11. Using the point H_a and the point E_a, construct a line h_a (rule W02); % DET: points H_a and E_a are not the same;

12. Using the point M_a and the line a, construct a line m_a (rule W10b); ;

13. Using the point $P`_a$ and the line $IM_a$, construct a line $AP`_a$ (rule W16); ;

14. Using the line $AP`_a$ and the line $h_a$, construct a point $A$ (rule W03); % NDG: lines $AP`_a$ and h_a are not parallel % DET: lines $AP`_a$ and h_a are not the same;

15. Using the point I and the point A, construct a line s_a (rule W02); % DET: points I and A are not the same;

16. Using the line m_a and the line s_a, construct a point N_a (rule W03); % NDG: lines m_a and s_a are not parallel % DET: lines m_a and s_a are not the same;

17. Using the point I and the point N_a, construct a circle $k(N_a, C)$ (rule W06); % NDG: points I and N_a are not the same;

18. Using the circle $k(N_a, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(N_a, C)$ intersect.

Non-degenerate conditions: line a and circle $k(N_a, C)$ intersect; points I and N_a are not the same; lines m_a and s_a are not parallel; lines $AP`_a$ and h_a are not parallel; line a and circle $k(N, M_a)$ intersect; point M_a is outside the circle $k(I, P_a)$; circles $k(I, P_a)$ and $k_over(I, M_a)$ intersect; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points I and M_a are not the same; line $m(H_bH_c)$ and circle $k(N, M_a)$ intersect; points M_a and N are not the same.

Determination conditions: lines m_a and s_a are not the same; points I and A are not the same; lines $AP`_a$ and h_a are not the same; points H_a and E_a are not the same; points M_a and H_a must be different; circles $k(I, P_a)$ and $k_over(I, M_a)$ are not the same; points M_a and E_a must be different; points M_a and N are not the same; points I and M_a are not the same.

Rules used: [W01,W02,W03,W04,W05,W05a,W06,W07,W09,W10b,W12,W16,W22]

Lemmas used: [D11,D2,D21,D27,D28,D3,D32,D47,D5,D65,D8,D85,GD01,GD02,GL01,GL03,GL09,L119,L19,L

Solving time: 52.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point I 74.37 61.15
point M_{a} 65 40
point N 72.5 61.93

color 220 0 0
fontsize 9
```

```
cmark_b I
cmark_r M_{a}
cmark_r N
color 0 0 0
fontsize 8

% DET: points I and M_{a} are not the same
% Constructing a line IM_{a} which passes through point I and point M_{a}
line IM_{a} I M_{a}

color 200 200 200
drawline IM_{a}
color 0 0 0



% DET: points M_{a} and N are not the same
% Constructing a line m(H_{b}H_{c}) which passes through point M_{a} and point N
line m(H_{b}H_{c}) M_{a} N

color 200 200 200
drawline m(H_{b}H_{c})
color 0 0 0



% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{b}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{a} and E_{a} must be
    different
% Constructing a point E_{a} which is an image of the point M_{a} in the symmetry to point/line N
sim E_{a} N M_{a}
cmark_r E_{a}


% NDG: points I and M_{a} are not the same
% Constructing midpoint P_{\_G170192} of the segment IM_{a}
midpoint P_{\_G170192} I M_{a}
cmark_r P_{\_G170192}

% Constructing a circle k_over(I,M_{a}) whose center is at point P_{\_G170192} and which passes
    through point I
circle k_over(I,M_{a}) P_{\_G170192} I

color 200 200 200
drawcircle k_over(I,M_{a})
color 0 0 0
```

```
% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G170378] from point N to point M_{a}
distance V[_G170378] N M_{a}


% Calculating distance V[_G170402] from point N to point I
distance V[_G170402] N I


% Calculating value V[_G170423] using formula V[_G170378]/V[_G170402]
expression V[_G170423] { V[_G170378]/V[_G170402] }


% Constructing a point P_{\_G170454} such that NP_{\_G170454}/NI=V[_G170378]/V[_G170402]
towards P_{\_G170454} N I V[_G170423]
cmark_r P_{\_G170454}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    170454}
circle k(I,P_{a}) I P_{\_G170454}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: circles k(I,P_{a}) and k_over(I,M_{a}) intersect% DET: circles k(I,P_{a}) and k_over(I,M_{a
    }) are not the same
% Constructing points P_{a} and A_{fi} which are in intersection of k(I,P_{a}) and k_over(I,M_{a})
intersec2 P_{a} A_{fi} k(I,P_{a}) k_over(I,M_{a})
cmark_r P_{a}
cmark_r A_{fi}



% Constructing a point P‘_{a} such that P_{a}P‘_{a}/P_{a}M_{a}=2
towards P‘_{a} P_{a} M_{a} 2
cmark_r P‘_{a}
color 200 200 200
drawsegment P_{a} P‘_{a}
color 0 0 0


% NDG: point M_{a} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G171060} of the segment M_{a}I
midpoint P_{\_G171060} M_{a} I
cmark_r P_{\_G171060}

% Constructing a circle C_{\_G171063} whose center is at point P_{\_G171060} and which passes
    through point M_{a}
circle C_{\_G171063} P_{\_G171060} M_{a}

color 200 200 200
```

```
drawcircle C_{\_G171063}
color 0 0 0


% Constructing points P_{\_G171066} and P_{\_G171069} which are in intersection of C_{\_G171063}
    and k(I,P_{a})
intersec2 P_{\_G171066} P_{\_G171069} C_{\_G171063} k(I,P_{a})
cmark_r P_{\_G171066}
cmark_r P_{\_G171069}

% Constructing a line x1 which passes through point M_{a} and point P_{\_G171066}
line x1 M_{a} P_{\_G171066}

color 200 200 200
drawline x1
color 0 0 0


% Constructing a line a which passes through point M_{a} and point P_{\_G171069}
line a M_{a} P_{\_G171069}

color 200 200 200
drawline a
color 0 0 0



% NDG: line a and circle k(N,M_{a}) intersect% DET: points M_{a} and H_{a} must be different
% Constructing a point P_{\_G171403} which is a foot of the point N on the line a
foot P_{\_G171403} N a
cmark_r P_{\_G171403}
color 200 200 200
drawline N P_{\_G171403}
color 0 0 0

% Constructing a point H_{a} which is an image of the point M_{a} in the symmetry to point/line P
    _{\_G171403}
sim H_{a} P_{\_G171403} M_{a}
cmark_r H_{a}


% DET: points H_{a} and E_{a} are not the same
% Constructing a line h_{a} which passes through point H_{a} and point E_{a}
line h_{a} H_{a} E_{a}

color 200 200 200
drawline h_{a}
color 0 0 0




% Constructing a line m_{a} which is perpendicular to line a and which passes through point M_{a}
perp m_{a} M_{a} a

color 200 200 200
```

```
drawline m_{a}
color 0 0 0



% Constructing a line AP‘_{a} which contains the point P‘_{a} and is parallel to the line IM_{a}
parallel AP‘_{a} P‘_{a} IM_{a}

color 200 200 200
drawline AP‘_{a}
color 0 0 0



% NDG: lines AP‘_{a} and h_{a} are not parallel% DET: lines AP‘_{a} and h_{a} are not the same
% Constructing a point A which belongs to line AP‘_{a} and line h_{a}
intersec A AP‘_{a} h_{a}
cmark_t A


% DET: points I and A are not the same
% Constructing a line s_{a} which passes through point I and point A
line s_{a} I A

color 200 200 200
drawline s_{a}
color 0 0 0



% NDG: lines m_{a} and s_{a} are not parallel% DET: lines m_{a} and s_{a} are not the same
% Constructing a point N_{a} which belongs to line m_{a} and line s_{a}
intersec N_{a} m_{a} s_{a}
cmark_b N_{a}


% NDG: points I and N_{a} are not the same
% Constructing a circle k(N_{a},C) whose center is at point N_{a} and which passes through point I
circle k(N_{a},C) N_{a} I

color 200 200 200
drawcircle k(N_{a},C)
color 0 0 0



% NDG: line a and circle k(N_{a},C) intersect
% Constructing points C and B which are in intersection of k(N_{a},C) and a
intersec2 C B k(N_{a},C) a
cmark_l C
cmark_b B



drawsegment A B
```

Figure 1: Illustration of the problem 1113

```
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line a and circle k(N_{a},C) intersect; points I and N_{a} are not the
     same; lines m_{a} and s_{a} are not parallel; lines AP'_{a} and h_{a} are not parallel; line a
     and circle k(N,M_{a}) intersect; point M_{a} is outside the circle k(I,P_{a}); circles k(I,P_{
    a}) and k_over(I,M_{a}) intersect; point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points I and M_{a} are not the same; line m(H_{b}H_{c}) and circle k(N,M_{a})
    intersect; points M_{a} and N are not the same
% Determination conditions: lines m_{a} and s_{a} are not the same; points I and A are not the same
    ; lines AP'_{a} and h_{a} are not the same; points H_{a} and E_{a} are not the same; points M_{
    a} and H_{a} must be different; circles k(I,P_{a}) and k_over(I,M_{a}) are not the same; points
     M_{a} and E_{a} must be different; points M_{a} and N are not the same; points I and M_{a} are
     not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving I=_I

Proving failed

4.1.2 Proving M_a=_M_a

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving I=_I

Proving failed

4.2.2 Proving M_a=_M_a

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving I=_I

Proving failed

4.3.2 Proving M_a=_M_a

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving I=_I

Proving failed

4.4.2 Proving M_a=_M_a

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1114

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1114: Given a point I, a point M_b and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point I and the point M_b, construct a line IM_b (rule W02); % DET: points I and M_b are not the same;

2. Using the point M_b and the point N, construct a line $m(H_aH_c)$ (rule W02); % DET: points M_b and N are not the same;

3. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;

4. Using the circle $k(N, M_a)$, the line $m(H_aH_c)$, the point N and the point M_b, construct a point E_b (rule W05a); % NDG: line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect % DET: points M_b and E_b must be different;

5. Using the point I and the point M_b, construct a circle $k_over(I, M_b)$ (rule W09); % NDG: points I and M_b are not the same;

6. Using the point I, the circle $k(N, M_a)$, the point N and the point M_b, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

7. Using the circle $k(I, P_a)$ and the circle $k_over(I, M_b)$, construct a point B_{fi} and a point P_b (rule W07); % NDG: circles $k(I, P_a)$ and $k_over(I, M_b)$ intersect % DET: circles $k(I, P_a)$ and $k_over(I, M_b)$ are not the same;

8. Using the point P_b and the point M_b, construct a point $P`_b$ (rule W01); ;

9. Using the circle $k(I, P_a)$, the point M_b and the point I, construct a line $x2$ and a line b (rule W12); % NDG: point M_b is outside the circle $k(I, P_a)$;

10. Using the circle $k(N, M_a)$, the line b, the point N and the point M_b, construct a point H_b (rule W05); % NDG: line b and circle $k(N, M_a)$ intersect % DET: points M_b and H_b must be different;

11. Using the point H_b and the point E_b, construct a line h_b (rule W02); % DET: points H_b and E_b are not the same;

12. Using the point M_b and the line b, construct a line m_b (rule W10b); ;

13. Using the point $P`_b$ and the line $IM_b$, construct a line $BP`_b$ (rule W16); ;

14. Using the line $BP`_b$ and the line $h_b$, construct a point $B$ (rule W03); % NDG: lines $BP`_b$ and h_b are not parallel % DET: lines $BP`_b$ and h_b are not the same;

15. Using the point I and the point B, construct a line s_b (rule W02); % DET: points I and B are not the same;

16. Using the line m_b and the line s_b, construct a point N_b (rule W03); % NDG: lines m_b and s_b are not parallel % DET: lines m_b and s_b are not the same;

17. Using the point I and the point N_b, construct a circle $k(N_b, A)$ (rule W06); % NDG: points I and N_b are not the same;

18. Using the circle $k(N_b, A)$ and the line b, construct a point A and a point C (rule W04); % NDG: line b and circle $k(N_b, A)$ intersect.

Non-degenerate conditions: line b and circle $k(N_b, A)$ intersect; points I and N_b are not the same; lines m_b and s_b are not parallel; lines $BP`_b$ and h_b are not parallel; line b and circle $k(N, M_a)$ intersect; point M_b is outside the circle $k(I, P_a)$; circles $k(I, P_a)$ and $k_over(I, M_b)$ intersect; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points I and M_b are not the same; line $m(H_aH_c)$ and circle $k(N, M_a)$ intersect; points M_b and N are not the same.

Determination conditions: lines m_b and s_b are not the same; points I and B are not the same; lines $BP`_b$ and h_b are not the same; points H_b and E_b are not the same; points M_b and H_b must be different; circles $k(I, P_a)$ and $k_over(I, M_b)$ are not the same; points M_b and E_b must be different; points M_b and N are not the same; points I and M_b are not the same.

Rules used: [W01,W02,W03,W04,W05,W05a,W06,W07,W09,W10b,W12,W16,W22]

Lemmas used: [D12,D2,D22,D27,D29,D3,D32,D48,D6,D66,D86,D9,GD01,GD02,GL01,GL03,GL09,L119,L13,L

Solving time: 52.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point I 74.37 61.15
point M_{b} 95 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9
```

```
cmark_b I
cmark_lt M_{b}
cmark_r N
color 0 0 0
fontsize 8

% DET: points I and M_{b} are not the same
% Constructing a line IM_{b} which passes through point I and point M_{b}
line IM_{b} I M_{b}

color 200 200 200
drawline IM_{b}
color 0 0 0



% DET: points M_{b} and N are not the same
% Constructing a line m(H_{a}H_{c}) which passes through point M_{b} and point N
line m(H_{a}H_{c}) M_{b} N

color 200 200 200
drawline m(H_{a}H_{c})
color 0 0 0



% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{a}H_{c}) and circle k(N,M_{a}) intersect% DET: points M_{b} and E_{b} must be
    different
% Constructing a point E_{b} which is an image of the point M_{b} in the symmetry to point/line N
sim E_{b} N M_{b}
cmark_r E_{b}


% NDG: points I and M_{b} are not the same
% Constructing midpoint P_{\_G226156} of the segment IM_{b}
midpoint P_{\_G226156} I M_{b}
cmark_r P_{\_G226156}

% Constructing a circle k_over(I,M_{b}) whose center is at point P_{\_G226156} and which passes
    through point I
circle k_over(I,M_{b}) P_{\_G226156} I

color 200 200 200
drawcircle k_over(I,M_{b})
color 0 0 0
```

```
% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G226342] from point N to point M_{b}
distance V[_G226342] N M_{b}


% Calculating distance V[_G226366] from point N to point I
distance V[_G226366] N I


% Calculating value V[_G226387] using formula V[_G226342]/V[_G226366]
expression V[_G226387] { V[_G226342]/V[_G226366] }


% Constructing a point P_{\_G226418} such that NP_{\_G226418}/NI=V[_G226342]/V[_G226366]
towards P_{\_G226418} N I V[_G226387]
cmark_r P_{\_G226418}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    226418}
circle k(I,P_{a}) I P_{\_G226418}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: circles k(I,P_{a}) and k_over(I,M_{b}) intersect% DET: circles k(I,P_{a}) and k_over(I,M_{b
    }) are not the same
% Constructing points B_{fi} and P_{b} which are in intersection of k(I,P_{a}) and k_over(I,M_{b})
intersec2 B_{fi} P_{b} k(I,P_{a}) k_over(I,M_{b})
cmark_r B_{fi}
cmark_r P_{b}



% Constructing a point P‘_{b} such that P_{b}P‘_{b}/P_{b}M_{b}=2
towards P‘_{b} P_{b} M_{b} 2
cmark_r P‘_{b}
color 200 200 200
drawsegment P_{b} P‘_{b}
color 0 0 0


% NDG: point M_{b} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G227024} of the segment M_{b}I
midpoint P_{\_G227024} M_{b} I
cmark_r P_{\_G227024}

% Constructing a circle C_{\_G227027} whose center is at point P_{\_G227024} and which passes
    through point M_{b}
circle C_{\_G227027} P_{\_G227024} M_{b}

color 200 200 200
```

```
drawcircle C_{\_G227027}
color 0 0 0


% Constructing points P_{\_G227030} and P_{\_G227033} which are in intersection of C_{\_G227027}
    and k(I,P_{a})
intersec2 P_{\_G227030} P_{\_G227033} C_{\_G227027} k(I,P_{a})
cmark_r P_{\_G227030}
cmark_r P_{\_G227033}

% Constructing a line x2 which passes through point M_{b} and point P_{\_G227030}
line x2 M_{b} P_{\_G227030}

color 200 200 200
drawline x2
color 0 0 0


% Constructing a line b which passes through point M_{b} and point P_{\_G227033}
line b M_{b} P_{\_G227033}

color 200 200 200
drawline b
color 0 0 0



% NDG: line b and circle k(N,M_{a}) intersect% DET: points M_{b} and H_{b} must be different
% Constructing a point P_{\_G227367} which is a foot of the point N on the line b
foot P_{\_G227367} N b
cmark_r P_{\_G227367}
color 200 200 200
drawline N P_{\_G227367}
color 0 0 0

% Constructing a point H_{b} which is an image of the point M_{b} in the symmetry to point/line P
    _{\_G227367}
sim H_{b} P_{\_G227367} M_{b}
cmark_l H_{b}


% DET: points H_{b} and E_{b} are not the same
% Constructing a line h_{b} which passes through point H_{b} and point E_{b}
line h_{b} H_{b} E_{b}

color 200 200 200
drawline h_{b}
color 0 0 0




% Constructing a line m_{b} which is perpendicular to line b and which passes through point M_{b}
perp m_{b} M_{b} b

color 200 200 200
```

```
drawline m_{b}
color 0 0 0



% Constructing a line BP‘_{b} which contains the point P‘_{b} and is parallel to the line IM_{b}
parallel BP‘_{b} P‘_{b} IM_{b}

color 200 200 200
drawline BP‘_{b}
color 0 0 0



% NDG: lines BP‘_{b} and h_{b} are not parallel% DET: lines BP‘_{b} and h_{b} are not the same
% Constructing a point B which belongs to line BP‘_{b} and line h_{b}
intersec B BP‘_{b} h_{b}
cmark_b B


% DET: points I and B are not the same
% Constructing a line s_{b} which passes through point I and point B
line s_{b} I B

color 200 200 200
drawline s_{b}
color 0 0 0



% NDG: lines m_{b} and s_{b} are not parallel% DET: lines m_{b} and s_{b} are not the same
% Constructing a point N_{b} which belongs to line m_{b} and line s_{b}
intersec N_{b} m_{b} s_{b}
cmark_rb N_{b}


% NDG: points I and N_{b} are not the same
% Constructing a circle k(N_{b},A) whose center is at point N_{b} and which passes through point I
circle k(N_{b},A) N_{b} I

color 200 200 200
drawcircle k(N_{b},A)
color 0 0 0



% NDG: line b and circle k(N_{b},A) intersect
% Constructing points A and C which are in intersection of k(N_{b},A) and b
intersec2 A C k(N_{b},A) b
cmark_t A
cmark_l C



drawsegment A B
```

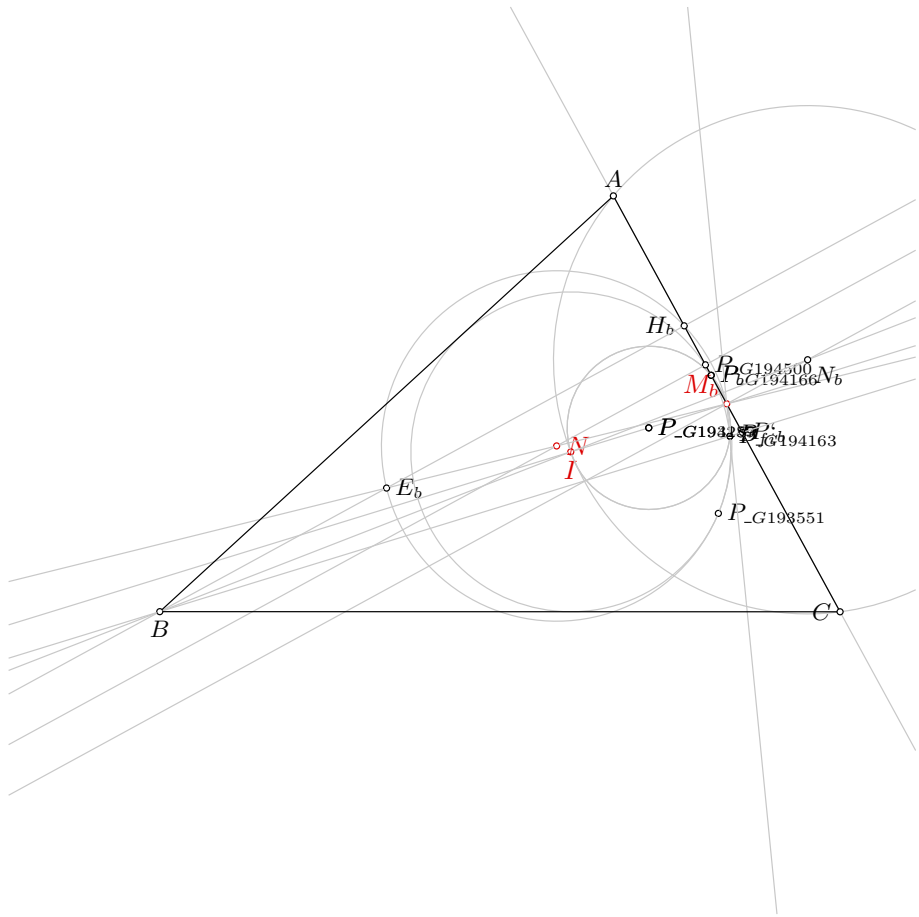

Figure 1: Illustration of the problem 1114

```
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line b and circle k(N_{b},A) intersect; points I and N_{b} are not the
     same; lines m_{b} and s_{b} are not parallel; lines BP'_{b} and h_{b} are not parallel; line b
     and circle k(N,M_{a}) intersect; point M_{b} is outside the circle k(I,P_{a}); circles k(I,P_{
    a}) and k_over(I,M_{b}) intersect; point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points I and M_{b} are not the same; line m(H_{a}H_{c}) and circle k(N,M_{a})
    intersect; points M_{b} and N are not the same
% Determination conditions: lines m_{b} and s_{b} are not the same; points I and B are not the same
    ; lines BP'_{b} and h_{b} are not the same; points H_{b} and E_{b} are not the same; points M_{
    b} and H_{b} must be different; circles k(I,P_{a}) and k_over(I,M_{b}) are not the same; points
     M_{b} and E_{b} must be different; points M_{b} and N are not the same; points I and M_{b} are
     not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving I=_I

Proving failed

4.1.2 Proving M_b=_M_b

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving I=_I

Proving failed

4.2.2 Proving M_b=_M_b

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving I=_I

Proving failed

4.3.2 Proving M_b=_M_b

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving I=_I

Proving failed

4.4.2 Proving M_b=_M_b

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1115

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1115: Given a point I, a point M_c and a point N, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point I and the point M_c, construct a line IM_c (rule W02); % DET: points I and M_c are not the same;

2. Using the point M_c and the point N, construct a line $m(H_bH_a)$ (rule W02); % DET: points M_c and N are not the same;

3. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;

4. Using the circle $k(N, M_a)$, the line $m(H_bH_a)$, the point N and the point M_c, construct a point E_c (rule W05a); % NDG: line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect % DET: points M_c and E_c must be different;

5. Using the point I and the point M_c, construct a circle $k_over(I, M_c)$ (rule W09); % NDG: points I and M_c are not the same;

6. Using the point I, the circle $k(N, M_a)$, the point N and the point M_c, construct a circle $k(I, P_a)$ (rule W22); % NDG: point I is inside the circle $k(N, M_a)$; points I and N are not the same;

7. Using the circle $k(I, P_a)$ and the circle $k_over(I, M_c)$, construct a point C_{fi} and a point P_c (rule W07); % NDG: circles $k(I, P_a)$ and $k_over(I, M_c)$ intersect % DET: circles $k(I, P_a)$ and $k_over(I, M_c)$ are not the same;

8. Using the point P_c and the point M_c, construct a point $P`_c$ (rule W01); ;

9. Using the circle $k(I, P_a)$, the point M_c and the point I, construct a line $x3$ and a line c (rule W12); % NDG: point M_c is outside the circle $k(I, P_a)$;

10. Using the circle $k(N, M_a)$, the line c, the point N and the point M_c, construct a point H_c (rule W05); % NDG: line c and circle $k(N, M_a)$ intersect % DET: points M_c and H_c must be different;

11. Using the point H_c and the point E_c, construct a line h_c (rule W02); % DET: points H_c and E_c are not the same;

12. Using the point M_c and the line c, construct a line m_c (rule W10b); ;

13. Using the point $P`_c$ and the line $IM_c$, construct a line $CP`_c$ (rule W16); ;

14. Using the line $CP`_c$ and the line $h_c$, construct a point $C$ (rule W03); % NDG: lines $CP`_c$ and h_c are not parallel % DET: lines $CP`_c$ and h_c are not the same;

15. Using the point I and the point C, construct a line s_c (rule W02); % DET: points I and C are not the same;

16. Using the line m_c and the line s_c, construct a point N_c (rule W03); % NDG: lines m_c and s_c are not parallel % DET: lines m_c and s_c are not the same;

17. Using the point I and the point N_c, construct a circle $k(N_c, B)$ (rule W06); % NDG: points I and N_c are not the same;

18. Using the circle $k(N_c, B)$ and the line c, construct a point B and a point A (rule W04); % NDG: line c and circle $k(N_c, B)$ intersect.

Non-degenerate conditions: line c and circle $k(N_c, B)$ intersect; points I and N_c are not the same; lines m_c and s_c are not parallel; lines $CP`_c$ and h_c are not parallel; line c and circle $k(N, M_a)$ intersect; point M_c is outside the circle $k(I, P_a)$; circles $k(I, P_a)$ and $k_over(I, M_c)$ intersect; point I is inside the circle $k(N, M_a)$; points I and N are not the same; points I and M_c are not the same; line $m(H_bH_a)$ and circle $k(N, M_a)$ intersect; points M_c and N are not the same.

Determination conditions: lines m_c and s_c are not the same; points I and C are not the same; lines $CP`_c$ and h_c are not the same; points H_c and E_c are not the same; points M_c and H_c must be different; circles $k(I, P_a)$ and $k_over(I, M_c)$ are not the same; points M_c and E_c must be different; points M_c and N are not the same; points I and M_c are not the same.

Rules used: [W01,W02,W03,W04,W05,W05a,W06,W07,W09,W10b,W12,W16,W22]

Lemmas used: [D10,D13,D20,D27,D30,D32,D49,D67,D7,D87,GD01,GD02,GL01,GL03,GL09,L119,L14,L18,L19

Solving time: 52.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point I 74.37 61.15
point M_{c} 50 67.5
point N 72.5 61.93

color 220 0 0
fontsize 9
```

```
cmark_b I
cmark_lt M_{c}
cmark_r N
color 0 0 0
fontsize 8

% DET: points I and M_{c} are not the same
% Constructing a line IM_{c} which passes through point I and point M_{c}
line IM_{c} I M_{c}

color 200 200 200
drawline IM_{c}
color 0 0 0



% DET: points M_{c} and N are not the same
% Constructing a line m(H_{b}H_{a}) which passes through point M_{c} and point N
line m(H_{b}H_{a}) M_{c} N

color 200 200 200
drawline m(H_{b}H_{a})
color 0 0 0



% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line m(H_{b}H_{a}) and circle k(N,M_{a}) intersect% DET: points M_{c} and E_{c} must be
    different
% Constructing a point E_{c} which is an image of the point M_{c} in the symmetry to point/line N
sim E_{c} N M_{c}
cmark_r E_{c}


% NDG: points I and M_{c} are not the same
% Constructing midpoint P_{\_G69510} of the segment IM_{c}
midpoint P_{\_G69510} I M_{c}
cmark_r P_{\_G69510}

% Constructing a circle k_over(I,M_{c}) whose center is at point P_{\_G69510} and which passes
    through point I
circle k_over(I,M_{c}) P_{\_G69510} I

color 200 200 200
drawcircle k_over(I,M_{c})
color 0 0 0
```

```
% NDG: point I is inside the circle k(N,M_{a}); points I and N are not the same
% Calculating distance V[_G69696] from point N to point M_{c}
distance V[_G69696] N M_{c}


% Calculating distance V[_G69720] from point N to point I
distance V[_G69720] N I


% Calculating value V[_G69741] using formula V[_G69696]/V[_G69720]
expression V[_G69741] { V[_G69696]/V[_G69720] }


% Constructing a point P_{\_G69772} such that NP_{\_G69772}/NI=V[_G69696]/V[_G69720]
towards P_{\_G69772} N I V[_G69741]
cmark_r P_{\_G69772}

% Constructing a circle k(I,P_{a}) whose center is at point I and which passes through point P_{\_G
    69772}
circle k(I,P_{a}) I P_{\_G69772}

color 200 200 200
drawcircle k(I,P_{a})
color 0 0 0



% NDG: circles k(I,P_{a}) and k_over(I,M_{c}) intersect% DET: circles k(I,P_{a}) and k_over(I,M_{c
    }) are not the same
% Constructing points C_{fi} and P_{c} which are in intersection of k(I,P_{a}) and k_over(I,M_{c})
intersec2 C_{fi} P_{c} k(I,P_{a}) k_over(I,M_{c})
cmark_r C_{fi}
cmark_r P_{c}



% Constructing a point P‘_{c} such that P_{c}P‘_{c}/P_{c}M_{c}=2
towards P‘_{c} P_{c} M_{c} 2
cmark_r P‘_{c}
color 200 200 200
drawsegment P_{c} P‘_{c}
color 0 0 0


% NDG: point M_{c} is outside the circle k(I,P_{a})
% Constructing midpoint P_{\_G70377} of the segment M_{c}I
midpoint P_{\_G70377} M_{c} I
cmark_r P_{\_G70377}

% Constructing a circle C_{\_G70380} whose center is at point P_{\_G70377} and which passes through
     point M_{c}
circle C_{\_G70380} P_{\_G70377} M_{c}

color 200 200 200
```

```
drawcircle C_{\_G70380}
color 0 0 0


% Constructing points P_{\_G70383} and P_{\_G70386} which are in intersection of C_{\_G70380} and k
    (I,P_{a})
intersec2 P_{\_G70383} P_{\_G70386} C_{\_G70380} k(I,P_{a})
cmark_r P_{\_G70383}
cmark_r P_{\_G70386}

% Constructing a line x3 which passes through point M_{c} and point P_{\_G70383}
line x3 M_{c} P_{\_G70383}

color 200 200 200
drawline x3
color 0 0 0


% Constructing a line c which passes through point M_{c} and point P_{\_G70386}
line c M_{c} P_{\_G70386}

color 200 200 200
drawline c
color 0 0 0



% NDG: line c and circle k(N,M_{a}) intersect% DET: points M_{c} and H_{c} must be different
% Constructing a point P_{\_G70720} which is a foot of the point N on the line c
foot P_{\_G70720} N c
cmark_r P_{\_G70720}
color 200 200 200
drawline N P_{\_G70720}
color 0 0 0

% Constructing a point H_{c} which is an image of the point M_{c} in the symmetry to point/line P
    _{\_G70720}
sim H_{c} P_{\_G70720} M_{c}
cmark_rt H_{c}


% DET: points H_{c} and E_{c} are not the same
% Constructing a line h_{c} which passes through point H_{c} and point E_{c}
line h_{c} H_{c} E_{c}

color 200 200 200
drawline h_{c}
color 0 0 0




% Constructing a line m_{c} which is perpendicular to line c and which passes through point M_{c}
perp m_{c} M_{c} c

color 200 200 200
```

```
drawline m_{c}
color 0 0 0



% Constructing a line CP‘_{c} which contains the point P‘_{c} and is parallel to the line IM_{c}
parallel CP‘_{c} P‘_{c} IM_{c}

color 200 200 200
drawline CP‘_{c}
color 0 0 0



% NDG: lines CP‘_{c} and h_{c} are not parallel% DET: lines CP‘_{c} and h_{c} are not the same
% Constructing a point C which belongs to line CP‘_{c} and line h_{c}
intersec C CP‘_{c} h_{c}
cmark_l C


% DET: points I and C are not the same
% Constructing a line s_{c} which passes through point I and point C
line s_{c} I C

color 200 200 200
drawline s_{c}
color 0 0 0



% NDG: lines m_{c} and s_{c} are not parallel% DET: lines m_{c} and s_{c} are not the same
% Constructing a point N_{c} which belongs to line m_{c} and line s_{c}
intersec N_{c} m_{c} s_{c}
cmark_b N_{c}


% NDG: points I and N_{c} are not the same
% Constructing a circle k(N_{c},B) whose center is at point N_{c} and which passes through point I
circle k(N_{c},B) N_{c} I

color 200 200 200
drawcircle k(N_{c},B)
color 0 0 0



% NDG: line c and circle k(N_{c},B) intersect
% Constructing points B and A which are in intersection of k(N_{c},B) and c
intersec2 B A k(N_{c},B) c
cmark_b B
cmark_t A



drawsegment A B
```

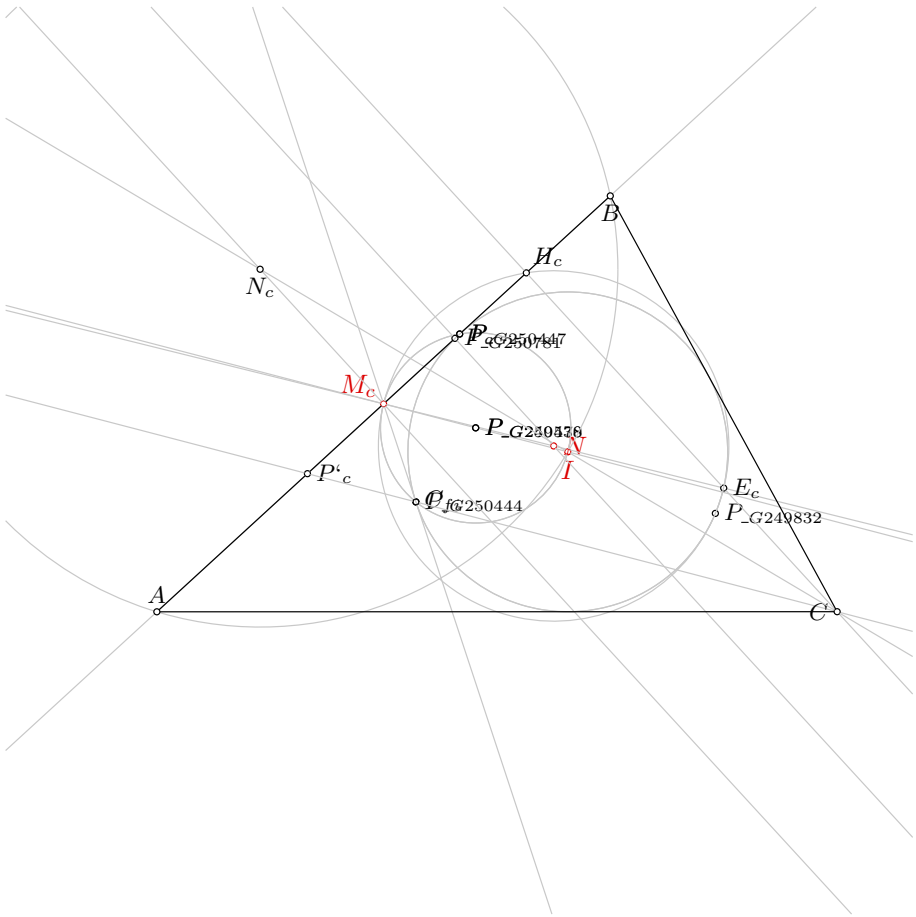

Figure 1: Illustration of the problem 1115

```
drawsegment A C
drawsegment B C

% Non-degenerate conditions: line c and circle k(N_{c},B) intersect; points I and N_{c} are not the
     same; lines m_{c} and s_{c} are not parallel; lines CP‘_{c} and h_{c} are not parallel; line c
     and circle k(N,M_{a}) intersect; point M_{c} is outside the circle k(I,P_{a}); circles k(I,P_{
    a}) and k_over(I,M_{c}) intersect; point I is inside the circle k(N,M_{a}); points I and N are
    not the same; points I and M_{c} are not the same; line m(H_{b}H_{a}) and circle k(N,M_{a})
    intersect; points M_{c} and N are not the same
% Determination conditions: lines m_{c} and s_{c} are not the same; points I and C are not the same
    ; lines CP‘_{c} and h_{c} are not the same; points H_{c} and E_{c} are not the same; points M_{
    c} and H_{c} must be different; circles k(I,P_{a}) and k_over(I,M_{c}) are not the same; points
     M_{c} and E_{c} must be different; points M_{c} and N are not the same; points I and M_{c} are
     not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving I=_I

Proving failed

4.1.2 Proving M_c=_M_c

Proving failed

4.1.3 Proving N=_N

Proving failed

4.2 GCLC - Area method

4.2.1 Proving I=_I

Proving failed

4.2.2 Proving M_c=_M_c

Proving failed

4.2.3 Proving N=_N

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving I=_I

Proving failed

4.3.2 Proving M_c=_M_c

Proving failed

4.3.3 Proving N=_N

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving I=_I

Proving failed

4.4.2 Proving M_c=_M_c

Proving failed

4.4.3 Proving N=_N

Proving failed

Problem 1116

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1116: Given a point I, a point N and a point O, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1117

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1117: Given a point I, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1118

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1118: Given a point I, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1119

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1119: Given a point I, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1120

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1120: Given a point M_b, a point N and a point M_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
2. Choose freely a point M_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Choose freely a point A (rule free);
4. Using the point A and the point M_b, construct a point C (rule W01); ;
5. Using the point M_a and the point C, construct a point B (rule W01); .

Non-degenerate conditions: points M_b and N are not the same.
Determination conditions: .
Rules used: [W01,W06,WOncircle1,free]
Lemmas used: [D21,D22,D32,GL03,GL04,L17]
Solving time: 149.1 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{b} 95 67.5
point N 72.5 61.93
point M_{a} 65 40

color 220 0 0
fontsize 9
```

```
cmark_lt M_{b}
cmark_r N
cmark_r M_{a}
color 0 0 0
fontsize 8

% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point M_{a} on the circle with center N through point M_{b}
oncircle M_{a} N M_{b}
cmark_r M_{a}
color 200 200 200
drawcircle N M_{b}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point B such that M_{a}B/M_{a}C=-1
towards B M_{a} C -1
cmark_b B
color 200 200 200
drawsegment C B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points M_{b} and N are not the same
```

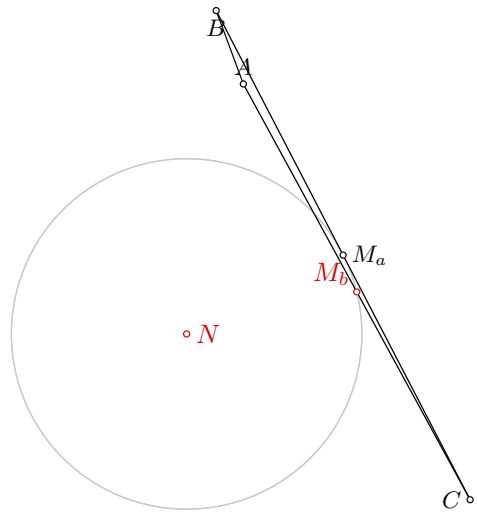

Figure 1: Illustration of the problem 1120

```
% Determination conditions:
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_b=_M_b

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.051 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving M_a=$\_M_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 12 terms.

Time Complexity: Time spent by the prover is 0.148 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving M_b=$\_M_b$

NDG conditions are:

$S_{\_M_a BC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_b AC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a} BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a \_M_b F^1_{\_m_b}} \neq S_{F^0_{\_m_a} \_M_b F^1_{\_m_b}}$ i.e., lines $\_M_a F^0_{\_m_a}$ and $\_M_b F^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 42
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving M_a=$\_M_a$

NDG conditions are:

$S_{\_M_a BC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_b AC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a} BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a \_M_b F^1_{\_m_b}} \neq S_{F^0_{\_m_a} \_M_b F^1_{\_m_b}}$ i.e., lines $\_M_a F^0_{\_m_a}$ and $\_M_b F^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 44
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving M_b=$\_M_b$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 28 terms.

Time Complexity: Time spent by the prover is 0.060 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving M_b=_M_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 1121

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1121: Given a point M_c, a point N and a point M_a, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
2. Choose freely a point M_a on the circle $k(N, M_a)$ (rule WOncircle);
3. Choose freely a point A (rule free);
4. Using the point A and the point M_c, construct a point B (rule W01); ;
5. Using the point M_a and the point B, construct a point C (rule W01); .

Non-degenerate conditions: points M_c and N are not the same.
Determination conditions: .
Rules used: [W01,W06,WOncircle1,free]
Lemmas used: [D20,D21,D32,GL03,GL04,L18]
Solving time: 150.5 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{c} 50 67.5
point N 72.5 61.93
point M_{a} 65 40

color 220 0 0
fontsize 9
```

```
cmark_lt M_{c}
cmark_r N
cmark_r M_{a}
color 0 0 0
fontsize 8

% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point M_{a} on the circle with center N through point M_{c}
oncircle M_{a} N M_{c}
cmark_r M_{a}
color 200 200 200
drawcircle N M_{c}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



% Constructing a point C such that M_{a}C/M_{a}B=-1
towards C M_{a} B -1
cmark_l C
color 200 200 200
drawsegment B C
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points M_{c} and N are not the same
```

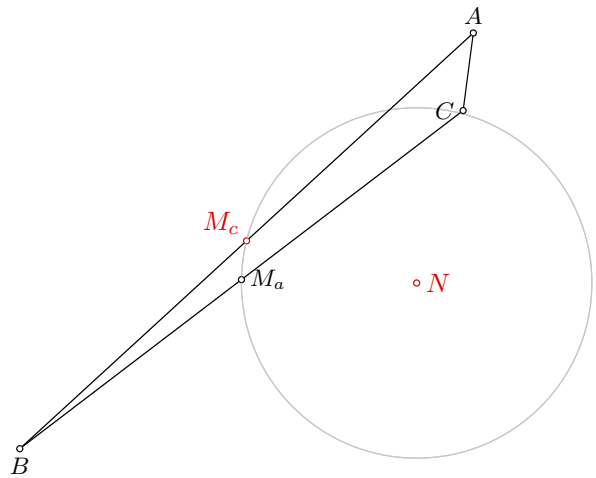

Figure 1: Illustration of the problem 1121

```
% Determination conditions:
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.055 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving M_a=$\_M_a$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 12 terms.

Time Complexity: Time spent by the prover is 0.157 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving M_c=$\_M_c$

NDG conditions are:

$S_{\_M_a BC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_b AC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a} BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a \_M_b F^1_{\_m_b}} \neq S_{F^0_{\_m_a} \_M_b F^1_{\_m_b}}$ i.e., lines $\_M_a F^0_{\_m_a}$ and $\_M_b F^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving M_a=$\_M_a$

NDG conditions are:

$S_{\_M_a BC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_b AC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a} BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a \_M_b F^1_{\_m_b}} \neq S_{F^0_{\_m_a} \_M_b F^1_{\_m_b}}$ i.e., lines $\_M_a F^0_{\_m_a}$ and $\_M_b F^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving M_a=_M_a

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 28 terms.

Time Complexity: Time spent by the prover is 0.070 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving M_c=_M_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving M_a=_M_a

Proving failed

Problem 1122

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1122: Given a point M_a, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point M_a and the point G, construct a point A (rule W01); ;
3. Using the point N and the point O, construct a point H (rule W01); ;
4. Using the point A and the point H, construct a point E_a (rule W01); ;
5. Using the point A and the point H, construct a line h_a (rule W02); % DET: points A and H are not the same;
6. Using the point M_a and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_a and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_a, the point N and the point E_a, construct a point H_a (rule W05); % NDG: line h_a and circle $k(N, M_a)$ intersect % DET: points E_a and H_a must be different;
8. Using the point H_a and the point M_a, construct a line a (rule W02); % DET: points H_a and M_a are not the same;
9. Using the point A and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points A and O are not the same;
10. Using the circle $k(O, C)$ and the line a, construct a point C and a point B (rule W04); % NDG: line a and circle $k(O, C)$ intersect.

Non-degenerate conditions: line a and circle $k(O, C)$ intersect; points A and O are not the same; line h_a and circle $k(N, M_a)$ intersect; points M_a and N are not the same.

Determination conditions: points H_a and M_a are not the same; points E_a and H_a must be different; points A and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D21,D26,D28,D3,D31,D32,D5,D8,GD01,GL03,GL04,GL09,L11,L12,L15,L19,L22,L55]

Solving time: 7.3 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{a} 65 40
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_r M_{a}
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G188317} which passes through point N and point O
line L_{\_G188317} N O

color 200 200 200
drawline L_{\_G188317}
color 0 0 0


% Constructing a point P_{\_G188418} with coordinates (0,0)
point P_{\_G188418} 0 0
cmark_r P_{\_G188418}

% Constructing a point P_{\_G188342} such that NP_{\_G188342}/NP_{\_G188418}=1
towards P_{\_G188342} N P_{\_G188418} 1
cmark_r P_{\_G188342}
color 200 200 200
drawsegment N P_{\_G188342}
color 0 0 0

% Constructing a point P_{\_G188387} such that NP_{\_G188387}/NP_{\_G188418}=3
towards P_{\_G188387} N P_{\_G188418} 3
cmark_r P_{\_G188387}
color 200 200 200
drawsegment N P_{\_G188387}
color 0 0 0

% Constructing a line L_{\_G188348} which passes through point O and point P_{\_G188387}
line L_{\_G188348} O P_{\_G188387}
```

```
color 200 200 200
drawline L_{\_G188348}
color 0 0 0


% Constructing a line L_{\_G188311} which contains the point P_{\_G188342} and is parallel to the
    line L_{\_G188348}
parallel L_{\_G188311} P_{\_G188342} L_{\_G188348}

color 200 200 200
drawline L_{\_G188311}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G188311} and line L_{\_G188317}
intersec G L_{\_G188311} L_{\_G188317}
cmark_t G



% Constructing a point A such that M_{a}A/M_{a}G=3
towards A M_{a} G 3
cmark_t A
color 200 200 200
drawsegment M_{a} A
color 0 0 0



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point E_{a} such that AE_{a}/AH=0.5
towards E_{a} A H 0.5
cmark_r E_{a}
color 200 200 200
drawsegment A H
color 0 0 0


% DET: points A and H are not the same
% Constructing a line h_{a} which passes through point A and point H
line h_{a} A H

color 200 200 200
drawline h_{a}
color 0 0 0
```

```
% NDG: points M_{a} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{a}
circle k(N,M_{a}) N M_{a}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{a} and circle k(N,M_{a}) intersect% DET: points E_{a} and H_{a} must be different
% Constructing a point P_{\_G189402} which is a foot of the point N on the line h_{a}
foot P_{\_G189402} N h_{a}
cmark_r P_{\_G189402}
color 200 200 200
drawline N P_{\_G189402}
color 0 0 0

% Constructing a point H_{a} which is an image of the point E_{a} in the symmetry to point/line P
    _{\_G189402}
sim H_{a} P_{\_G189402} E_{a}
cmark_r H_{a}


% DET: points H_{a} and M_{a} are not the same
% Constructing a line a which passes through point H_{a} and point M_{a}
line a H_{a} M_{a}

color 200 200 200
drawline a
color 0 0 0



% NDG: points A and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point A
circle k(O,C) O A

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line a and circle k(O,C) intersect
% Constructing points C and B which are in intersection of k(O,C) and a
intersec2 C B k(O,C) a
cmark_l C
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

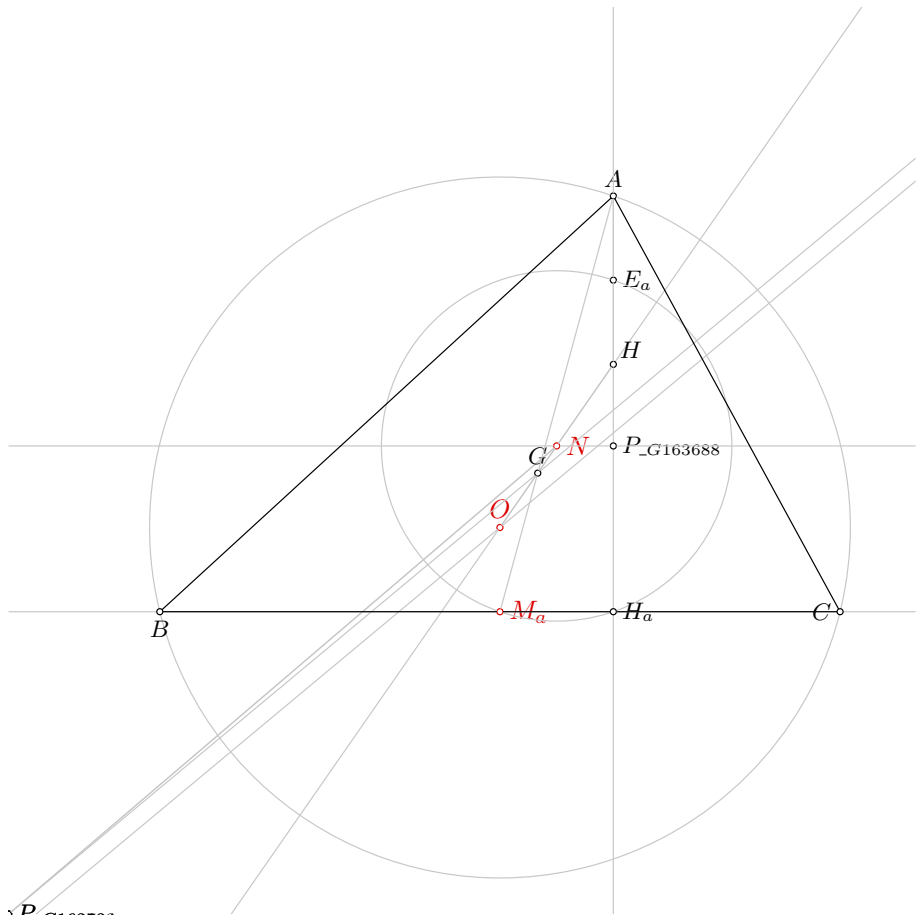

Figure 1: Illustration of the problem 1122

```
% Non-degenerate conditions: line a and circle k(O,C) intersect; points A and O are not the same;
    line h_{a} and circle k(N,M_{a}) intersect; points M_{a} and N are not the same
% Determination conditions: points H_{a} and M_{a} are not the same; points E_{a} and H_{a} must be
     different; points A and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_a=_M_a

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving O=_O

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 4927 terms.

Time Complexity: Time spent by the prover is 11.886 seconds.

NDG conditions Points $P\_{G184115}$, N and O are not collinear

Line through points $P\_{G184115}$ and O is not parallel with line through points N and M_a

Points A and H are not identical

Line through points A and N is not perpendicular to line through points N and H

Points M_a and H_a are not identical

Points M_a and H_a are not identical

Points A, B and C are not collinear

Line through points B and N is not perpendicular to line through points N and C

4.2 GCLC - Area method

4.2.1 Proving M_a=_M_a

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_a=_M_a

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_a=_M_a

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving $O{=}\_O$

Proving failed

Problem 1123

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1123: Given a point M_a, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1124

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1124: Given a point M_a, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1125

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1125: Given a point M_a, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1126

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1126: Given a point M_c, a point N and a point M_b, construct the triangle ABC.

2 Status

Problem is locus dependent.

3 Solution

3.1 Construction in natural language form

1. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
2. Choose freely a point M_b on the circle $k(N, M_a)$ (rule WOncircle);
3. Choose freely a point A (rule free);
4. Using the point A and the point M_b, construct a point C (rule W01); ;
5. Using the point A and the point M_c, construct a point B (rule W01); .

Non-degenerate conditions: points M_c and N are not the same.
Determination conditions: .
Rules used: [W01,W06,WOncircle1,free]
Lemmas used: [D20,D22,D32,GL03,GL04,L18]
Solving time: 153.2 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{c} 50 67.5
point N 72.5 61.93
point M_{b} 95 67.5

color 220 0 0
fontsize 9
```

```
cmark_lt M_{c}
cmark_r N
cmark_lt M_{b}
color 0 0 0
fontsize 8

% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0




% Choosing randomly a point M_{b} on the circle with center N through point M_{c}
oncircle M_{b} N M_{c}
cmark_lt M_{b}
color 200 200 200
drawcircle N M_{c}
color 0 0 0



% Constructing a free point A
point A 80 95

cmark_t A



% Constructing a point C such that AC/AM_{b}=2
towards C A M_{b} 2
cmark_l C
color 200 200 200
drawsegment A C
color 0 0 0



% Constructing a point B such that AB/AM_{c}=2
towards B A M_{c} 2
cmark_b B
color 200 200 200
drawsegment A B
color 0 0 0



drawsegment A B
drawsegment A C
drawsegment B C

% Non-degenerate conditions: points M_{c} and N are not the same
```

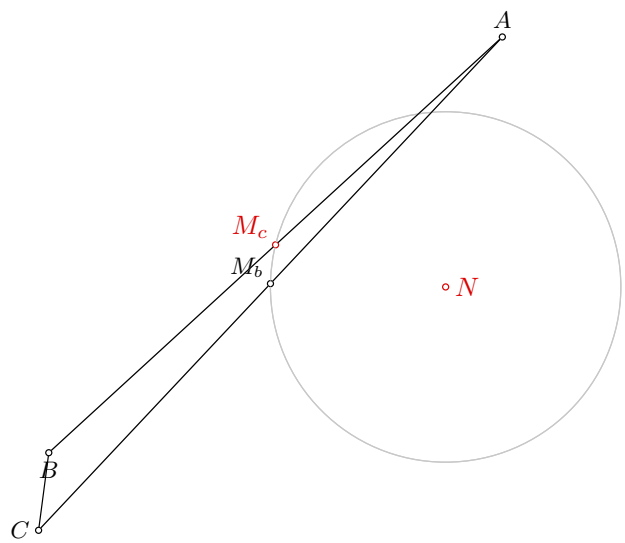

Figure 1: Illustration of the problem 1126

```
% Determination conditions:
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_c=_M_c

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3 terms.

Time Complexity: Time spent by the prover is 0.048 seconds.

NDG conditions There are no NDG conditions for this theorem

4.1.2 Proving N=$\_N$

Proving failed

4.1.3 Proving M_b=$\_M_b$

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 8 terms.

Time Complexity: Time spent by the prover is 0.137 seconds.

NDG conditions There are no NDG conditions for this theorem

4.2 GCLC - Area method

4.2.1 Proving M_c=$\_M_c$

NDG conditions are:

$S_{\_M_a BC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_b AC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a} BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a \_M_b F^1_{\_m_b}} \neq S_{F^0_{\_m_a} \_M_b F^1_{\_m_b}}$ i.e., lines $\_M_a F^0_{\_m_a}$ and $\_M_b F^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 41
Time spent by the prover: 0.000 seconds

4.2.2 Proving N=$\_N$

Proving failed

4.2.3 Proving M_b=$\_M_b$

NDG conditions are:

$S_{\_M_a BC} \neq 0$ i.e., points $\_M_a$, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{\_M_b AC} \neq 0$ i.e., points $\_M_b$, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABC} \neq 0$ i.e., points A, B and C are not collinear (foot is not the point itself; construction based assumption)
$S_{BAC} \neq 0$ i.e., points B, A and C are not collinear (foot is not the point itself; construction based assumption)
$S_{ABF^3_{\_h_b}} \neq S_{F^2_{\_h_a} BF^3_{\_h_b}}$ i.e., lines $AF^2_{\_h_a}$ and $BF^3_{\_h_b}$ are not parallel (construction based assumption)
$S_{\_M_a \_M_b F^1_{\_m_b}} \neq S_{F^0_{\_m_a} \_M_b F^1_{\_m_b}}$ i.e., lines $\_M_a F^0_{\_m_a}$ and $\_M_b F^1_{\_m_b}$ are not parallel (construction based assumption)

Total number of proof steps: 42
Time spent by the prover: 0.000 seconds

4.3 GCLC - Wu method

4.3.1 Proving M_c=$\_M_c$

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 22 terms.

Time Complexity: Time spent by the prover is 0.040 seconds.There are no ndg conditions.

4.3.2 Proving N=$\_N$

Proving failed

4.3.3 Proving M_b=_M_b

Status: The conjecture has been proved.

Space Complexity: The biggest polynomial obtained during proof process contained 28 terms.

Time Complexity: Time spent by the prover is 0.060 seconds.There are no ndg conditions.

4.4 GCLC - Grobner basis method

4.4.1 Proving M_c=_M_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving M_b=_M_b

Proving failed

Problem 1127

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1127: Given a point M_b, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point M_b and the point G, construct a point B (rule W01); ;
3. Using the point N and the point O, construct a point H (rule W01); ;
4. Using the point B and the point H, construct a point E_b (rule W01); ;
5. Using the point B and the point H, construct a line h_b (rule W02); % DET: points B and H are not the same;
6. Using the point M_b and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_b and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_b, the point N and the point E_b, construct a point H_b (rule W05); % NDG: line h_b and circle $k(N, M_a)$ intersect % DET: points E_b and H_b must be different;
8. Using the point H_b and the point M_b, construct a line b (rule W02); % DET: points H_b and M_b are not the same;
9. Using the point B and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points B and O are not the same;
10. Using the circle $k(O, C)$ and the line b, construct a point C and a point A (rule W04); % NDG: line b and circle $k(O, C)$ intersect.

Non-degenerate conditions: line b and circle $k(O, C)$ intersect; points B and O are not the same; line h_b and circle $k(N, M_a)$ intersect; points M_b and N are not the same.

Determination conditions: points H_b and M_b are not the same; points E_b and H_b must be different; points B and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D22,D26,D29,D3,D31,D32,D6,D9,GD01,GL03,GL04,GL09,L11,L12,L15,L17,L20,L23,L56]

Solving time: 7.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{b} 95 67.5
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_lt M_{b}
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G58374} which passes through point N and point O
line L_{\_G58374} N O

color 200 200 200
drawline L_{\_G58374}
color 0 0 0


% Constructing a point P_{\_G58475} with coordinates (0,0)
point P_{\_G58475} 0 0
cmark_r P_{\_G58475}

% Constructing a point P_{\_G58399} such that NP_{\_G58399}/NP_{\_G58475}=1
towards P_{\_G58399} N P_{\_G58475} 1
cmark_r P_{\_G58399}
color 200 200 200
drawsegment N P_{\_G58399}
color 0 0 0

% Constructing a point P_{\_G58444} such that NP_{\_G58444}/NP_{\_G58475}=3
towards P_{\_G58444} N P_{\_G58475} 3
cmark_r P_{\_G58444}
color 200 200 200
drawsegment N P_{\_G58444}
color 0 0 0

% Constructing a line L_{\_G58405} which passes through point O and point P_{\_G58444}
line L_{\_G58405} O P_{\_G58444}
```

```
color 200 200 200
drawline L_{\_G58405}
color 0 0 0


% Constructing a line L_{\_G58368} which contains the point P_{\_G58399} and is parallel to the
    line L_{\_G58405}
parallel L_{\_G58368} P_{\_G58399} L_{\_G58405}

color 200 200 200
drawline L_{\_G58368}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G58368} and line L_{\_G58374}
intersec G L_{\_G58368} L_{\_G58374}
cmark_t G



% Constructing a point B such that M_{b}B/M_{b}G=3
towards B M_{b} G 3
cmark_b B
color 200 200 200
drawsegment M_{b} B
color 0 0 0



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point E_{b} such that BE_{b}/BH=0.5
towards E_{b} B H 0.5
cmark_r E_{b}
color 200 200 200
drawsegment B H
color 0 0 0


% DET: points B and H are not the same
% Constructing a line h_{b} which passes through point B and point H
line h_{b} B H

color 200 200 200
drawline h_{b}
color 0 0 0
```

```
% NDG: points M_{b} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{b}
circle k(N,M_{a}) N M_{b}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{b} and circle k(N,M_{a}) intersect% DET: points E_{b} and H_{b} must be different
% Constructing a point P_{\_G59459} which is a foot of the point N on the line h_{b}
foot P_{\_G59459} N h_{b}
cmark_r P_{\_G59459}
color 200 200 200
drawline N P_{\_G59459}
color 0 0 0

% Constructing a point H_{b} which is an image of the point E_{b} in the symmetry to point/line P
    _{\_G59459}
sim H_{b} P_{\_G59459} E_{b}
cmark_l H_{b}


% DET: points H_{b} and M_{b} are not the same
% Constructing a line b which passes through point H_{b} and point M_{b}
line b H_{b} M_{b}

color 200 200 200
drawline b
color 0 0 0



% NDG: points B and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point B
circle k(O,C) O B

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line b and circle k(O,C) intersect
% Constructing points C and A which are in intersection of k(O,C) and b
intersec2 C A k(O,C) b
cmark_l C
cmark_t A



drawsegment A B
drawsegment A C
drawsegment B C
```

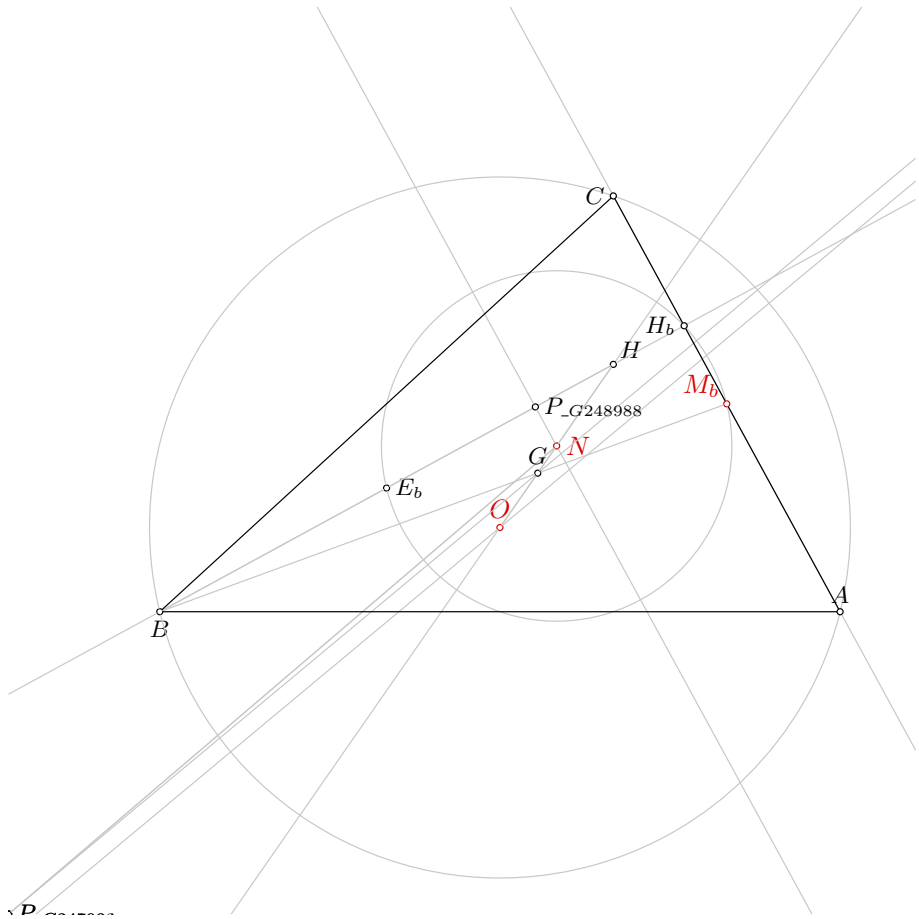

Figure 1: Illustration of the problem 1127

```
% Non-degenerate conditions: line b and circle k(O,C) intersect; points B and O are not the same;
    line h_{b} and circle k(N,M_{a}) intersect; points M_{b} and N are not the same
% Determination conditions: points H_{b} and M_{b} are not the same; points E_{b} and H_{b} must be
     different; points B and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_b=_M_b

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving O=_O

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 1828 terms.

Time Complexity: Time spent by the prover is 5.436 seconds.

NDG conditions Points N, O and P_{G54169} are not collinear

Line through points M_b and N is not parallel with line through points O and P_{G54169}

Points B and H are not identical

Line through points M_b and B is not perpendicular to line through points B and N

Points M_b and H_b are not identical

Points M_b and H_b are not identical

Points A, B and C are not collinear

Line through points M_b and B is not perpendicular to line through points B and N

4.2 GCLC - Area method

4.2.1 Proving M_b=_M_b

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_b=_M_b

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_b=_M_b

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving $O{=}\_O$

Proving failed

Problem 1128

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1128: Given a point M_b, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1129

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1129: Given a point M_b, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1130

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1130: Given a point M_b, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1131

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1131: Given a point M_c, a point N and a point O, construct the triangle ABC.

2 Status

Problem is solvable.

3 Solution

3.1 Construction in natural language form

1. Using the point N and the point O, construct a point G (rule W01); ;
2. Using the point M_c and the point G, construct a point C (rule W01); ;
3. Using the point N and the point O, construct a point H (rule W01); ;
4. Using the point C and the point H, construct a point E_c (rule W01); ;
5. Using the point C and the point H, construct a line h_c (rule W02); % DET: points C and H are not the same;
6. Using the point M_c and the point N, construct a circle $k(N, M_a)$ (rule W06); % NDG: points M_c and N are not the same;
7. Using the circle $k(N, M_a)$, the line h_c, the point N and the point E_c, construct a point H_c (rule W05); % NDG: line h_c and circle $k(N, M_a)$ intersect % DET: points E_c and H_c must be different;
8. Using the point H_c and the point M_c, construct a line c (rule W02); % DET: points H_c and M_c are not the same;
9. Using the point C and the point O, construct a circle $k(O, C)$ (rule W06); % NDG: points C and O are not the same;
10. Using the circle $k(O, C)$ and the line c, construct a point A and a point B (rule W04); % NDG: line c and circle $k(O, C)$ intersect.

Non-degenerate conditions: line c and circle $k(O, C)$ intersect; points C and O are not the same; line h_c and circle $k(N, M_a)$ intersect; points M_c and N are not the same.

Determination conditions: points H_c and M_c are not the same; points E_c and H_c must be different; points C and H are not the same.

Rules used: [W01,W02,W04,W05,W06]

Lemmas used: [D10,D20,D26,D30,D31,D32,D7,GD01,GL03,GL04,GL09,L11,L12,L15,L18,L21,L24,L3,L57]

Solving time: 7.4 seconds.

3.2 Construction in GCLC language

```
dim 120 120

point M_{c} 50 67.5
point N 72.5 61.93
point O 65 51.14

color 220 0 0
fontsize 9

cmark_lt M_{c}
cmark_r N
cmark_t O
color 0 0 0
fontsize 8


% Constructing a line L_{\_G117879} which passes through point N and point O
line L_{\_G117879} N O

color 200 200 200
drawline L_{\_G117879}
color 0 0 0


% Constructing a point P_{\_G117980} with coordinates (0,0)
point P_{\_G117980} 0 0
cmark_r P_{\_G117980}

% Constructing a point P_{\_G117904} such that NP_{\_G117904}/NP_{\_G117980}=1
towards P_{\_G117904} N P_{\_G117980} 1
cmark_r P_{\_G117904}
color 200 200 200
drawsegment N P_{\_G117904}
color 0 0 0

% Constructing a point P_{\_G117949} such that NP_{\_G117949}/NP_{\_G117980}=3
towards P_{\_G117949} N P_{\_G117980} 3
cmark_r P_{\_G117949}
color 200 200 200
drawsegment N P_{\_G117949}
color 0 0 0

% Constructing a line L_{\_G117910} which passes through point O and point P_{\_G117949}
line L_{\_G117910} O P_{\_G117949}
```

```
color 200 200 200
drawline L_{\_G117910}
color 0 0 0


% Constructing a line L_{\_G117873} which contains the point P_{\_G117904} and is parallel to the
    line L_{\_G117910}
parallel L_{\_G117873} P_{\_G117904} L_{\_G117910}

color 200 200 200
drawline L_{\_G117873}
color 0 0 0


% Constructing a point G which belongs to line L_{\_G117873} and line L_{\_G117879}
intersec G L_{\_G117873} L_{\_G117879}
cmark_t G



% Constructing a point C such that M_{c}C/M_{c}G=3
towards C M_{c} G 3
cmark_l C
color 200 200 200
drawsegment M_{c} C
color 0 0 0



% Constructing a point H such that NH/NO=-1
towards H N O -1
cmark_rt H
color 200 200 200
drawsegment O H
color 0 0 0



% Constructing a point E_{c} such that CE_{c}/CH=0.5
towards E_{c} C H 0.5
cmark_r E_{c}
color 200 200 200
drawsegment C H
color 0 0 0


% DET: points C and H are not the same
% Constructing a line h_{c} which passes through point C and point H
line h_{c} C H

color 200 200 200
drawline h_{c}
color 0 0 0
```

```
% NDG: points M_{c} and N are not the same
% Constructing a circle k(N,M_{a}) whose center is at point N and which passes through point M_{c}
circle k(N,M_{a}) N M_{c}

color 200 200 200
drawcircle k(N,M_{a})
color 0 0 0



% NDG: line h_{c} and circle k(N,M_{a}) intersect% DET: points E_{c} and H_{c} must be different
% Constructing a point P_{\_G118964} which is a foot of the point N on the line h_{c}
foot P_{\_G118964} N h_{c}
cmark_r P_{\_G118964}
color 200 200 200
drawline N P_{\_G118964}
color 0 0 0

% Constructing a point H_{c} which is an image of the point E_{c} in the symmetry to point/line P
    _{\_G118964}
sim H_{c} P_{\_G118964} E_{c}
cmark_rt H_{c}


% DET: points H_{c} and M_{c} are not the same
% Constructing a line c which passes through point H_{c} and point M_{c}
line c H_{c} M_{c}

color 200 200 200
drawline c
color 0 0 0



% NDG: points C and O are not the same
% Constructing a circle k(O,C) whose center is at point O and which passes through point C
circle k(O,C) O C

color 200 200 200
drawcircle k(O,C)
color 0 0 0



% NDG: line c and circle k(O,C) intersect
% Constructing points A and B which are in intersection of k(O,C) and c
intersec2 A B k(O,C) c
cmark_t A
cmark_b B



drawsegment A B
drawsegment A C
drawsegment B C
```

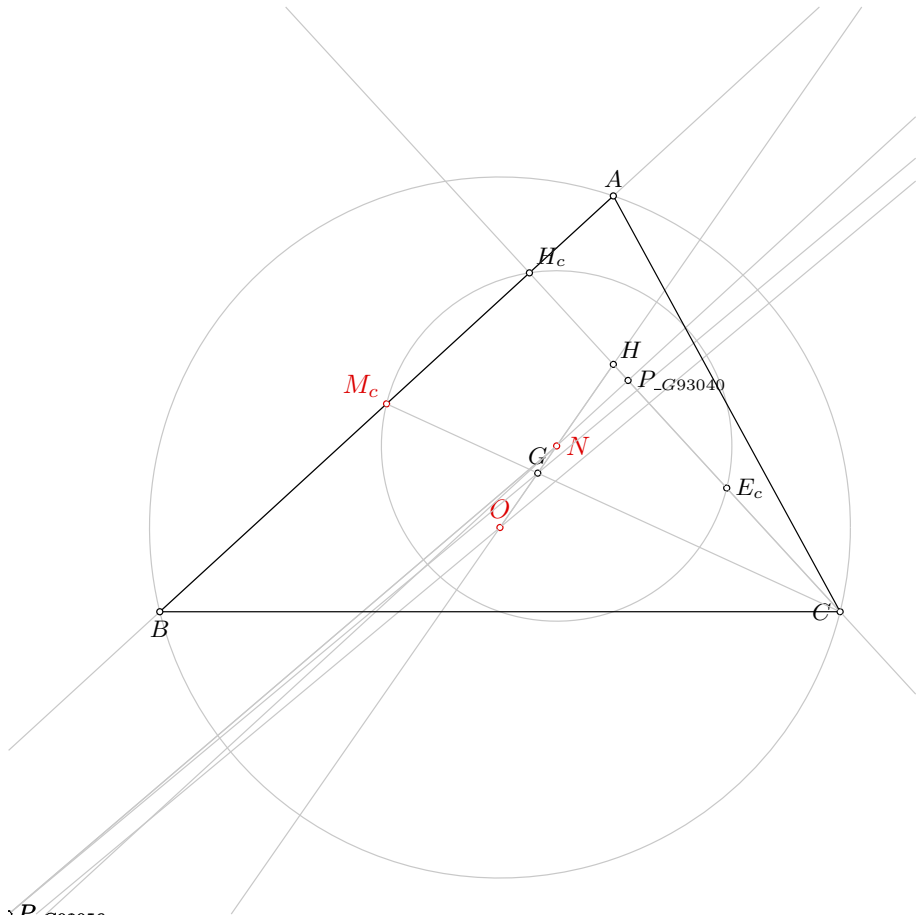

Figure 1: Illustration of the problem 1131

```
% Non-degenerate conditions: line c and circle k(O,C) intersect; points C and O are not the same;
    line h_{c} and circle k(N,M_{a}) intersect; points M_{c} and N are not the same
% Determination conditions: points H_{c} and M_{c} are not the same; points E_{c} and H_{c} must be
     different; points C and H are not the same
```

3.3 Illustration

Illustration of the constructed figure is given in Figure 1

3.4 Construction in OpenGeoProver format

4 Correctness proof

4.1 OGP - Wu method

4.1.1 Proving M_c=_M_c

Proving failed

4.1.2 Proving N=_N

Proving failed

4.1.3 Proving O=_O

Status: Theorem has been proved.

Space Complexity: The biggest polynomial obtained during prover execution contains 3990 terms.

Time Complexity: Time spent by the prover is 9.024 seconds.

NDG conditions Points $P\_{G113641}$, N and O are not collinear

Line through points $P\_{G113641}$ and O is not parallel with line through points M_c and N

Points C and H are not identical

Line through points C and M_c is not perpendicular to line through points M_c and H

Points H_c and M_c are not identical

Points H_c and M_c are not identical

Points A, B and C are not collinear

Line through points B and M_c is not perpendicular to line through points M_c and C

4.2 GCLC - Area method

4.2.1 Proving M_c=_M_c

Proving failed

4.2.2 Proving N=_N

Proving failed

4.2.3 Proving O=_O

Proving failed

4.3 GCLC - Wu method

4.3.1 Proving M_c=_M_c

Proving failed

4.3.2 Proving N=_N

Proving failed

4.3.3 Proving O=_O

Proving failed

4.4 GCLC - Grobner basis method

4.4.1 Proving M_c=_M_c

Proving failed

4.4.2 Proving N=_N

Proving failed

4.4.3 Proving $O{=}\_O$

Proving failed

Problem 1132

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1132: Given a point M_c, a point N and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1133

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1133: Given a point M_c, a point N and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1134

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1134: Given a point M_c, a point N and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1135

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1135: Given a point N, a point O and a point T_a, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1136

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1136: Given a point N, a point O and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1137

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1137: Given a point N, a point O and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1138

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1138: Given a point N, a point T_a and a point T_b, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1139

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1139: Given a point N, a point T_a and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.

Problem 1140

Generated automatically by ArgoTriCS
Developed by Vesna Marinković, University of Belgrade

1 Problem

Problem 1140: Given a point N, a point T_b and a point T_c, construct the triangle ABC.

2 Status

Status of the problem is unknown.