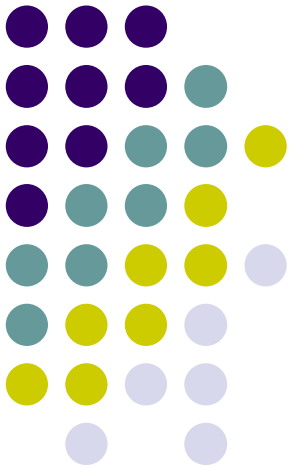
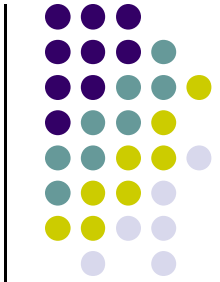
Programski jezik C

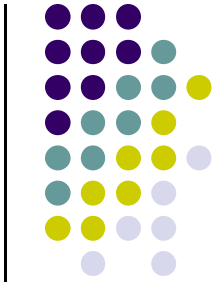


Znakovni (karakterski) tip



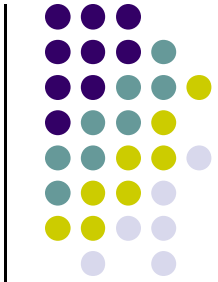
- 1 karakter - 1 bajt
- Uređenje prema ASCII kodnoj shemi
- 1 karakter – 1 broj
- Konstanta znakovnog tipa – broj, zapisan ‘x’
  - Npr, ‘0’ je 48,
  - Neki karakteri – kodna sekvenca: \n, \t, \b, \\ - izgledaju kao dva, ali predstavljaju 1 karakter
  - ‘\0’ – karakter sa vrednošću 0, 0-karakter
  - U obliku oktalnog broja, npr. ‘\101’, ‘\061’
  - U obliku heksadekadnog broja, npr. ‘\x41’, ‘\x31’

Znakovni (karakterski) tip



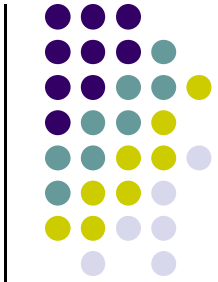
- Imenovanje znakovne konstante, npr.
  - #define GRANICNIK '$'
- Niska karaktera, literal, string:
  - 0 ili >0 karaktera, između dvostrukih navodnika,
  - Npr. "Ovo je string"
  - Nula-karakter na kraju
- <string.h> - standardno zaglavlje
  - Funkcija strlen(s) – bez nula-karaktera

Znakovni tip - promenljive



- promenljiva: ime, tip, adresa, vrednost
  - Ime: slova, cifre, _
    - Razlikuju se mala i velika slova
  - Definicija: ime, tip (char), adresa (? vrednost)
  - Deklaracija: ime, tip
    - Na primer,
      - char c, linija[1000];
      - extern char c, linija[1000];
  - Promenljiva sa nepromenljivom vrednošću
    - const char poruka[ ] = ”warning: ”;
    - int strlen(const char[ ]);

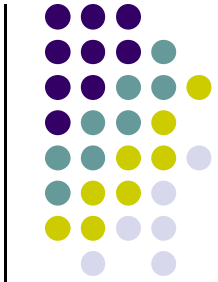
Znakovni tip - promenljive



- Kvalifikator signed / unsigned
- unsigned char c /* vrednost od 0 do 255 */
- signed char c /*vrednost -128 do +127 */
- Primeri: 11111111, 00000000, 10000001, 10000000

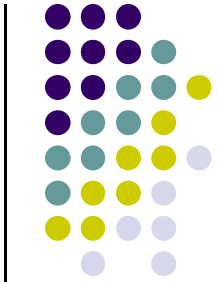
- Operacije: kao za cele brojeve

Celobrojni tip



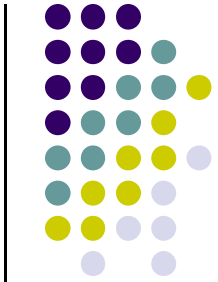
- konačni podskup skupa celih brojeva
- definisan implementacijom
- (16 bitova): [-2^{15}; $2^{15} - 1$] (-32768; 32767)
- kvalifikatori: short i long
- short int <= int <= long int (2-2-4 bajta)
- operator **sizeof**(*tip*) (**sizeof** *izraz*) vraća koliko je bajtova potrebno za skladištenje *tipa (*vrednosti *izraza)*. Na primer
  - sizeof(char) je 1
  - sizeof(int) je 2 ili 4
- u <limits.h> - definicije konstanti
- kvalifikatori signed / unsigned

Celobrojni tip: konstante



- Tip konstante – iz zapisa
- Primeri:
  - 1234 – int
  - 1234l, 1234L, – long int
  - 123456 – (?long int)
  - 65000u, 65000U – unsigned int
  - 4000000000ul, 4000000000UL– unsigned long int
  - U oktalnom sistemu: 0, npr. 037
  - U heksadekadnom sistemu: 0x, 0X, npr. 0x1f, 0X1F

Celobrojni tip: operatori



- +, -, *, / (celobrojno deljenje), % (ostatak pri deljenju)
- unarni -, +
- ++, -- za promenljive tj. adrese
  a % *b* = *a* - ((*a* / *b*) * *b*)
- == , ! = , <, >, <=, >=
- Prioriteti:
  (unarni +, -) , (++, - -), (*, /, %), (binarni +, -), (<, >, <=, >=), (==, !=)
- Celobrojni rezultat

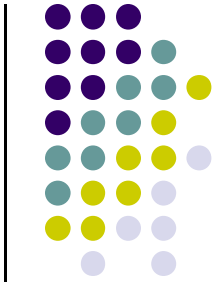
- Implementacija: dvostruki komplement

  $x = 25_{10}$ x: 0000000000011001

  $-x = -25_{10}$ -x: 2^{16} -25 = 1111111111100111

  (1111111111111111-x+1)

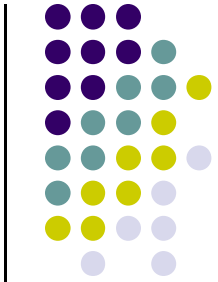
Celobrojni tip: operatori uvećanja i umanjenja



- primer, if(c==’\n’) ++n;

- x = n++;
- x = ++n;

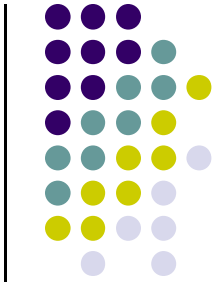
Celobrojni tip: funkcije



- <stdlib.h>
- atoi(s)
- abs(x)
- int atoi(char s[ ])

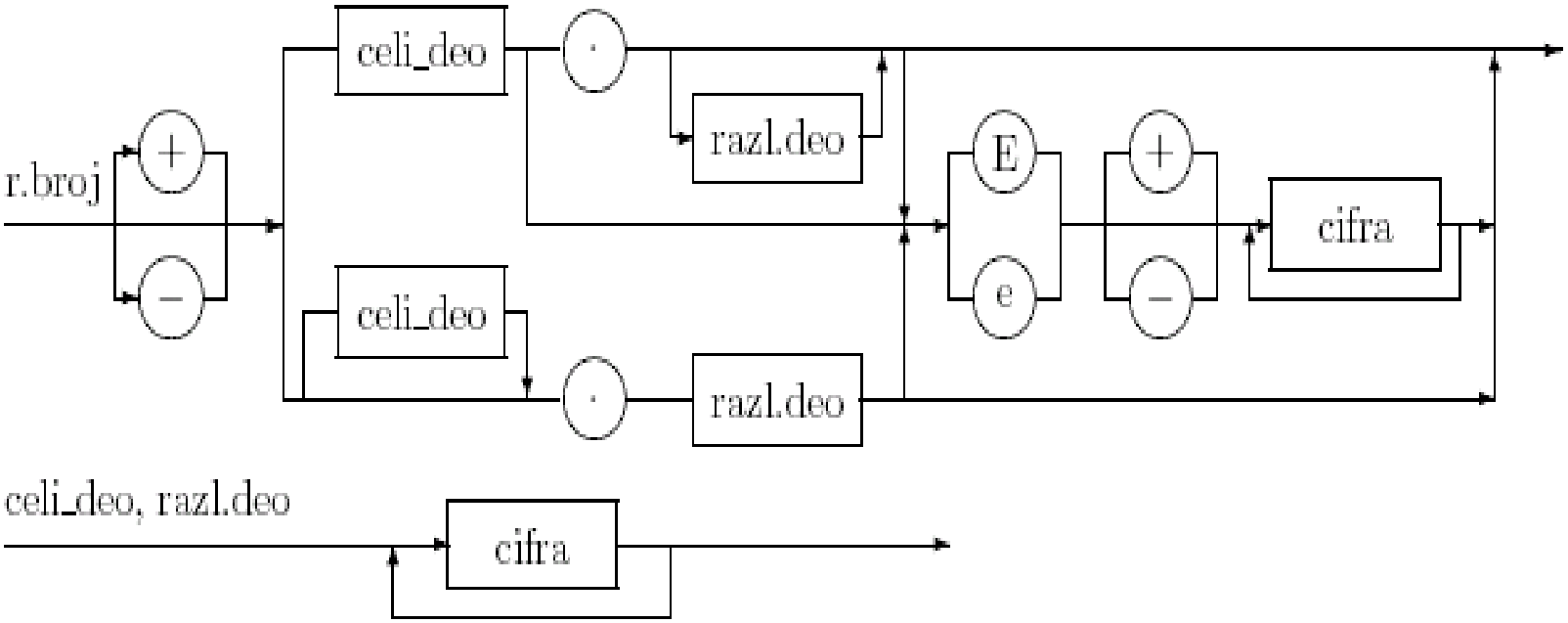
```
{ int i, n;
        n=0;
        for (i=0; s[i]>='0' && s[i] <='9'; ++i)
                n=10*n + (s[i] -'0');
        return n;
}
```

Realni tip: konstanta u C-u

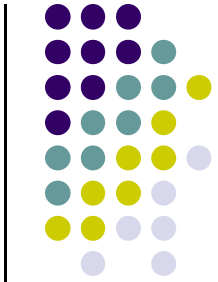


- primeri: 0.2, .2, 5., 1e-2, 9.10E-31 kg (masa elektrona)
- loše: 3.0E
- tip: double
- 2.5f (2.5F), 2.5l (2.5L)
- F, f (float) <= double <= l, L (long double): 32-64
  - sizeof(float) je 4
  - sizeof(double) je 4 ili 8
- (!sintaksni dijagram!)

Realni tip: konstanta u C-u

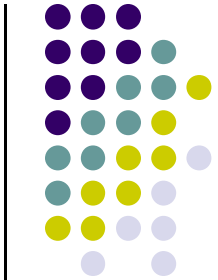


Realni tip: promenljiva



- double x;
- float x;
- long double x;

Realni tip: implementacija

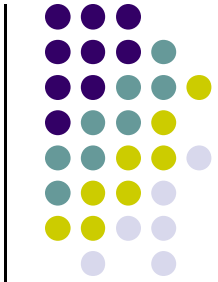


- najmanji, najveći, gustina:
  <float.h>
- float: 4 bajta, x !=0 je u intervalu $10^{-38} \leq |x| \leq 10^{38}$

tačnost je 7 značajnih cifara

- Gustina (ε – mašine): najmanji ε
  t.d. 1+ ε != 1
- Predstavljanje: pokretni zarez
  (zapeta, tačka)

Realni tip: implementacija



- X: pomoću dva cela broja m i e:

  m (mantisa) $m \in [-M, M], M \in N$

  e (eksponent) $e \in [-E, E], E > 0$

$$x = m * B^e$$

B je izabrana osnova, npr. 2

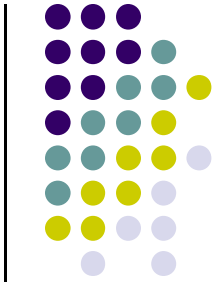
Primer:

normalizovana mantisa: 24 bita (7 dekadnih cifara)

eksponent: 8 bita, $-128 <= e_b <= 127$ ($-38 <= e_d <= 38$)

znak mantise: 1 bit

Realni tip: implementacija



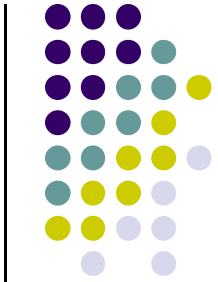
Normalizovana mantisa:

1/B <= m < 1

- Gustina: [0.1, 1] ima isto "realnih" brojeva kao i [10^4, 10^5] za osnovu B = 10.
- Operatori su +, -, *, /, ...
- Prioriteti
- Funkcije: <math.h> - sin, cos…,exp, log, log10, ceil, floor, sqrt, pow(x,y) – tip double
- konverzija “užih” u “šire” tipove

  Npr. ako je x float, x + 1 je float

Konverzija char u double tip – funkcija atof ()



```
#include <ctype.h>
/* atof: konvertuje string s u realni broj dvostruke tacnosti */
double atof(char [ ])
{ double vred, stepen;
      int i, znak;
      for (i=0; s[i]=='\b' || s[i] == '\t'; i++); /* preskoci sve beline i tabulatore */
      znak = (s[i] == '–')? –1:1;
      if (s[i]=='+' || s[i]=='–') i++;
/* celobrojni deo */
      for(vred=0.0; '0'<=s[i] && s[i] <='9'; i++)
      vred = 10.0 * vred + (s[i]-'0');
      if(s[i]=='.')i++;
/* razlomljeni deo */
      for(stepen=1.0; '0'<= s[i]&& s[i]<='9'; i++)
      { vred = 10.0 * vred + (s[i] – '0');
      stepen *=10.0;
      }
      return znak * vred / stepen;
}
```