$x_j = \frac{2\pi j}{n}, j = 0, ..., n-1$ ekvidistantne tačke iz $[0, 2\pi)$

Uslov: $f(x_j) = \sum\limits_{k=0}^{n-1} c_k e^{-ik\frac{2\pi j}{n}}, j = 0, ..., n-1.$

Knjiga:

Oznaka: $w = e^{i\frac{2\pi}{n}}$.

Furijeova matrica:

$$F = \begin{bmatrix} 1 & 1 & 1 & \cdots & 1 \\ 1 & w & w^2 & \cdots & w^{(n-1)} \\ 1 & w^2 & w^4 & \cdots & w^{2(n-1)} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & w^{(n-1)} & w^{2(n-1)} & \cdots & w^{(n-1)^2} \end{bmatrix}$$

```
F = conj(dftmtx(n))/n
```

$f = F^* c \Rightarrow c = (F^*)^{-1} f = \frac{1}{n} F f$

tj. $c_k = \frac{1}{n} \sum\limits_{j=0}^{n-1} w^{jk} f_j$

```
c = ifft(f)
```

Inverzna DFT:

$f_j = \sum\limits_{j=0}^{n-1} \overline{w}^{jk} c_j, \quad \overline{w} = e^{-i\frac{2\pi}{n}}$

```
f = fft(c)
```

MATLAB:

Oznaka: $w = e^{-i\frac{2\pi}{n}}$.

Furijeova matrica:

$$F = \begin{bmatrix} 1 & 1 & 1 & \cdots & 1 \\ 1 & w & w^2 & \cdots & w^{(n-1)} \\ 1 & w^2 & w^4 & \cdots & w^{2(n-1)} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & w^{(n-1)} & w^{2(n-1)} & \cdots & w^{(n-1)^2} \end{bmatrix}$$

```
F = dftmtx(n)
```

$c = F f$

tj. $c_k = \sum\limits_{j=0}^{n-1} w^{jk} f_j$

```
c = fft(f)
```

Inverzna DFT:

$f_j = \frac{1}{n} \sum\limits_{j=0}^{n-1} \overline{w}^{jk} c_j, \quad \overline{w} = e^{i\frac{2\pi}{n}}$

```
f = ifft(c)
```

Mnozenje polinoma

$p_1(x) = \sum\limits_{j=0}^{n_1} f_j x^j, \ p_2(x) = \sum\limits_{j=0}^{n_2} g_j x^j, \ p(x) = p_1(x) p_2(x) = \sum\limits_{j=0}^{n} c_j x^j$

$f = [f_0, f_1, ..., f_{n_1}, 0, ...0]$ i $g = [g_0, g_1, ..., g_{n_2}, 0, ...0]$ oba vektora dopunjena nulama do dimenzije koja odgovara stepenu proizvoda polinoma, tj. duzine $n + 1 = n_1 + n_2 + 1$. Vektor $c = [c_0, ..., c_n]$ sadrži koeficijente proizvoda polinoma.

Oznake: $\hat{f}$ je DFT od vektora f, $\hat{g}$ je DFT od vektora g, $\hat{c}$ je DFT od vektora c.

$\hat{f} = \frac{1}{n} F f \Rightarrow \hat{f}_k = \frac{1}{n} \sum\limits_{j=0}^{n} w^{jk} f_j = \frac{1}{n} p_1(w^k)$

$\hat{g} = \frac{1}{n} F g \Rightarrow \hat{g}_k = \frac{1}{n} \sum\limits_{j=0}^{n} w^{jk} g_j = \frac{1}{n} p_2(w^k)$

$\hat{c} = \frac{1}{n} F g \Rightarrow \hat{c}_k = \frac{1}{n} \sum\limits_{j=0}^{n} w^{jk} c_j = \frac{1}{n} p(w^k)$

$\hat{f}_k \cdot \hat{g}_k = \frac{1}{n^2} p_1(w^k) p_2(w^k) = \frac{1}{n^2} p(w^k)$

$(\hat{f} \cdot \hat{g})_k = \frac{1}{n^2} p(w^k) = \frac{1}{n} \hat{c}_k$

Napomena: gornje množenje (oznaka $\cdot$) sa leve strane jednakosti je tačka po tačka (operator .* u MATLAB-u).

$\hat{f} \cdot \hat{g} = \frac{1}{n} \hat{c} = \frac{1}{n^2} F c$ (pomnožimo levu i desnu stranu sa F^*)

$F^*(\hat{f} \cdot \hat{g}) = \frac{1}{n^2} F^* F c = \frac{1}{n^2} n I c = \frac{1}{n} c$

$c = n F^*(\hat{f} \cdot \hat{g}) = f * g$

$\hat{f} = F f \Rightarrow \hat{f}_k = \sum\limits_{j=0}^{n} w^{jk} f_j = p_1(w^k)$

$\hat{g} = F g \Rightarrow \hat{g}_k = \sum\limits_{j=0}^{n} w^{jk} g_j = p_2(w^k)$

$\hat{c} = F g \Rightarrow \hat{c}_k = \sum\limits_{j=0}^{n} w^{jk} c_j = p(w^k)$

$\hat{f}_k \cdot \hat{g}_k = p_1(w^k) p_2(w^k) = p(w^k)$

$(\hat{f} \cdot \hat{g})_k = p(w^k) = \hat{c}_k$

Napomena: gornje množenje (oznaka $\cdot$) sa leve strane jednakosti je tačka po tačka (operator .* u MATLAB-u).

$\hat{f} \cdot \hat{g} = \hat{c} = F c$ (pomnožimo levu i desnu stranu sa F^*)

$F^*(\hat{f} \cdot \hat{g}) = F^* F c = n I c$

$c = \frac{1}{n} F^*(\hat{f} \cdot \hat{g}) = f * g$