$x = [2, 5, -1, -3] \qquad N = 4$

$$X[k] = \sum_{n=0}^{N-1} x[n] e^{-\frac{i2\pi}{N} \cdot n \cdot k} \quad , \quad k = 0, 1, \dots N-1$$

<u>$k=0$</u>

$$X[0] = \sum_{n=0}^{3} x[n] \underbrace{e^{-\frac{i2\pi}{4} \cdot n \cdot 0}}_{=1} = 2 + 5 - 1 - 3 = \underline{\underline{3}}$$

<u>$k=1$</u>

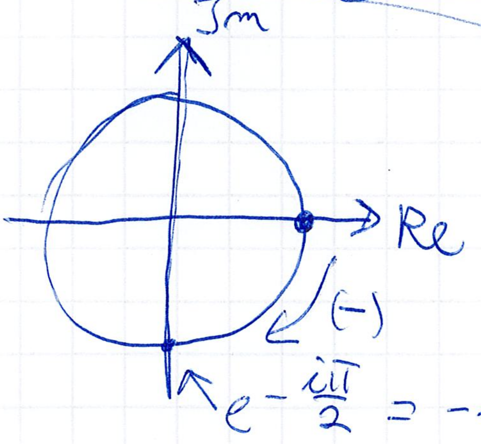
$$X[1] = \sum_{n=0}^{3} x[n] e^{-\frac{i2\pi}{4} \cdot n \cdot 1}$$

$$= x[0] \underbrace{e^{-\frac{i2\pi}{4} \cdot 0 \cdot 1}}_{=1} + x[1] \underbrace{e^{-\frac{i2\pi}{4} \cdot 1 \cdot 1}}_{e^{-\frac{i\pi}{2}} = -i} + x[2] \overbrace{e^{-\frac{i2\pi}{4} \cdot 2 \cdot 1}}^{=-1} + x[3] \overbrace{e^{-\frac{i2\pi}{4} \cdot 3 \cdot 1}}^{=i}$$

$$X[1] = 2 \cdot 1 + 5 \cdot (-i) - 1 \cdot (-1) - 3 \cdot (i)$$

$$= 2 - 5i + 1 - 3i$$

$$= \underline{\underline{3 - 8i}}$$



TAI

$$e^{-i\theta} = \cos(\theta) - i \sin(\theta)$$

$$e^{-i\frac{\pi}{2}} = \underbrace{\cos\left(\frac{\pi}{2}\right)}_{=0} + i \underbrace{\sin\left(\frac{\pi}{2}\right)}_{=1} = -i$$

$\underline{K=2}$

$$X[2] = \sum_{n=0}^{3} x[n] e^{-\frac{i2\pi}{4} \cdot n \cdot 2}$$

$$= x[0]\underbrace{e^{-\frac{i2\pi}{4}\cdot 0\cdot 2}}_{=1} + x[1]\underbrace{e^{-\frac{i2\pi}{4}\cdot 1\cdot 2}}_{=-1} + x[2]\underbrace{e^{-\frac{i2\pi}{4}\cdot 2\cdot 2}}_{=1} + x[3]\underbrace{e^{-\frac{i2\pi}{4}\cdot 3\cdot 2}}_{=-1}$$

$$= 2\cdot 1 + 5\cdot(-1) - 1\cdot 1 - 3\cdot(-1) = 2-5-1+3 = \underline{\underline{-1}}$$

$\underline{K=3}$

KÄYTETÄÄN HYVÄKSI DFT:N SYMMETRISYYTTÄ

$$X[k] = [3,\ 3-8i,\ -1,\ \underline{3+8i}]$$

ESITÄ KOMPLEKSILUKU $z = 3e^{i\frac{13\pi}{3}}$ KARTEESISESSA MUODOSSA

$$e^{i\theta} = \cos(\theta) + i\sin(\theta)$$

$$3e^{i\frac{13\pi}{3}} = 3\left[\cos\left(\frac{13\pi}{3}\right) + i\sin\left(\frac{13\pi}{3}\right)\right]$$

$$= 3(0{,}5 + i\,0{,}8660) = \underline{\underline{1{,}5 + 2{,}5981\,i}}$$