

ENEE 222: 3/14 Class

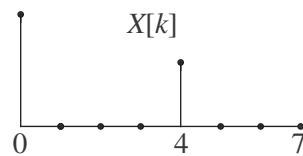
Material: Lecture videos 12.1, 12.2, 12.3

- Which of the following statements are true about the discrete Fourier transform (or spectrum) \mathbf{X} of a signal vector \mathbf{x} ?
 - \mathbf{x} and \mathbf{X} are vectors of the same length.
 - \mathbf{X} contains information about the amplitude and phase of standard sinusoidal vectors which, when summed together, produce the signal vector \mathbf{x} .
 - If one of the entries of the DFT \mathbf{X} is zero, then \mathbf{x} must also contain (at least) one zero entry.
 - If \mathbf{x} is real-valued, then so is \mathbf{X} .

- What is the smallest vector length N such that the $N \times N$ matrix of Fourier (DFT) sinusoids contains the entry

$$-\frac{\sqrt{3}}{2} + \frac{j}{2} ?$$

- 6
 - 8
 - 12
 - 24
- Which of the following signals \mathbf{x} could have the (real-valued) DFT \mathbf{X} plotted below?



- $\mathbf{x} = [0 \ 1 \ 2 \ 3 \ 4 \ 3 \ 2 \ 1]^T$
- $\mathbf{x} = [5 \ 1 \ 5 \ 1 \ 5 \ 1 \ 5 \ 1]^T$
- $\mathbf{x} = [1 \ 0 \ 3 \ 0 \ 5 \ 0 \ 3 \ 0]^T$
- $\mathbf{x} = [2 \ 0 \ 0 \ 0 \ 2 \ 0 \ 0 \ 0]^T$

4. (HW 13 \supset) Construct the matrix

$$\mathbf{V} = [\mathbf{v}^{(0)} \quad \mathbf{v}^{(1)} \quad \mathbf{v}^{(2)} \quad \mathbf{v}^{(3)} \quad \mathbf{v}^{(4)} \quad \mathbf{v}^{(5)} \quad \mathbf{v}^{(6)} \quad \mathbf{v}^{(7)}]$$

of Fourier sinusoids of length $N = 8$.

5. (HW 13 \subset i) Compute the DFT \mathbf{X} of

$$\mathbf{x} = [3 \quad 1 \quad -5 \quad 3 \quad 3 \quad 1 \quad -5 \quad 3]^T$$

6. (HW 13 \sim v) Determine the least squares approximation $\hat{\mathbf{x}}$ of \mathbf{x} in terms of $\mathbf{v}^{(2)}$ and $\mathbf{v}^{(6)}$. Display the entries of $\hat{\mathbf{x}}$ and compute the squared error norm $\|\mathbf{x} - \hat{\mathbf{x}}\|^2$.