

ECE 310 Quiz 7 Section CCS Fall 2018 Solutions

1. (6 pts) Let $x[n] = \{1, 0, 2, 0\}$

(a) Compute the DFT $X[k]$ of $x[n]$.

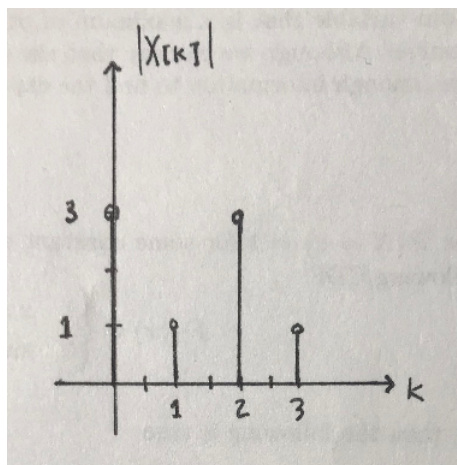
$$\begin{aligned} X[k] &= \sum_{n=0}^{N-1} x[n] e^{-j \frac{2\pi k}{N} n} \\ &= \sum_{n=0}^3 x[n] e^{-j \frac{2\pi k}{4} n} \\ &= 1 + 2e^{-j\pi k} \\ &= \boxed{\{3, -1, 3, -1\}} \end{aligned}$$

Grading:

+2 for setting up DFT correctly.

+2 for correct solution.

(b) Sketch the magnitude of $X[k]$.



Grading:

+2 for correct solution.

2. (4 pts) Let $X[k]$ be the DFT of $x[n] = \{4, 3, 2, 1\}$. Determine the sequence $y[n]$ whose DFT is given by $Y[k] = e^{-j\pi(k-1)/2}X[k]$.

$$\begin{aligned} Y[k] &= e^{-j\pi(k-1)/2}X[k] \\ &= e^{-j\pi k/2+j\pi/2}X[k] \\ &= e^{-j\pi k/2}e^{j\pi/2}X[k] \\ &= je^{-j\pi k/2}X[k] \\ &= je^{-j\frac{2\pi k}{N}}X[k] \quad \text{where } N = 4 \end{aligned}$$

Recall the time shift property for the DFT: $x[\langle n-d \rangle_N] \longleftrightarrow X[k]e^{-j\frac{2\pi k}{N}d}$. Note that $d = 1$ in this problem. Therefore, $y[n] = jx[\langle n-1 \rangle_4]$.

$y[n] = \{j, 4j, 3j, 2j\}$

Grading:

+1 for time shift.

+1 for factoring out j .

+2 for correct solution.