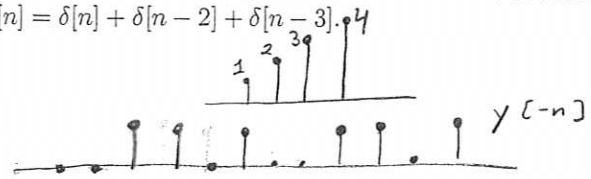
ECEn 487 - Introduction to Digital Signal Processing

Winter 2013

Quiz 6

1. (2 pts) Evaluate the circular convolution with $N = 6$ of the sequences $x[n] = \delta[n]+2\delta[n-1]+3\delta[n-2]+4\delta[n-3]$ and $y[n] = \delta[n] + \delta[n-2] + \delta[n-3]$.



$x[n] \textcircled{6} y[n] = 5\delta[n] + 2\delta[n-1] + 4\delta[n-2] + 7\delta[n-3] + 5\delta[n-4] + 7\delta[n-5]$

2. (3 pts) Suppose I have an aperiodic sequence of length 6, $x[n]$, which has a Fourier Transform of $X\left(e^{jw}\right) = 1 + e^{-jw} + 2e^{-5jw}$. Suppose I now take Discrete Fourier Transform of this sequence with a length of 8. What is $X[k]$?

$$X[k] = X\left(e^{jw\left(\frac{2\pi}{N}\right)k}\right) = 1 + e^{-jw\left(\frac{2\pi}{N}\right)k} + 2e^{-5jw\left(\frac{2\pi}{N}\right)k}$$

$$X[k] = 1 + e^{-jw\left(\frac{2\pi}{8}\right)k} + 2e^{-5jw\left(\frac{2\pi}{8}\right)k}, \text{ for } k = 0, \ldots, 7$$

Problem

3. (3 pts) Suppose I take the result of ~~Part~~ 2, $X[k]$, and find $Y[k] = e^{-j(2\pi/8)3k}X[k]$. If I take the inverse DFT of $Y[k]$, what is $y[n]$?

This corresponds to $y[n] = x[((n-3))_8]$

$x[n] = \delta[n] + \delta[n-1] + 2\delta[n-5]$

$y[n] = \delta[n-3] + \delta[n-4] + 2\delta[n-8]$ → circular convolution → $n = 0$

$y[n] = 2\delta[n] + \delta[n-3] + \delta[n-4]$

4. (2 pts) Suppose I implement FIR filtering using the overlap-add method. I want to filter blocks of length 128. My filter length is 65. What is the least DFT length I need to implement this correctly?

$$L + P - 1 = 128 + 65 - 1 = 128 + 64 = \underline{\underline{192}}$$