MATLAB Assignment 6

Spring 2020, Section A

This homework deals with digital filters in a low-level sense. You are expected to know a bit about the z-transform, but if you are not in Signals and Systems, please contact me separately for some additional information on this homework. All plots should have a title, x-axis and y-axis labels, and if there is more than one function in the same figure, a legend as well. Additionally, make sure your plot's axis bounds are adequate.

Please submit this homework as a *.m* file, with suppressed output. Remember that all lectures and homeworks may be found at *github.com/guybaryosef/ECE210-materials*. Homework is due by the end of the semester to guybymatlab@gmail.com.

1. Z it up! For this question, you will be working with the discrete system described by the transfer function:

$$H(z) = \frac{\frac{1}{2} + \frac{2}{3}z + \frac{3}{7}z^2}{2 + \frac{1}{3}z + \frac{1}{2}z^3}$$

a. Store this transfer function in MATLAB as numerator and denominator vectors and then find the poles and zeros.

b. Plot the poles and zeros of H.

c. Use ***impz*** to obtain the first 50 points of the impulse response and plot them using the appropriate plotting function.

d. Let $x[n] = (-\frac{3}{4})^n$, and take n from 0 to 49. Apply the digital filter H to x using ***filter***.

e. Now let us apply the filter analytically using convolution. Apply the digital filter to x using ***conv***.

f. Plot your results for part (d) and (e) in 2 side-by-side subplots in order to show that they are equivalent. Note that you will have to throw out some values from part (e) to get the same result.

2. You Gotta be Fibbin' Me! The Fibonacci sequence is a sequence of numbers such that every number after the first two is the sum of the two preceding numbers. The first two numbers of the sequence are 0 and 1. It is cute to imagine a discrete-tyme system whose impulse response is the Fibonacci sequence!

a. Use a for loop to generate the first 100 values of the Fibonacci sequence and plot these values using MATLAB and plot them using ***semilogy***.

b. Assuming this is the impulse response of a system, find the output of the system with input $x[n]$ from the previous problem and plot it using an appropriate function.