Math 77A Project 3 (Due January 24)

Instructions: This project will require some MATLAB code. Please submit your solution as an `.m` file. When turning in the project, name your file `project3_yourlastname.m` and email it to `eesser@uci.edu`. If you are submitting multiple files, please zip them together in a file named `project3_yourlastname.zip`.

1. Write a MATLAB function `delay.m` of the form `y = delay(x,k)` that uses MATLAB's `filter` function to delay the input signal x by k sampling intervals. For example, `delay([1 2 3 4],1)` should return `0 1 2 3`.

Also write a function `ave.m` of the form `y = ave(x,w)` that uses MATLAB's `filter` function to average the previous w samples of the input signal x. For example, `ave([1 2 3 4],2)` should return `.5 1.5 2.5 3.5`.

Define a signal x representing a step function and apply your `delay(x,k)` and `ave(x,w)` functions. You may choose the values of k and w. Plot the original, delayed and averaged signals in the same figure.

2. Use MATLAB's `butter` function to define an order 3 Butterworth lowpass filter with a normalized cutoff frequency of .2 by `[b,a] = butter(3,.2,'low')`. Plot the first 128 elements of the impulse response. Also use the discrete Fourier transform (DFT) to calculate a sampling of the frequency response by plotting the absolute value of the DFT of the first 128 elements of the impulse response. Finally, apply this filter to the step function you defined in Problem 1. Plot both the step function and the filtered version in the same figure.

3. Following the notation of MATLAB's `filter` function, define vectors a and b of filter coefficients to define a filter whose impulse response is $1, 2, 3, 4, 5, ...$