Homework #3: Chapter 3 (due Sep. 21, 2012)

Preliminary

- All problems are worth +10 points unless otherwise noted.
- Download the CompanionFiles3.zip file

  http://www.ece.nmsu.edu/~pdeleon/Teaching/EE395/Homework/CompanionFiles3.zip
- Code the following tools from *DSP Software Toolkit* Chapter 4: **convltn.m** and **fltr.m** .
- For now, you need not be concerned with the z-transform of difference equations for fltr.m—simply code the algorithm as stated in the manual. *Include* printouts of convltn.m and fltr.m.
- Use plotdsig.m for impulse response plots. The x-axis should be labeled n and y-axis should be labeled $h(n)$.
- Please attach at the *end* of your assignment printouts of **main1.m** (code to solve software problem 1), **main2.m** (code to solve software problem 2), etc.... as well as any new tools developed in this assignment.
- As a reminder, Exam #1 is Wed. Sep. 21, 2011. The examination will consist of an in-class portion from 10:30-11:20am and a take-home portion which will be given out before the in-class exam. The take-home portion is due on or before 10:30am Fri. Sep. 23, 2011 in Prof. De Leon's office.
- There will be no class on Fri. Sep. 23, 2011.

Software Problems

Use your software tools to solve the following problems.

1. (Example 3.4.6 revisited). Use your fltr.m tool with $\mathbf{a} = [1, 0.8]^T$ and $\mathbf{b} = [1]^T$ and $\mathbf{x} = [1, 0, \ldots, 0]^T$. Plot and verify the first 21 terms of the causal impulse response.
2. Repeat Problem 1 but for the difference equation in Example 3.4.8.
3. (Delay of N samples). A system which delays the input by N samples has an impulse response of $h(n) = \delta(n - N)$ or in vector notation, $\mathbf{h} = [0, \ldots, 0, 1]^T$ where we have N leading zeros. Let $x(n) = \sin(2\pi n f_0/f_s)$ with $f_0 = 500$ Hz and $f_s = 2000$ Hz. Plot the first 50 samples of the input and 50 samples of the output (convltn.m) for the system with $N = 8$. Verify a delay of N samples.
4. Repeat Problem 3 but use your fltr.m tool. What are the **a** and **b** you need to use?
5. (Example 3.5.1 revisited). Use your fltr.m tool with $\mathbf{a} = [1]^T$ and $\mathbf{b} = [1/M, \ldots, 1/M]^T$, [length($\mathbf{b}$)=$M$] to implement the causal $M = 7$ tap smoothing filter. Download and filter year-to-date closing data for the Standard & Poor's (S&P) 500 stock market index

   http://finance.yahoo.com/q/hp?s=%5EGSPC+Historical+Prices

   Plot the data (input signal) and the filtered data (output signal) on a single plot and *comment*. You may wish to try different lengths of smoothing filters and experiment.

   Notes:

   - S&P 500 data can be downloaded as a (spreadsheet) Comma Separated Variable (.csv) file and imported in MATLAB using csvread. The data is listed in time-reversed order so be sure to reverse the data so it is processed in time-forward order.

- Yahoo! Finance offers technical analysis tools where a user can apply smoothing or moving average (MA) filters with different lengths to analyze trends as we are doing in this problem.
- The M-point smoothing filter has an inherent $(M-1)/2$ sample delay, so the output "lags" the input by $(M-1)/2$ samples. For a prettier plot, advance the output by $(M-1)/2$ samples so the signals overlay properly.
- Ignore the input-on transient and zoom-in on your plot so that the vertical axis limits are between minimum and maximum data values.

Textbook Problems

3.2(b); 3.3(b), (d); 3.4(b)

You may use your convltn.m and/or fltr.m tools only for Probs. 4.15 and 4.16.

4.1 Also compute the convolution using the inner product method given in Lecture 7.
4.15 (a)–(d). Do not implement C routine. See p. 129 for convolution table.
4.16 (a)–(d). Do not implement C routine.