EE351M Digital Signal Processing  
Dept. of Electrical and Computer Engineering  
The University of Texas at Austin  
Homework #3

Date assigned: February 2, 2005  
Date due: February 9, 2005, beginning of class

Reading

Discrete-Time Signal Processing, Sections 2.0, 2.1, 2.2, 2.3

Problems from Discrete-Time Signal Processing

Solve the following problems from the text book Discrete-Time Signal Processing: 2.1, 2.7, 2.13, 2.14, 2.18, 2.19, 2.22

Problem 3.1

Use MATLAB to confirm your answers to Problem 2.22. Convolution is implemented in MATLAB with the conv function. Type help conv to see the usage of the function. Use stem to plot discrete-time signals. Use subplot to plot three signals in a single figure. For example the following code plots two random signals in a single figure:

\[
x_1 = \text{randn}(1,10); \quad \% \text{generate a gaussian random sequence of length 10}
\]

\[
x_2 = \text{randn}(1,10); \quad \% \text{generate a gaussian random sequence of length 10}
\]

\[
\text{subplot}(2,1,1); \quad \% \text{split figure into 2 rows and 1 column, choose the 1st window}
\]

\[
\text{stem}(x_1) \quad \% \text{stem plot } x_1 \text{ into the chosen window}
\]

\[
\text{subplot}(2,1,2) \quad \% \text{choose the 2nd window}
\]

\[
\text{stem}(x_2) \quad \% \text{stem plot } x_2 \text{ into the chosen window}
\]

Problem 3.2

A linear time-invariant system is described by the difference equation

\[
y[n] = 2x[n] - 3x[n-1] + 2x[n-2]
\]

a) When the input to this system is

\[
x[n] = \begin{cases} 
0 & n < 0 \\
n + 1 & n = 0, 1, 2 \\
n - 5 & n = 3, 4 \\
1 & n \geq 5 
\end{cases}
\]

Compute the values of \( y[n] \), over the range \( 0 \leq n \leq 10 \)

b) For the previous part, plot both \( x[n] \) and \( y[n] \)

c) Determine the response of this system to an unit impulse input; i.e., find the output \( y[n] = h[n] \) when the input is \( x[n] = \delta[n] \). Plot \( h[n] \) as a function of \( n \).