ELEC 466 : DIGITAL SIGNAL PROCESSING
1995/96 WINTER SESSION TERM 2

Mid-Term Review Assignment

1. An analog signal is composed of the sum of a two sine waves. The first has amplitude 3 and frequency of 2 kHz. The second has amplitude 5 and frequency 5 kHz. This signal is (ideally) sampled with a sampling frequency of 8 kHz. Sketch the spectrum of the sampled signal.

2. The signal is now passed through a Butterworth low-pass filter to try to remove the 5 kHz signal before it is sampled. What is the lowest order filter (n) that would need to be used to reduce the power of the 5 kHz signal to a level that was the same or lower than the quantization noise power if an 8-bit A/D converter was to be used?

3. Compute the linear convolution of the sequences $\{2, 2\}$ and $\{3, 1, 2\}$. Use the properties of linear systems to find the convolution of the sequences $\{4, 4\}$ and $\{6, 2, 4\}$.

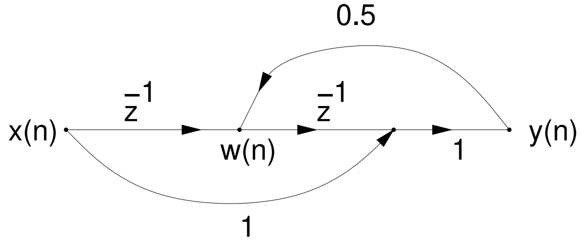
4. Compute the inverse DFT of the sequence $\{2, 0, 0, 1\}$.

5. Compute the (forward) DFT of the above sequence.

6. Draw the signal flow graph for a 4-point FFT that computes the DFT, $X(k)$ of a sequence $x(n)$. Label the input and output nodes and show the values of the twiddle factors.

7. Compute the z-transform of the sequence $\{1, 0, 2\}$.

8. Find the z-domain transfer function for the system defined by the following signal flow graph:



   - Find and plot the poles and zeros of the transfer function.
   - Is this system stable?
   - Find the first 3 values of the impulse response of the system by:
     - long division of the transfer function
     - computing the impulse response from the difference equation

You need to design a filter for the output of a toy that speaks. Would an FIR or IIR design be more suitable? Why?