

# Signal Processing Homework #1

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1. Determine the convolution  $y[n] = x[n] * h[n]$  for  $x[n] = 3\delta[n-2] - 2\delta[n+1]$  and  $h[n] = -2\delta[n+2] + 4\delta[n] - 2\delta[n-1]$ .

2. Consider the system

$$y[n] = T(x[n]) = x[n^2].$$

Is this system (1)stable, (2)causal, (3)linear and (4)time-invariant?

3. The input and output of a causal LTI system satisfy the difference equation

$$y[n] = \alpha y[n-1] + x[n].$$

For what values of  $\alpha$ , the system is stable?

4. A sequence has the DTFT

$$X(e^{j\omega}) = \frac{1 - \alpha^2}{(1 - \alpha e^{-j\omega})(1 - \alpha e^{j\omega})}$$

Find the sequence  $x[n]$ .

5. Design a length-4 FIR lowpass filter with symmetric impulse response  $h[n]$ , that is

$$h[0] = h[3], \quad h[1] = h[2],$$

and satisfying the following magnitude response values:

$$|H(e^{j0.2\pi})| = 0.8, \quad |H(e^{j0.5\pi})| = 0.5$$

Plot the phase and magnitude response of the filter.