HW#1

1. (Example 2.1)

Consider the discrete-time LTI system model $y[n] = x[n] + \frac{1}{2}x[n-1]$.

Letting $x[n] = \delta[n]$, we find that the impulse response is $h[n] = \begin{cases} 1, & n = 0 \\ \frac{1}{2}, & n = 1 \\ 0, & \text{otherwise} \end{cases}$.

Determine the output of this system in response to the input $x[n] = \begin{cases} 2, & n = 0 \\ 4, & n = 1 \\ -2, & n = 2 \\ 0, & \text{otherwise} \end{cases}$.

2. (Example 2.2)

Consider a system with impulse response $h[n] = \left(\frac{3}{4}\right)^n u[n]$. Use $y[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k] = \sum_{k=-\infty}^{\infty} \omega_n[k]$ to determine the output of the system at time $n = -5$, $n = 5$, and $n = 10$ when the input is $x[n] = u[n]$.

3. (Example 2.3)

The output $y[n]$ of the four-point moving-average system is related to the input $x[n]$ according to the formula $y[n] = \frac{1}{4}\sum_{k=0}^{3} x[n-k]$. The impulse response $h[n]$ of this system is obtained by letting $x[n] = d[n]$, which yields $h[n] = \frac{1}{4}(u[n] - u[n-4])$. Determine the output of the system when the input is the rectangular pulse defined as $x[n] = u[n] - u[n-10]$.

4. (Example 2.4)

The input-output relationship for the first-order recursive system is given by $y[n] - \rho y[n-1] = x[n]$. Let the input be given by $x[n] = b^n u[n+4]$. We use convolution to find the output of this system, assuming that $b \neq \rho$ and that the system is causal.