Exercises Week 6

DSP

1. Consider the system with the following system equation:

$$y[n] = -0.1y[n-1] + 0.2y[n-2] + x[n] + x[n-1]$$

   a. Find the system function H(z), draw the pole-zero diagram, and specify if the system is stable
   b. Compute the impulse response $h[n]$ of the system
   c. Compute the response of the system to the unit step $x[n] = u[n]$
   d. Compute the response of the system to the input signal $x[n] = \left(\frac{1}{3}\right)^n u[n]$

2. A causal LTI system has the property that if the input signal is

$$x[n] = \left(\frac{1}{3}\right)^n u[n] - \frac{1}{4}\left(\frac{1}{3}\right)^n u[n-1],$$

   then the output signal is

$$y[n] = \left(\frac{1}{4}\right)^n u[n]$$

   a. Find the system function H(z), draw the pole-zero diagram
   b. Compute the impulse response $h[n]$ of the system
   c. Find the difference equation of the system
   d. Characterize the system with respect to:
      - length of impulse response (FIR or IIR)
      - implementation (recursive or non-recursive)
      - stability