ECE 401 Signal and Image Analysis
Homework 6

UNIVERSITY OF ILLINOIS
Department of Electrical and Computer Engineering

Assigned: Monday, 11/15/2021; Due: Monday, 11/29/2021
Reading: DSP First Chapters 9 and 10

Problem 6.1

Consider the difference equation:

\[ y[n] = x[n] - \frac{1}{2} x[n-1] + \frac{1}{4} x[n-2] \]

Find the frequencies, \( \omega = \angle z_1 \) and \( \omega = \angle z_2 \), of the two zeros.

Problem 6.2

A particular filter has the difference equation

\[ y[n] = x[n] - 1.2e^{3\pi/5} x[n-1] + 0.8e^{2\pi/5} y[n-1] \]

Express the frequency response of this filter as

\[ H(\omega) = \frac{e^{j\omega} - z_1}{e^{j\omega} - p_1} \]

for some zero \( z_1 \) and pole \( p_1 \).

Problem 6.3

Remember that

\[ G(z) = \frac{1}{1 - 0.8z^{-1}} \leftrightarrow g[n] = (0.8)^n u[n] \]

Use the linearity and time-shift properties of the Z-transform to find \( h[n] \), where

\[ H(z) = \frac{1 - 0.3z^{-1}}{1 - 0.8z^{-1}} = \frac{1}{1 - 0.8z^{-1}} - 0.3z^{-1} \frac{1}{1 - 0.8z^{-1}} \]

Problem 6.4

What is \( h[n] \) if

\[ H(z) = \frac{1}{(1 - e^{j0.1\pi} z^{-1})(1 - e^{-j0.1\pi} z^{-1})} \]