

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN  
Department of Electrical and Computer Engineering  
ECE 498MH SIGNAL AND IMAGE ANALYSIS

**Homework 9**  
Fall 2014

Assigned: 4/13/2017

Due: 4/13/2017

Reading: 394–415

**Problem 9.1**

Consider the following IIR filter:

$$y[n] = x[n] - 0.2x[n - 1] - 0.2y[n - 1] \quad (1)$$

(a)

$$h[n] = (-0.2)^n u[n] - 0.2(0.2)^{n-1} u[n - 1]$$

(b)

$$H(z) = \frac{1}{1 + 0.2z^{-1}} - \frac{0.2z^{-1}}{1 + 0.2z^{-1}}$$

(c)

$$H(z) = \frac{1 - 0.2z^{-1}}{1 + 0.2z^{-1}}$$

(d)

$$|H(e^{j\omega})| = \left| \frac{1 - 0.2e^{-j\omega}}{1 + 0.2e^{-j\omega}} \right|$$

For example  $|H(e^{j0})| = 0.8/1.2$ ,  $|H(e^{j\pi})| = 1.2/0.8$ , so it's kind of a highpass filter.

**Problem 9.2**

Consider the following IIR filter:

$$y[n] = x[n] + 0.2x[n - 1] + 0.2y[n - 1] \quad (2)$$

(a)

$$h[n] = (0.2)^n u[n] + 0.2(0.2)^{n-1} u[n - 1]$$

(b)

$$H(z) = \frac{1}{1 - 0.2z^{-1}} + \frac{0.2z^{-1}}{1 - 0.2z^{-1}}$$

(c)

$$H(z) = \frac{1 + 0.2z^{-1}}{1 - 0.2z^{-1}}$$

(d)

$$|H(e^{j\omega})| = \left| \frac{1 + 0.2e^{-j\omega}}{1 - 0.2e^{-j\omega}} \right|$$

For example  $|H(e^{j0})| = 1.2/0.8$ ,  $|H(e^{j\pi})| = 0.8/1.2$ , so it's kind of a lowpass filter.