Name __ANSWERS__

EE-3220-11 – Dr. Durant – Quiz 3
Winter 2015-'16, Week 3

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1. (2 points) ***Calculate*** the first 4 samples of the unit ***impulse*** response of y(n) = 0.8 y(n–1) + x(n) – 2x(n–1) + 3x(n–2). Recall that the impulse response is y(n) when x(n) = δ(n).

   - y(0) = 0.8 y(–1) + x(0) – 2x(–1) + 3x(–2) = 0.8×0 + ***1*** – 2×0 + 3×0 = 1
   - y(1) = 0.8 y(0) + x(1) – 2x(0) + 3x(–1) = 0.8×1 + 0 – 2×***1*** + 3×0 = -1.2
   - y(2) = 0.8 y(1) + x(2) – 2x(1) + 3x(0) = 0.8×-1.2 + 0 – 2×0 + 3×***1*** = 2.04
   - y(3) = 0.8 y(2) + x(3) – 2x(2) + 3x(1) = 0.8×2.04 + 0 – 2×0 + 3×0 = 1.632

2. (2 points) ***Calculate*** the first 4 samples of the unit ***step*** response of the above difference equation. Recall that the step response is y(n) when x(n) = u(n).

   - y(0) = 0.8 y(–1) + x(0) – 2x(–1) + 3x(–2) = 0.8×0 + ***1*** – 2×0 + 3×0 = 1
   - y(1) = 0.8 y(0) + x(1) – 2x(0) + 3x(–1) = 0.8×1 + 1 – 2×***1*** + 3×0 = -0.2
   - y(2) = 0.8 y(1) + x(2) – 2x(1) + 3x(0) = 0.8×-0.2 + 1 – 2×1 + 3×***1*** = 1.84
   - y(3) = 0.8 y(2) + x(3) – 2x(2) + 3x(1) = 0.8×1.84 + 1 – 2×1 + 3×1 = 3.472

3. (2 points) ***Re-write*** the equation in standard form. ***Indicate*** the name of each coefficient (a_1, etc.).

   - y(n) - 0.8 y(n–1) = x(n) – 2x(n–1) + 3x(n–2)
   - a_0 y(n) + a_1 y(n–1) = b_0 x(n) + b_1 x(n–1) + b_2 x(n–2)

4. (2 points) What is the vector of "a" or autoregressive or IIR (infinite impulse response) coefficients in the above equation? (Recall that the "b" or FIR coefficients correspond to a weighted sum of inputs.)

   - a = [1 -0.8]

5. (2 points) ***Write MATLAB code*** using filter function in MATLAB that calculates the first 10 samples of the unit ***impulse*** response, h. Write the complete code needed to calculate h.

   - h = filter([1 -2 3], [1 -0.8], [1 zeros(1,9)]);

Checking results in MATLAB:

```
a = [1 -0.8]; % move a1 to left side for standard form
b = [1 -2 3];

% Problem 1
y1 = filter(b,a,[1 0 0 0])

% Problem 2
y2 = filter(b,a,ones(1,4))

% Problem 5
h = filter([1 -2 3], [1 -0.8], [1 zeros(1,9)])

%{
Output
quiz3
y1 =
    1.0000   -1.2000    2.0400    1.6320
y2 =
    1.0000   -0.2000    1.8400    3.4720
h =
  Columns 1 through 9
    1.0000   -1.2000    2.0400    1.6320    1.3056    1.0445    0.8356    0.6685    0.5348
  Column 10
    0.4278
%}
```