

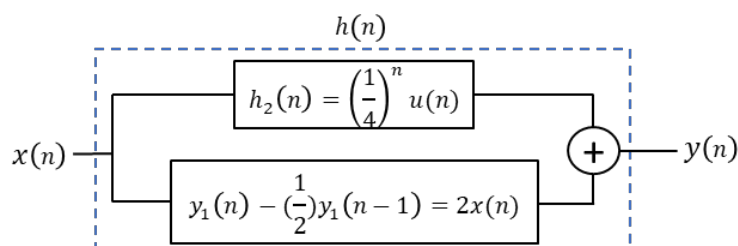


ECE 4830 Signal Processing II.

Laboratory 2

Problem 1

Find the first three samples in time ($h(0)$, $h(1)$ and $h(2)$) of the overall impulse response $h(n]$ (dashed rectangle) of the following causal LTI system.



Please check your solution using Matlab. You may be interested on using the following command in Matlab:

$y = \text{filter}(b, a, x)$ filters the input data x . For example, a system like $y(n) - 0.2y(n - 1) = x(n)$ would have

$b = 1;$

$a = [1 \ -0.2];$

Problem 2

For a system described as a difference equation in time. Answer the following questions with a yes or no. Please circle the answer in this page.

- a) If initial conditions are zero, the zero-input response would yield the impulse response
YES NO
- b) If initial conditions are non-zero, then I can use these initial condition values to compute the impulse response
YES NO

- c) I can compute the output of a system $y(n)$ for an input $x(n)$ using a convolution if I know the impulse response of the system.

YES

NO

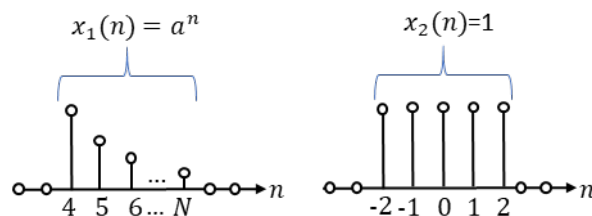
- d) I can compute the impulse response of a system using $h(n) = \frac{b_M}{a_N} \delta(n) + y_c(n)u(n)$ if the order associated to the input is greater than the output, that is $M > N$

YES

NO

Problem 3 (4 marks)

- (a) For the convolution $c(n) = x_1(n) * x_2(n)$ of the following signals where the length of $x_1(n)$ is much greater than the length of $x_2(n)$



select among the following options the time range where $c(n) \neq 0$

- (a) $c(n) \neq 0$ for $n \geq 2$ and $n \leq N - 1$
- (b) $c(n) \neq 0$ for $n \geq 2$ and $n \leq N + 1$
- (c) $c(n) \neq 0$ for $n \geq 2$ and $n \leq N$
- (d) $c(n) \neq 0$ for $n \geq 0$ and $n \leq N$
- (e) $c(n) \neq 0$ for $n \geq 0$ and $n \leq N - 1$
- (f) $c(n) \neq 0$ for $n \geq 0$ and $n \leq N + 1$
- (g) $c(n) \neq 0$ for $n \geq 2$ and $n \leq N + 2$
- (h) $c(n) \neq 0$ for $n \geq 2$ and $n \leq N - 2$
- (i) *none of the above*

What is the final length of the convolution.

(b)

- (A) $5+N-2$ (B) $5+N$ (C) $5+N-1$ (D) $5+N+1$
- (E) $4+N-2$ (F) $4+N$ (G) $4+N-1$ (H) $4+N+1$ (I) None of the options given

Problem 4

Find the mathematical expression of the zero impulse response of the same $y(n) + \frac{1}{2}y(n-1) - \frac{3}{4}y(n-2) = -\frac{3}{2}x(n) + \frac{3}{4}x(n-2)$ knowing that $y(-1) = 2$ and $y(-2) = 4$

Also verify your results using Matlab by calculating the values for $y(n)$ for $n = 0, 1, \dots, 10$