Full Name: _____ **Lab Section:** _____

EEL 4750 / EEE 5502 (Fall 2018) – HW #03 **Due Date: Sept. 13, 2018**

Homework learning objectives: By the end of this homework, you should be able to:

- Compute the output of a system from a known input
- Perform discrete-time convolution
- Determine if a system is memoryless, causal, and BIBO stable from the impulse response

Question #1: *(2 pts)* How many hours did you spend on this homework?

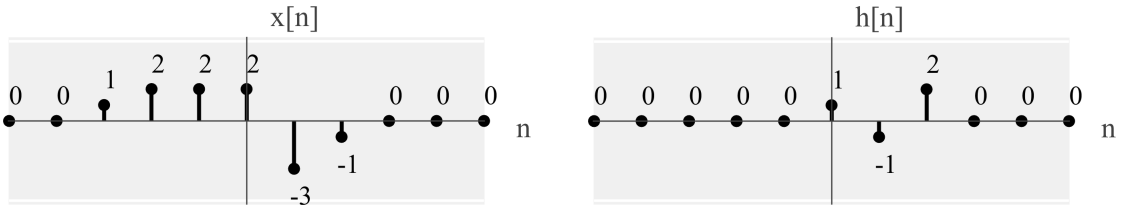
Question #2: *(6 pts)* Consider the system $y[n] = \mathcal{H}\{x[n]\} = \frac{1}{3}(x[n+1] + x[n] + x[n-1])$

(a) Compute the impulse response of this system $h[n]$. That is, compute $h[n] = \mathcal{H}\{\delta[n]\}$.

(b) Compute the system output for input $x[n] = [\delta[n] + 2\delta[n-3] - \delta[n-6]]$.

(c) Based on the previous results, what to you think is an application of this system?

Question #3: *(4 pts)* Consider the signal $x[n]$ and impulse response $h[n]$ plotted below.



(a) Sketch the convolution of $y_2[n] = x[n] * \delta[n-2]$

(b) Sketch the convolution of $y_2[n] = x[n] * h[n]$

Question #4: *(10 pts)* Consider the impulse response $h[n] = u[n-1]$.

(a) Write the impulse response $h[n]$ of this system.

(b) Is the LTI system defined by $h[n]$ causal? Why?

(c) Is the LTI system defined by $h[n]$ memoryless (instantaneous)? Why?

(d) Is the LTI system defined by $h[n]$ BIBO stable? Why?

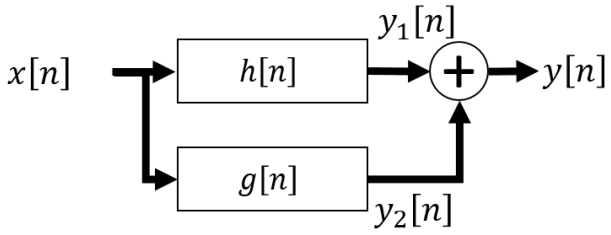
(e) Sketch the system output for input $x[n] = \delta[n] + \delta[n-1] - 2\delta[n-2]$

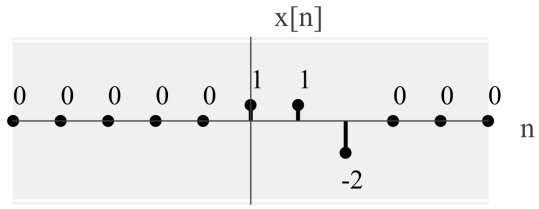
Question #5: *(10 pts)* Consider system illustrated below with impulse responses

$$h[n] = (1/2)(\delta[n] + \delta[n-1])$$

$$g[n] = (1/2)(\delta[n] - \delta[n-1])$$

and also consider the input below $x[n]$.





(a) Write the impulse response $h[n]$ of this system.

(b) Sketch the output $y_1[n]$ for input $x[n]$

(c) Sketch the output $y_2[n]$ for input $x[n]$

(d) Sketch the result $y[n]$ for input $x[n]$

(e) Show that the impulse response of the complete system is $h[n] = \delta[n]$

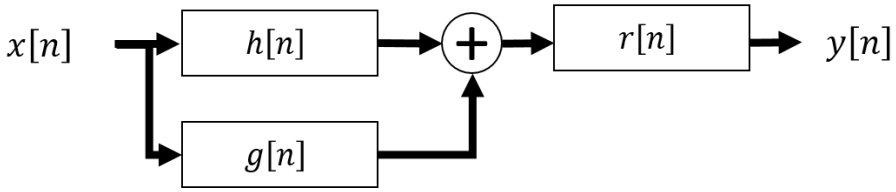
Question #6: *(8 pts)* Consider system illustrated below with impulse responses

$$h[n] = \delta[n-5]$$

$$g[n] = 4\delta[n+1]$$

$$r[n] = 10\delta[n] + 5\delta[n-1]$$

and also consider the input below $x[n]$.



(a) Write the impulse response $h[n]$ of the complete system.

(b) Is the system causal? Why?

(c) Is the LTI system defined by $h[n]$ memoryless (instantaneous)? Why?

(d) Is the LTI system defined by $h[n]$ BIBO stable? Why?