EE150 Signal and System
Homework 2

Due on 23: 59, Mar. 31, 2024.

Note:

- Please provide enough calculation process to get full marks.
- Please submit your homework to Blackboard in PDF version.
- It's highly recommended to write every exercise on a single sheet of page.
- Late submissions will have points deducted according to the penalty policy.
- Please use English only to complete the assignment, solutions in Chinese are not allowed.
- Plagiarizer will get zero points.
- The full score of this assignment is 100 points.

Exercise 1. (25pt)

For each pair of sequences in Figure 1, use discrete convolution to find the response to the input $x[n]$ of the linear time-invariant system with impulse response $h[n]$.

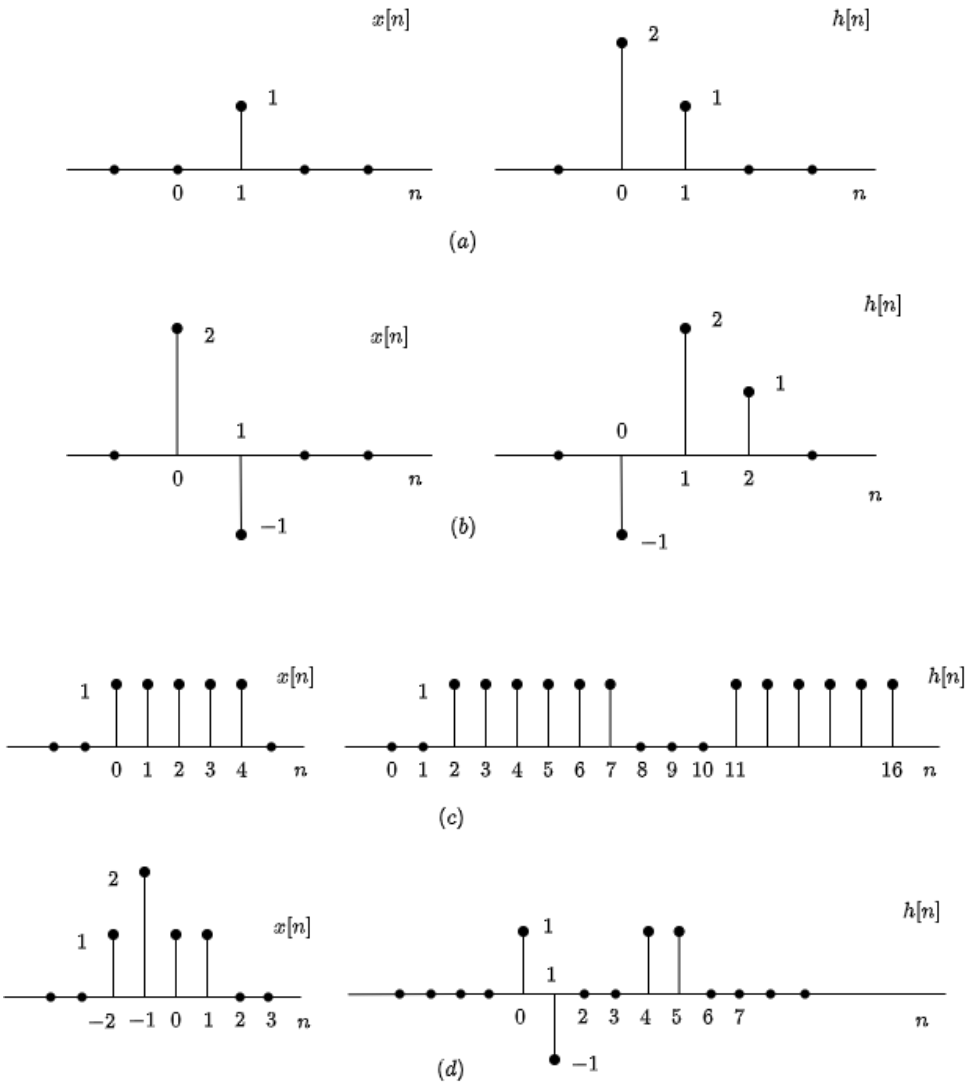


Figure 1: Excerse 1

Exercise 2. (25pt)

(a) Suppose that the LTI system of Figure 2(1) has the input $x(t)$ given in Figure 2(2). The impulse response is the unit step function $h(t) = u(t)$. Find and sketch the system output $y(t)$.

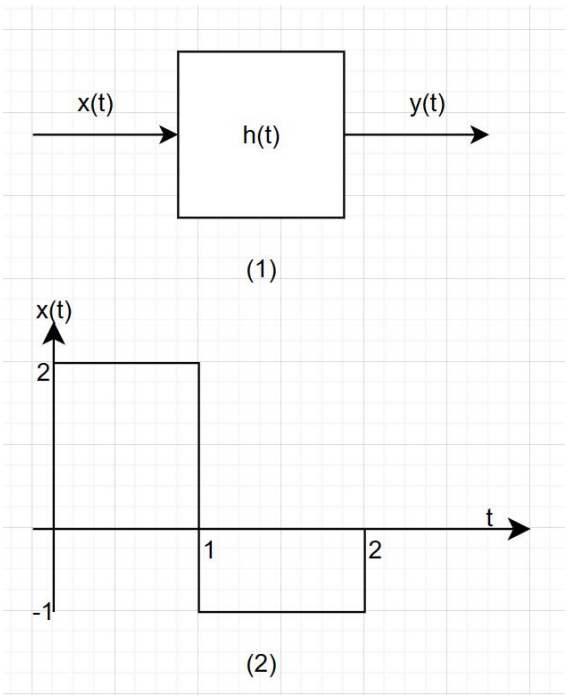


Figure 2: Exercise 2(a)

(b) For the system of Figure2(1), the input signal is $x(t)$, the output is $y(t)$, and the impulse response is $h(t)$. For each of the cases that follow, find and plot the output $y(t)$. The referenced signals are given in Figure 3.

(i) $x(t)$ in Figure 3(1), $h(t)$ in Figure 3(2)

(ii) $x(t)$ in Figure 3(1), $h(t)$ in Figure 3(1)

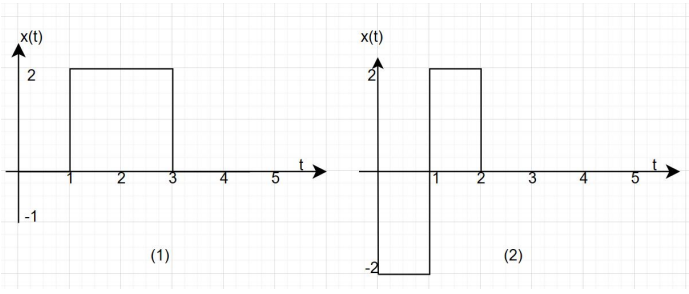


Figure 3: Exercise 2(b)

Exercise 3. (25pt)

For each of the following statements, determine whether it is true or false.

(a) If $x[n] = 0$ for $n < N_1$ and $h[n] = 0$ for $n < N_2$, then $x[n] * h[n] = 0$ for $n < N_1 + N_2$.

(b) If $y[n] = x[n] * h[n]$, then $y[n-1] = x[n-1] * h[n-1]$.

(c) If $y(t) = x(t) * h(t)$, then $y(-t) = x(-t) * h(-t)$.

(d) If $x(t) = 0$ for $t > T_1$ and $h(t) = 0$ for $t > T_2$, then $x(t) * h(t) = 0$ for $t > T_1 + T_2$.

(e) If an LTI system is causal, it is stable.

(f) The cascade of a non-causal LTI system with a causal one is necessarily non-causal.

(g) A continuous-time LTI system is stable if and only if its step response $s(t)$ is absolutely integrable—that is, if and only if $\int_{-\infty}^{+\infty} |s(t)|dt < \infty$.

Exercise 4. (25pt)

Consider an LTI system with the input and output related by

$$y[n] = 0.5x[n-1] + 0.7x[n]$$

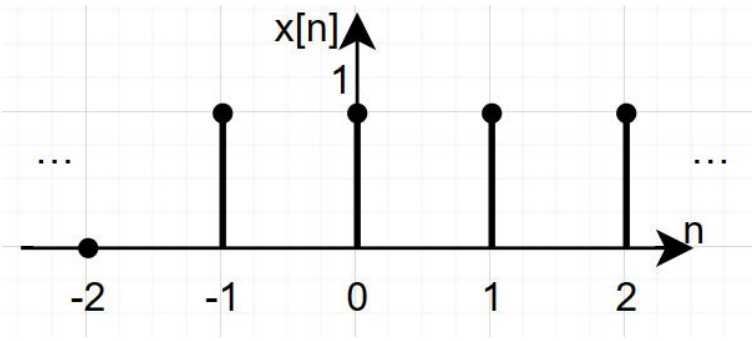
(a) Find the system impulse response $h[n]$.

(b) Is this system causal? Why?

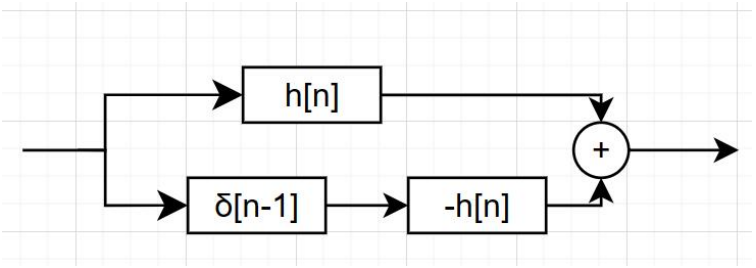
(c) Determine the system response $y[n]$ for the input shown in Figure 4(a).

(d) Consider the interconnection of the LTI systems gives in Figure 4(b), where $h[n]$ is the function found in sub-problem (a). Find the impulse response of the total system.

(e) Solve the response of the system of sub-problem (d) for the input of sub-problem (c).



(a) Input for (c)



(b) LTI system for (d)

Figure 4: Exercise 4