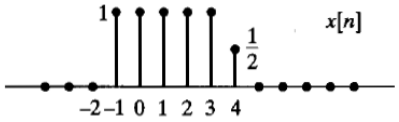
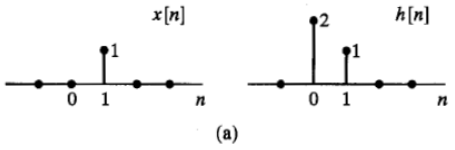
Convolution and its properties

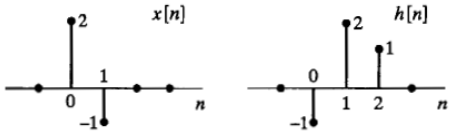
Important note: *A step function is denoted by either* $s[n]$ *or* $u[n]$

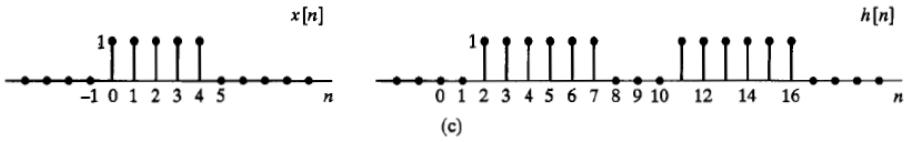
1. A discrete time signal is given in the following Figure:

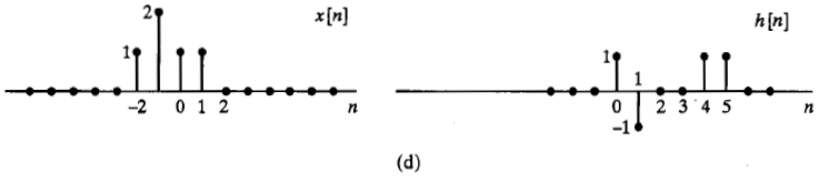


   Sketch and label carefully each of the following signals:
   a. $x[n-2]$
   b. $x[4-n]$
   c. $x[2n]$
   d. $x[n]u[2-n]$
   e. $x[n-1]\delta[n-3]$
2. Determine the output of the system described by the impulse response $h[n]$ for the corresponding input in each of the following cases:

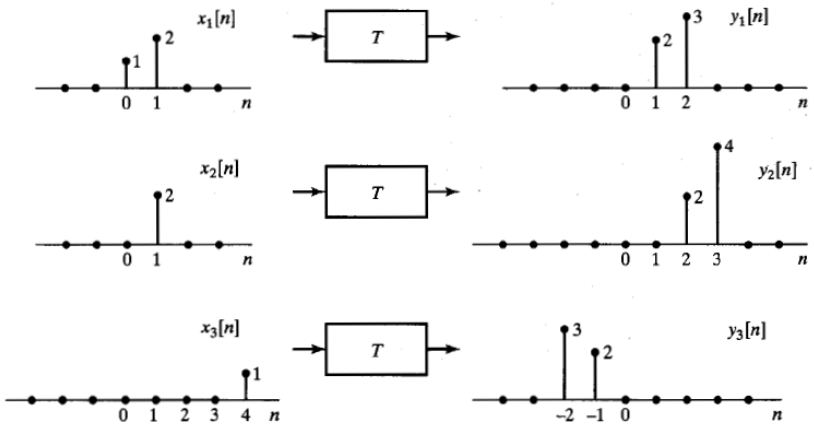








3. The system T is known to be shift invariant. The following figure gives the output of the system for three inputs:



a. Determine whether or not the system can be linear.
b. What is the response of the system to a unit impulse input?
c. What are all possible input signals for which we can determine the output of this system?

4. Find the convolution of the following two signals using both the input-side and output-side algorithms:

$$x[n]=\begin{cases}0 & n<0\\ n & 0\le n\le 4\\ 0 & n>4\end{cases},\qquad h[n]=\begin{cases}\dfrac{1}{n} & 1\le n\le 3\\ \dfrac{-1}{n} & 4\le n\le 6\\ 0 & otherwise\end{cases}$$

5. Write a program to calculate the convolution of two signals using the output side algorithm. Assume that the size of the input is 101 points and the size of the impulse response is 32 points. What will be the required size of the array holding the output? Which samples of the output are not reliable (if any) and why?