I. Given two discrete signals are

$$x_1[n] = \begin{cases} n, & 1 \le n \le 5 \\ 10 - n, & 6 \le n \le 9 \\ 0, & elsewhere \end{cases}$$

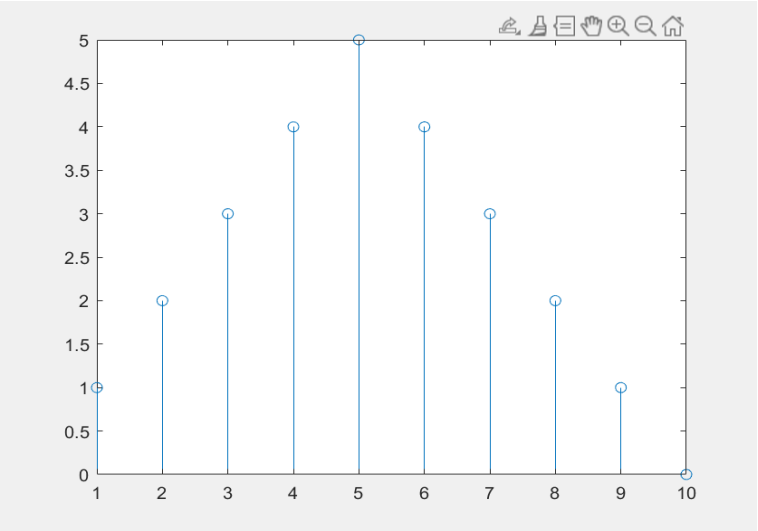
And

$$x_2[n] = u[n-1] - u[n-5]$$

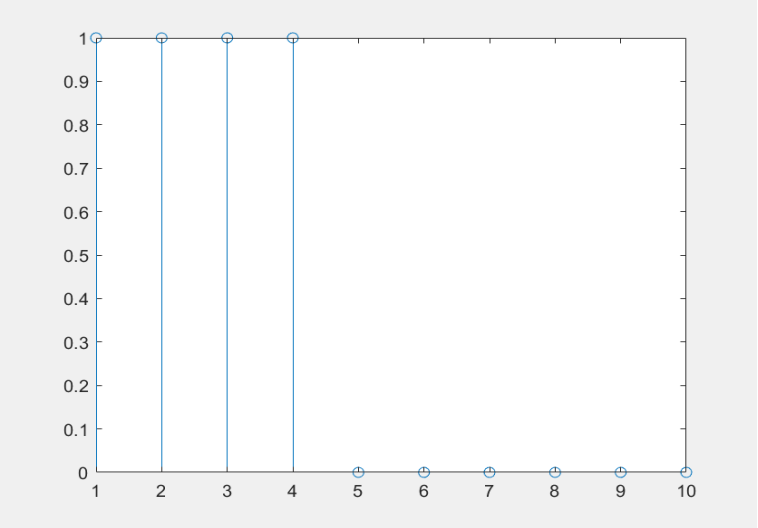
where u means the unit step function.

a. Use the MATLAB function stem to plot x1[n] vs n and x2[n] vs n.

x1[n] vs n

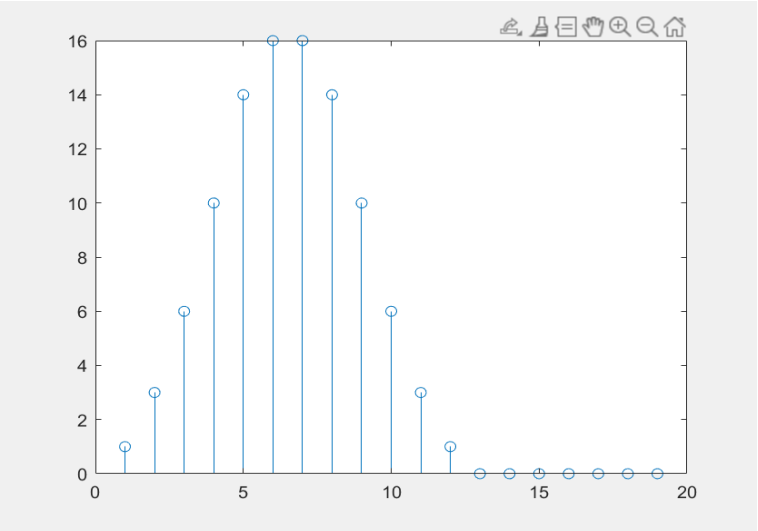


x2[n] vs n



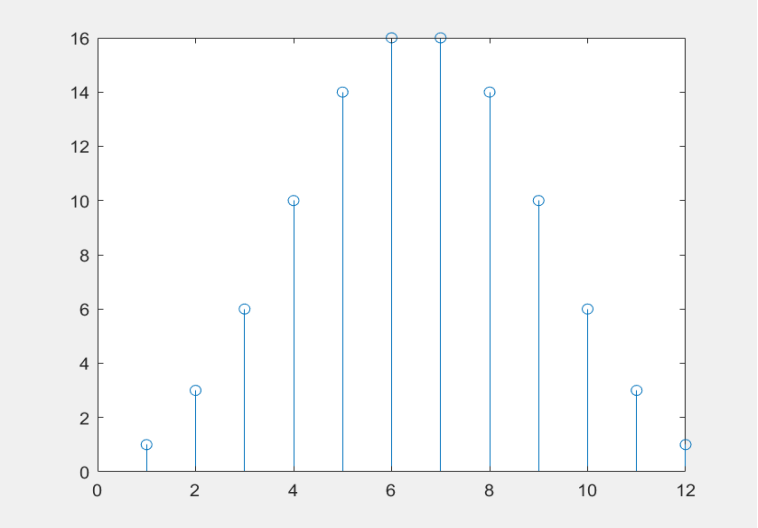
b. Directly use the MATLAB function conv to compute equation (1) and use stem to plot the output y[n] vs n.

y[n] vs n (using function conv)



c. Create a MATLAB program by yourself to compute equation (1) by using equation (3) matrix form and use stem to plot the output y[n] vs n. (You should verify whether the answer is the same as question b.)

y[n] vs n (using eq.3)



➢ Yes, the answer is the same as question b.

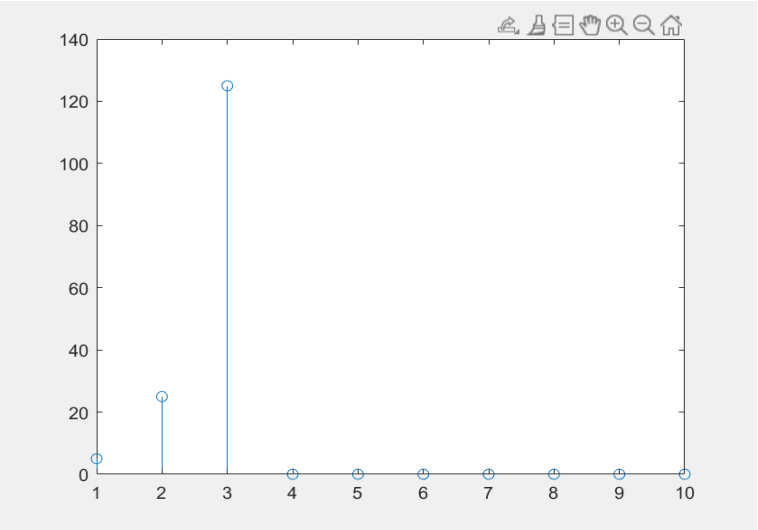
II. Repeat question I. again, but x1[n] and x2[n] are changed to the following:

$$x_1[n] = \begin{cases} 5^n u[n], & 1 \le n \le 3 \\ 0, & elsewhere \end{cases} ;$$

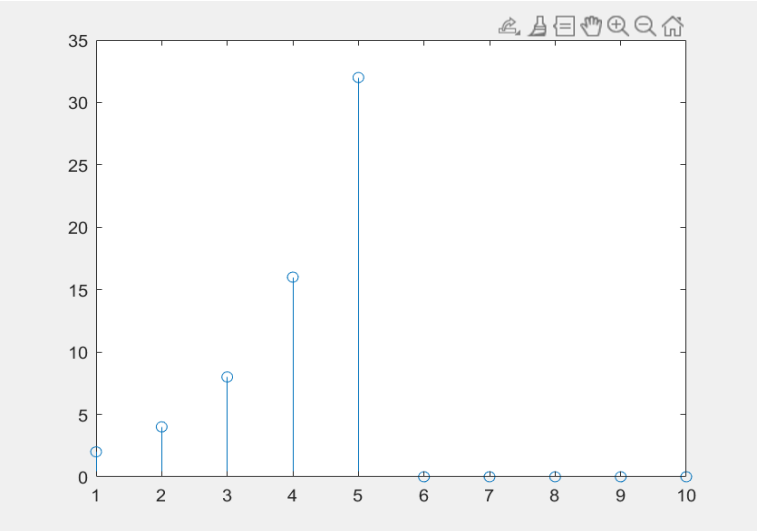
$$x_2[n] = \begin{cases} 2^n u[n-1], & 1 \le n \le 5 \\ 0, & elsewhere \end{cases} .$$

a.

x1[n] vs n

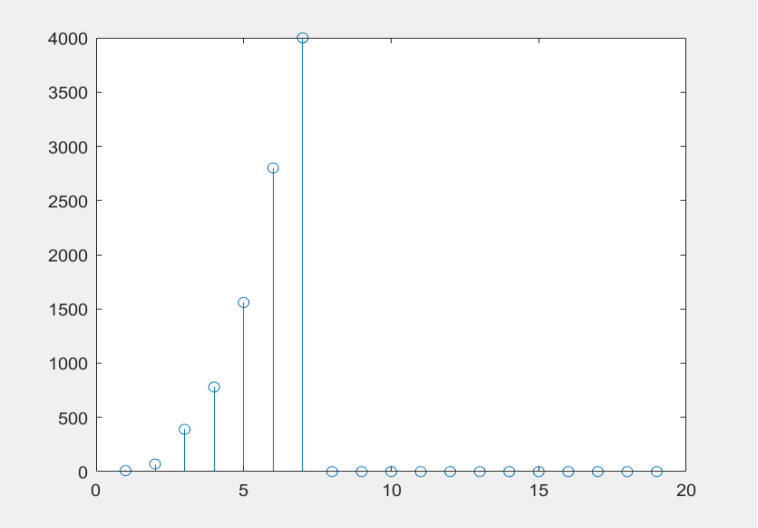


x2[n] vs n



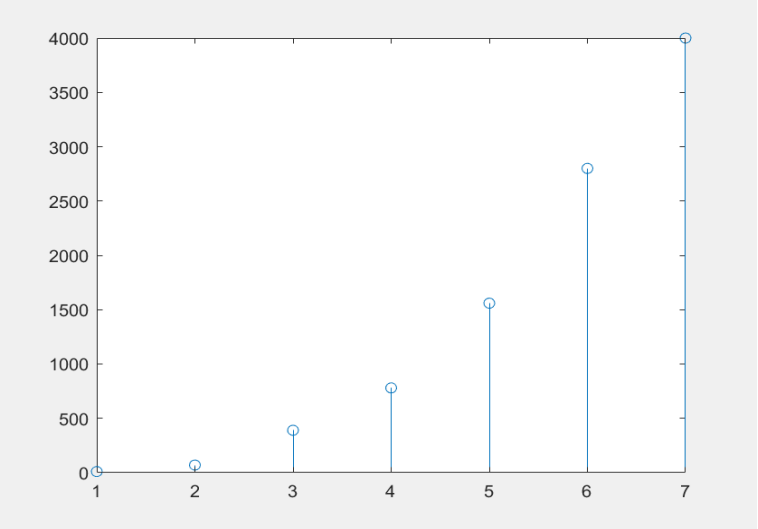
b.

y[n] vs n (using function conv)



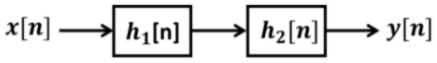
c.

y[n] vs n (using eq.3)



➢ Yes, the answer is the same as question b.

III. Consider the cascade of two discrete LTI systems as in the figure below,



where

$$h_1[n] = cos\left[\frac{\pi n}{4}\right](u[n] - u[n-9])$$

and

$$h_2[n] = a^n(u[n] - u[n-9])$$

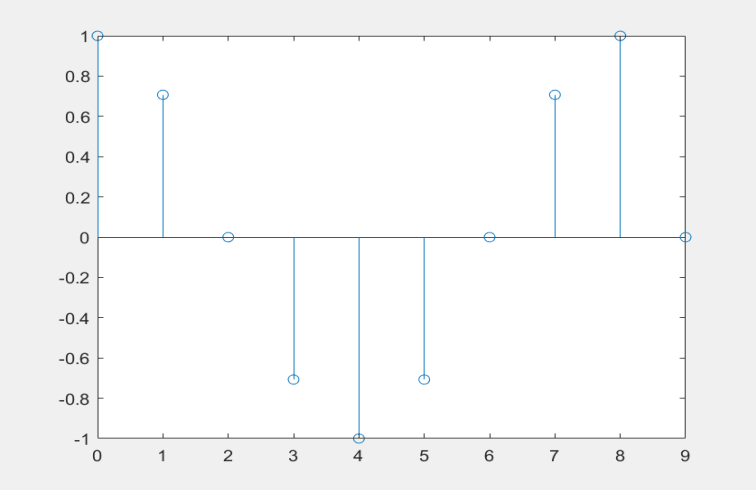
and where the input is

$$x[n] = \delta[n] - a\delta[n-1],$$

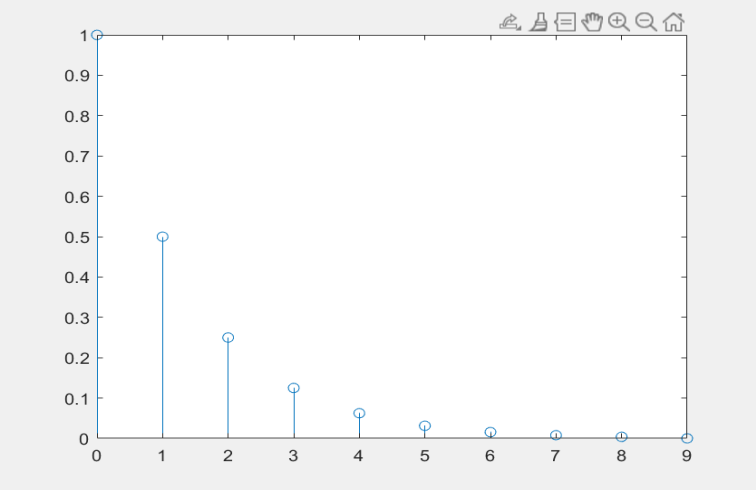
where δ means the unit delta function and a = 0.5 .

a. Use the MATLAB function stem to plot h1[n] vs n, h2[n] vs n, and x[n] vs n.

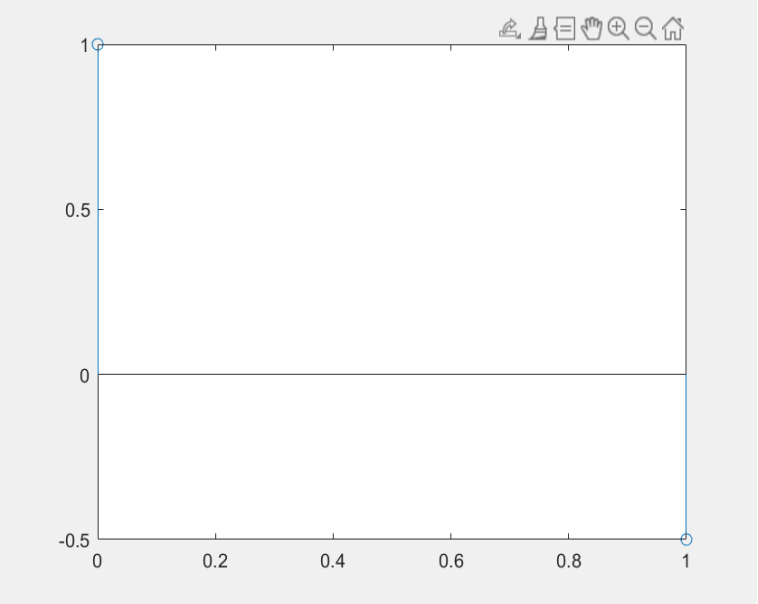
h1[n] vs n



h2[n] vs n

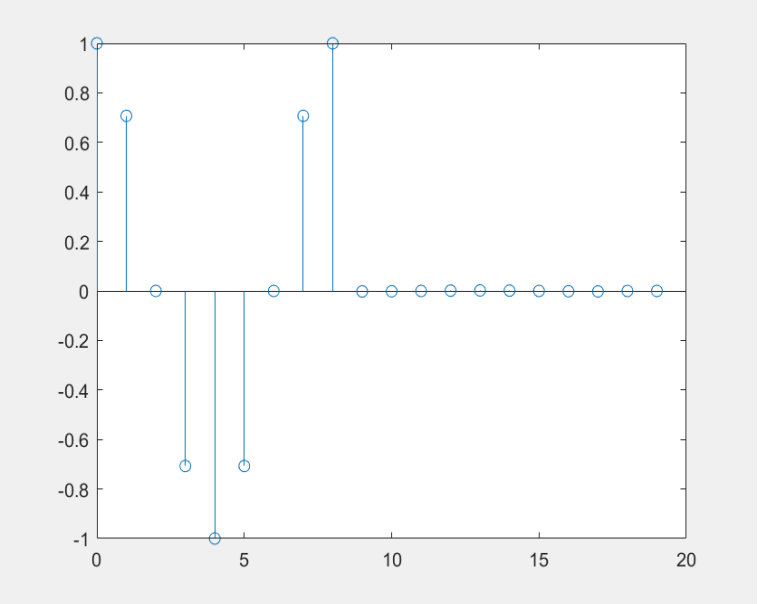


x[n] vs n



b. Directly use the MATLAB function conv to compute y[n] and use stem to plot the output y[n] vs n. Besides, is y[n] the same as h1[n] or h2[n] for $0 \le n \le 8$? Please explain why.

y[n] vs n (using function conv)



- y[n] is similar to h1[n] for $0 \le n \le 8$
- x[n]與 h1[n] convolution 後在 $0 \le n \le 8$ 產生 h1[n] – a * h1[n-1]的輸出，將 h1[n]分成$\delta[n]$、$\delta[n-1]$、…、$\delta[n-8]$討論，可以知道輸出的每一根$\delta[n-b]$(b = 0, 1, …, 8)，都能視作 h2[n-b]的圖形減去 h2[(n-b)-1]圖形乘上 a 倍相減後，落在 n=b 上的結果，這個結果很近似於$\delta[n-b]$，故輸出結果會很接近 h1[n]的圖形。