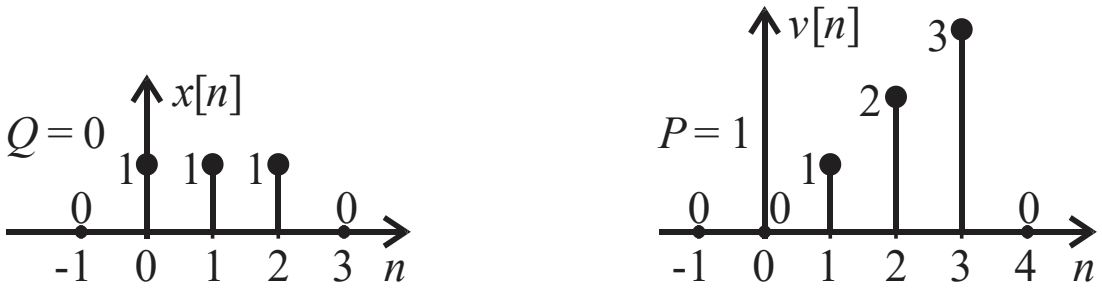
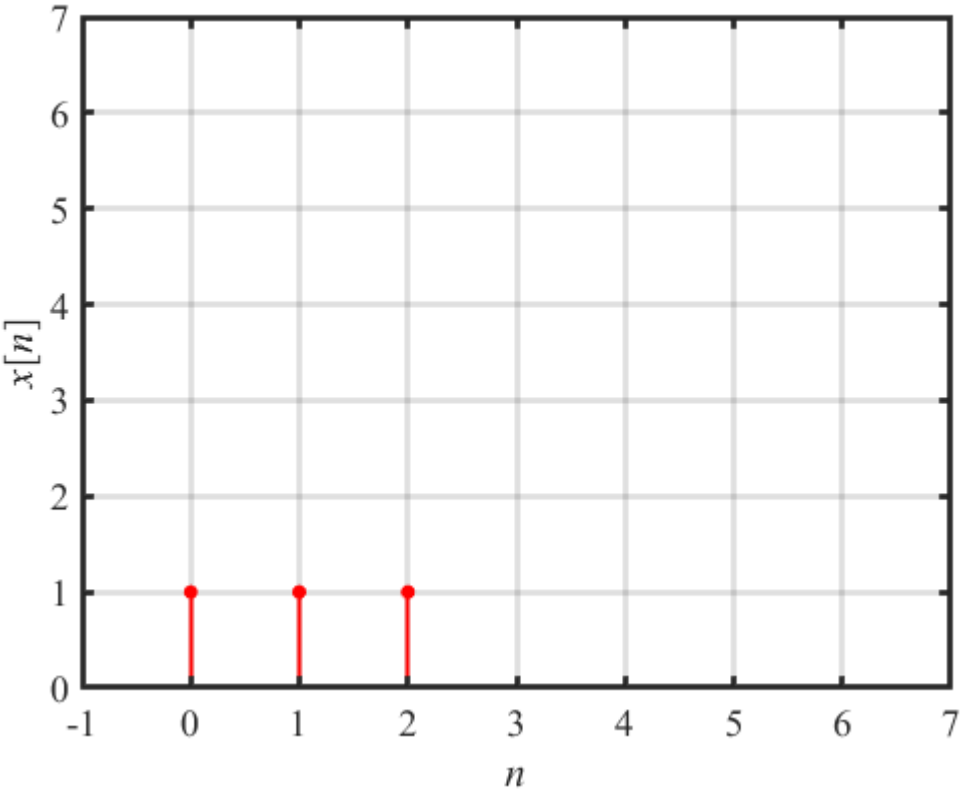
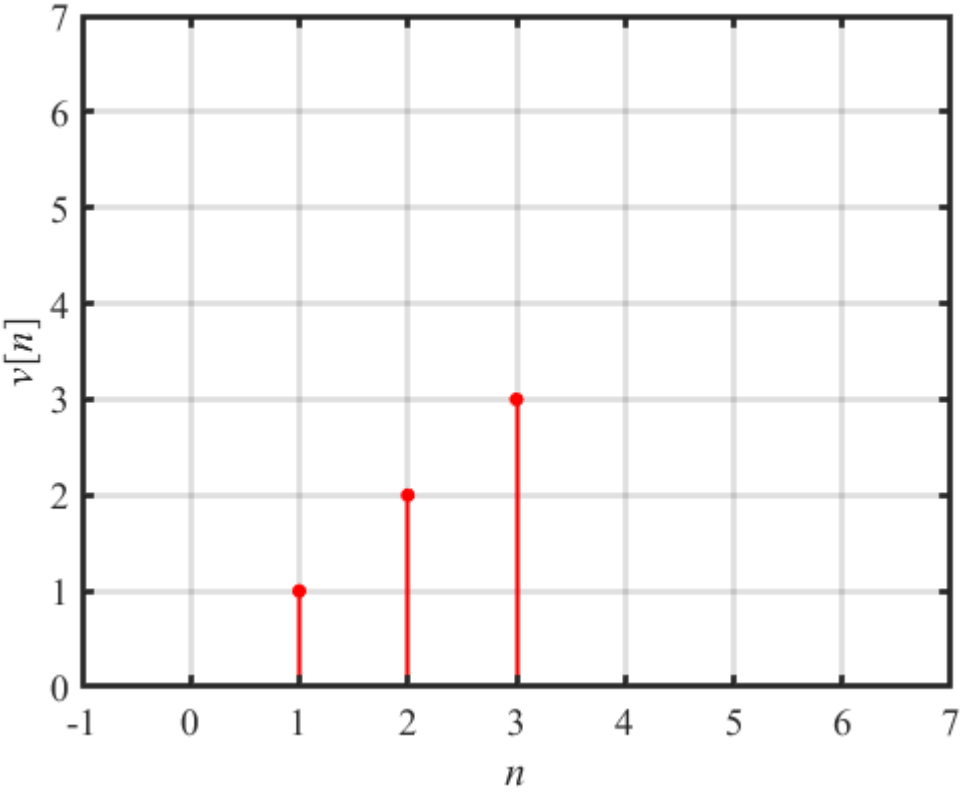
Ex. Convolve the signals $x[n]$ and $v[n]$ (shown below) using Matlab.

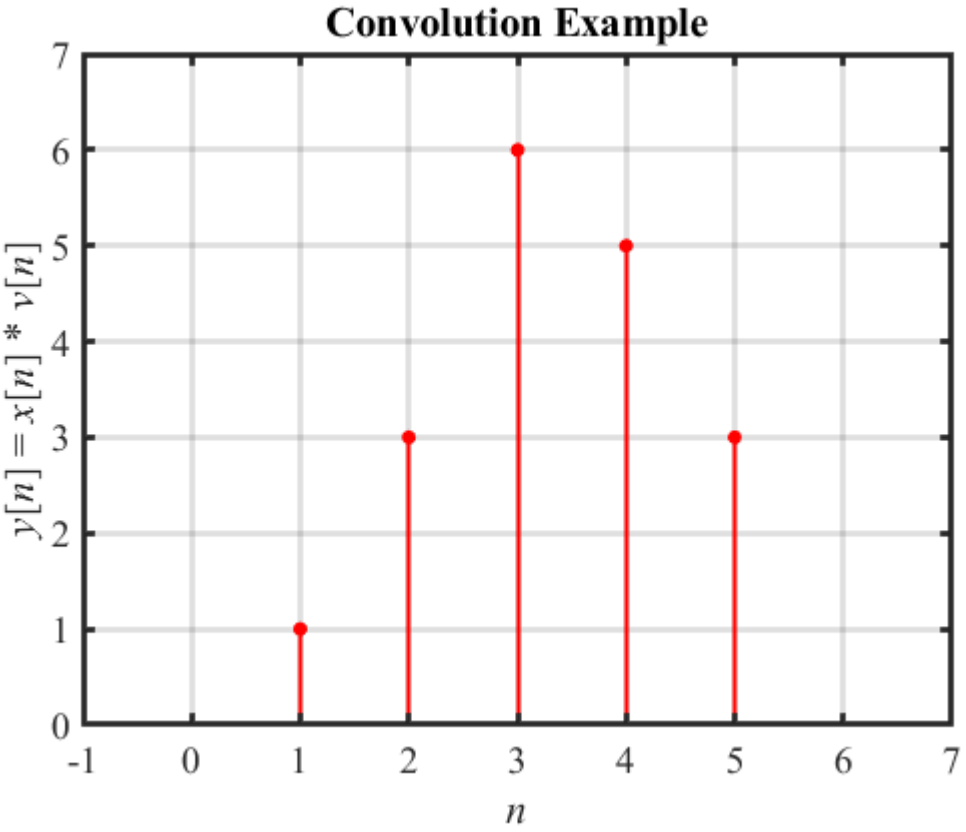



```
% Matlab DT Convolution Example (chap2_matlab_convolution.m)
%  Compute y[n]=x[n]*v[n] where
%  x[n] = u[n]-u[n-3] = p3[n-1]; rectangular pulse 3 steps long
%  v[n] = r[n]u[n] - r[n]u[n-4]; first 4 steps of a ramp function
clear; clc; close all
Q = 0; %starting index for x[]
P = 1; %starting index for v[]
x=[1,1,1]; % Define input vector x[n]
v=[1,2,3]; % Define input vector v[n]
nx = Q:1:(Q+length(x)-1); % Compute indices for x[n]
nv = P:1:(P+length(v)-1); % Compute indices for v[n]
% plot input x[n]
stem(nx,x,'r.','linewidth',1.5,'markersize',18);
axis([-1 7 0 7]), grid,
ylabel('{\itx}[{\itn}]','fontsize',14,'fontname','times'),
xlabel('{\itn}','fontsize',14,'fontname','times'),
% plot input v[n]
figure; stem(nv,v,'r.','linewidth',1.5,'markersize',18),
axis([-1 7 0 7]), grid,
ylabel('{\itv}[{\itn}]','fontsize',14,'fontname','times'),
xlabel('{\itn}','fontsize',14,'fontname','times'),
% Compute the output y[n] using conv.m and plot
y=conv(x,v);
n=(P+Q):1:(P+Q+length(y)-1); % Compute indices for y[n]
figure; stem(n,y,'r.','linewidth',1.5,'markersize',18),
axis([-1 7 0 7]),grid,
ylabel('{\ity}[{\itn}] = {\itx}[{\itn}] * {\itv}[{\itn}]',...
    'fontsize',14,'fontname','times'),
xlabel('{\itn}','fontsize',14,'fontname','times'),
title('Convolution Example','fontsize',16,'fontname','times'),
set(findobj('type','line'),'linewidth',1.5,'markersize',18)
set(findobj('type','axes'),'linewidth',2,'fontsize',14,'fontname','times')
```


x[n]
n
-1
0
1
2
3
4
5
6
7

*


v[n]
n
-1
0
1
2
3
4
5
6
7



Once again, we get the same answer.

Note:

- First non-zero term of $y[n]$ occurs at index $n = P + Q = 0 + 1 = \mathbf{1}$
- The length of $y[n]$ is $\{\text{length}(x[n]) + \text{length}(v[n]) - 1\} = 3 + 3 - 1 = \mathbf{5}$
- Last non-zero term of $y[n]$ occurs at $n = P + Q + \text{length}(y[n]) - 1$
  $= 0 + 1 + 5 - 1 = \mathbf{5}$