Lab Assignment – 02 – Spring 2020

Signal & Systems

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Plotting Graphs of Signals Given x(t) & y(t)

- This lab session mainly dealt with two parts. The first part consisted of plotting the graph of product of the shifted and scaled version of two continuous signals x(t) and y(t).
- While the second part had just a slight difference that the signals x(t) & y(t) were discrete and not continuous.

1. For the given signals

$$x(t) = \begin{cases} 0 & t < 1 \\ t - 1 & 1 \le t < 2 \\ 2 - \frac{t}{2} & 2 \le t < 4 \\ -1 & 4 \le t < 5 \\ 0 & \text{Otherwise} \end{cases} \qquad y(t) = \begin{cases} 0 & t < 1 \\ 1 & 1 \le t < 2 \\ -2 & 2 \le t < 4 \\ t - 4 & 4 \le t < 5 \\ 0 & \text{Otherwise} \end{cases}$$

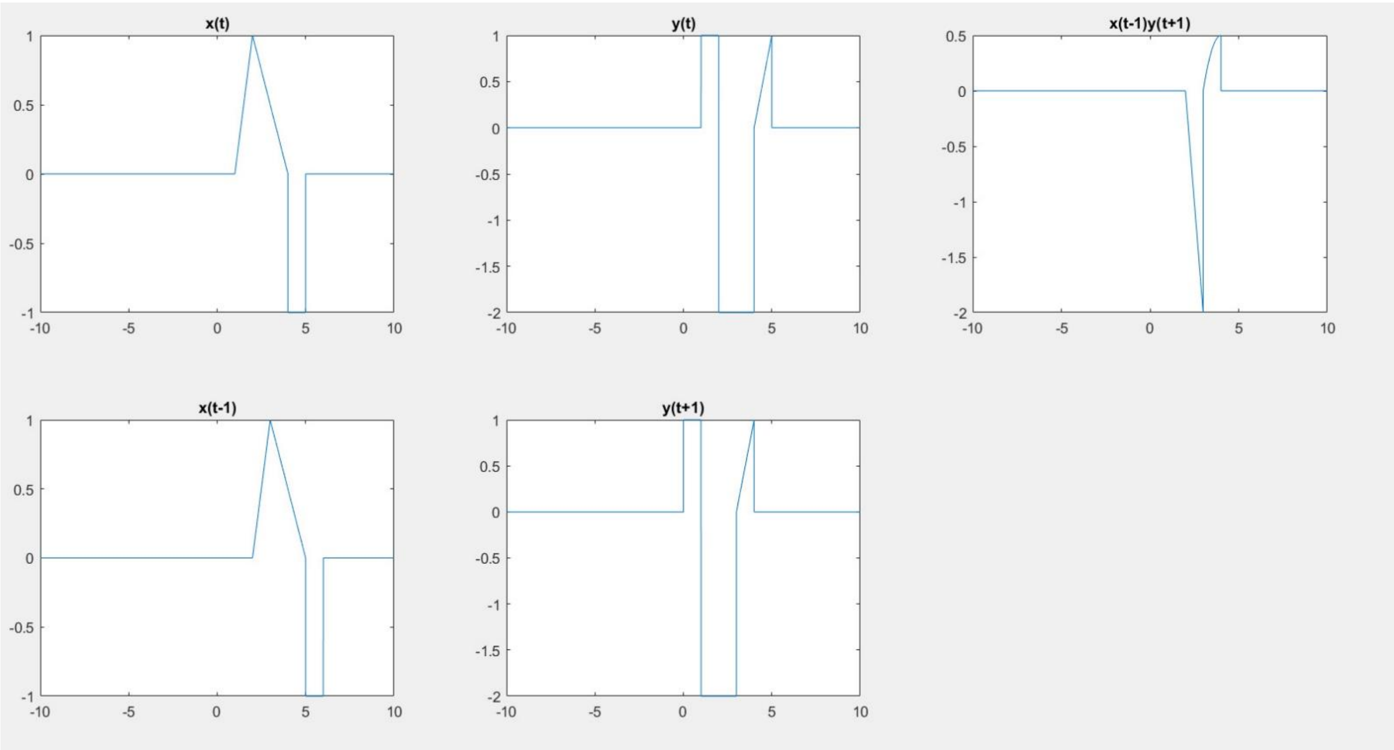
We have to plot:

a) x(t- 1) y(t+1), b) x(2 - t)y(1-t) and c) x(2t - 4)y(t)

a) The first and the most tedious way to solve this problem is by manipulating the time intervals, various instances where 't' has been used and subsequently plotting the graph, like this way.

```
clc
clear
close all

%
m=10;
t=-m:0.001:m;
x=zeros(size(t));
y=zeros(size(t));
x(t<1)=0;x(t>=1 & t<2)=t(t>=1 & t<2)-1;x(t>=2 & t<4)=2-((t(t>=2 & t<4))/2);x(t>=4 & t<5)=-1;x(t>=5)=0;
subplot(2,3,1);plot(t,x);title('x(t)');
y(t<1)=0;y(t>=1 & t<2)=1;y(t>=2 & t<4)=-2;y(t>=4 & t<5)=t(t>=4 & t<5)-4;y(t>=5)=0;
subplot(2,3,2);plot(t,y);title('y(t)');
x1=zeros(size(t));
y1=zeros(size(t));
x1(t<2)=0;
x1(t>=2 & t<3)=t(t>=2 & t<3)-2;
x1(t>=3 & t<5)=2-((t(t>=3 & t<5)-1)/2);
x1(t>=5 & t<6)=-1;
x1(t>=6)=0;
subplot(2,3,4);
plot(t,x1);
title('x(t-1)');
y1(t<0)=0;
y1(t>=0 & t<1)=1;
y1(t>=1 & t<3)=-2;
y1(t>=3 & t<4)=t(t>=3 & t<4)-3;
y1(t>=4)=0;
subplot(2,3,5);
plot(t,y1);
title('y(t+1)');
z=zeros(size(t));
z(t<1)=x1(t<1).*y1(t<1);
z(t>=1 & t<2)=x1(t>=1 & t<2).*y1(t>=1 & t<2);
z(t>=2 & t<4)=x1(t>=2 & t<4).*y1(t>=2 & t<4);
z(t>=4 & t<5)=x1(t>=4 & t<5).*y1(t>=4 & t<5);
z(t>=5)=x1(t>=5).*y1(t>=5);
subplot(2,3,3);
plot(t,z);
title('x(t-1)y(t+1)');
% subplot(3,3,4);
% plot(t+1,y);
% title('y(t+1)');
```

The output is given on the next page.



b) But there was a better method and that was using functions. So, in the example b), we are going to use functions to simplify the task. Here is the code:

f3.m | f4.m | lab2twoa.m | lab2twob.m | lab2twoc.m | f5.m | lab2three.m | f6.m | lab2four.m | lab2oneb.m

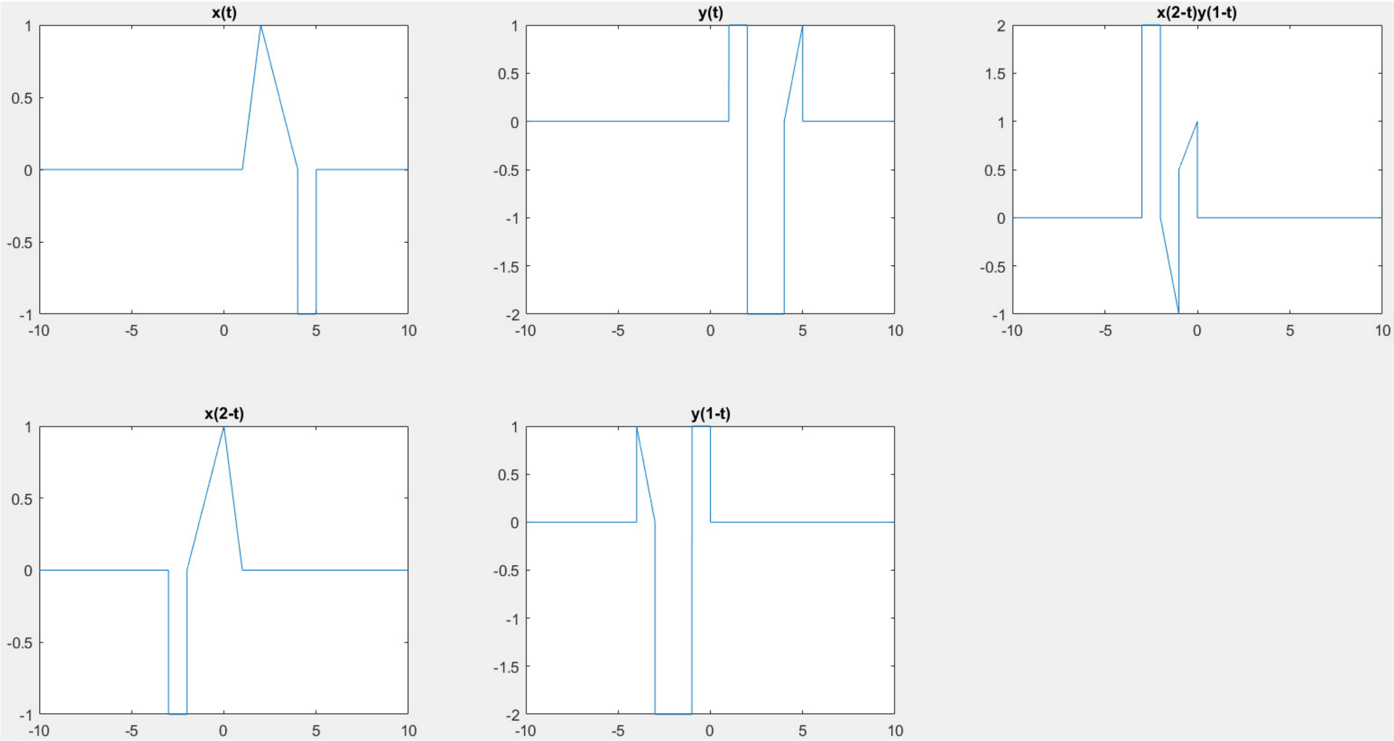
```
clc
clear
close all

%

t=-10:0.001:10;
x=zeros(size(t));
x(t<1)=0;x(t>=1 & t<2)=t(t>=1 & t<2)-1;x(t>=2 & t<4)=2-((t(t>=2 & t<4))/2);x(t>=4 & t<5)=-1;x(t>=5)=0;
y=zeros(size(t));
y(t<1)=0;y(t>=1 & t<2)=1;y(t>=2 & t<4)=-2;y(t>=4 & t<5)=t(t>=4 & t<5)-4;y(t>=5)=0;
x1=f1(2-t);
subplot(2,3,4);
plot(t,x1);
title('x(2-t)');
y1=f2(1-t);
subplot(2,3,5);
plot(t,y1);
title('y(1-t)');
z1=x1.*y1;
subplot(2,3,3);
plot(t,z1);
title('x(2-t)y(1-t)');
subplot(2,3,1);plot(t,x);title('x(t)');
subplot(2,3,2);plot(t,y);title('y(t)');
```

The functions f1 and f2 are given below:

```
function [x]=f1(t)
x=zeros(size(t));
x(t<1)=0;x(t>=1 & t<2)=t(t>=1 & t<2)-1;x(t>=2 & t<4)=2-((t(t>=2 & t<4))/2);x(t>=4 & t<5)=-1;x(t>=5)=0;
end
```

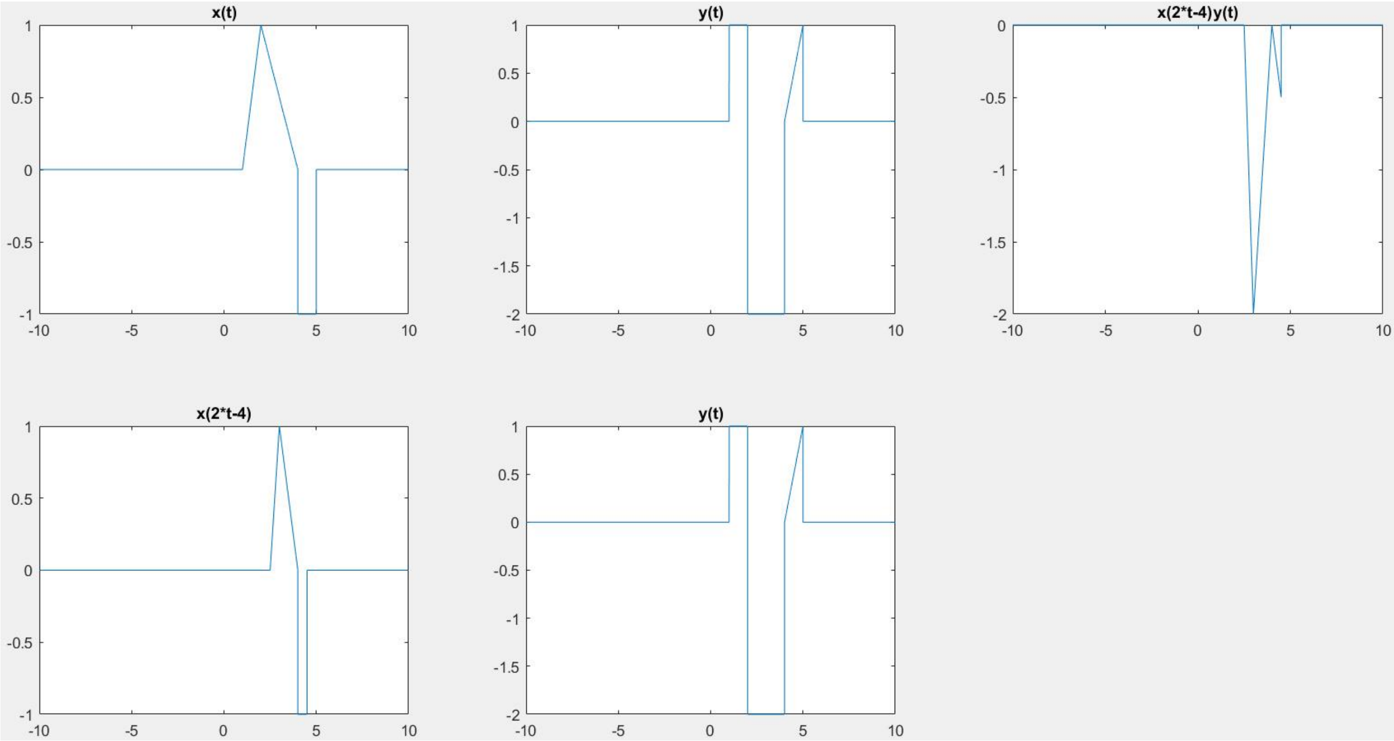
```
function [y] = f2(t)
y=zeros(size(t));
y(t<1)=0;
y(t>=1 & t<2)=1;
y(t>=2 & t<4)=-2;
y(t>=4 & t<5)=t(t>=4 & t<5)-4;
y(t>=5)=0;
end
```

Similarly functions f3 and f4 are used in this lab assignment.



c) By using the same method, this problem can be solved.

```
clc
clear
close all

%

t=-10:0.001:10;
x=zeros(size(t));
x(t<1)=0;x(t>=1 & t<2)=t(t>=1 & t<2)-1;x(t>=2 & t<4)=2-((t(t>=2 & t<4))/2);x(t>=4 & t<5)=-1;x(t>=5)=0;
y=zeros(size(t));
y(t<1)=0;y(t>=1 & t<2)=1;y(t>=2 & t<4)=-2;y(t>=4 & t<5)=t(t>=4 & t<5)-4;y(t>=5)=0;
x1=f1(2*t-4);
subplot(2,3,4);
plot(t,x1);
title('x(2*t-4)');
y1=f2(t);
subplot(2,3,5);
plot(t,y1);
title('y(t)');
z1=x1.*y1;
subplot(2,3,3);
plot(t,z1);
title('x(2*t-4)y(t)');
subplot(2,3,1);plot(t,x);title('x(t)');
subplot(2,3,2);plot(t,y);title('y(t)');
```



2. For the given signals

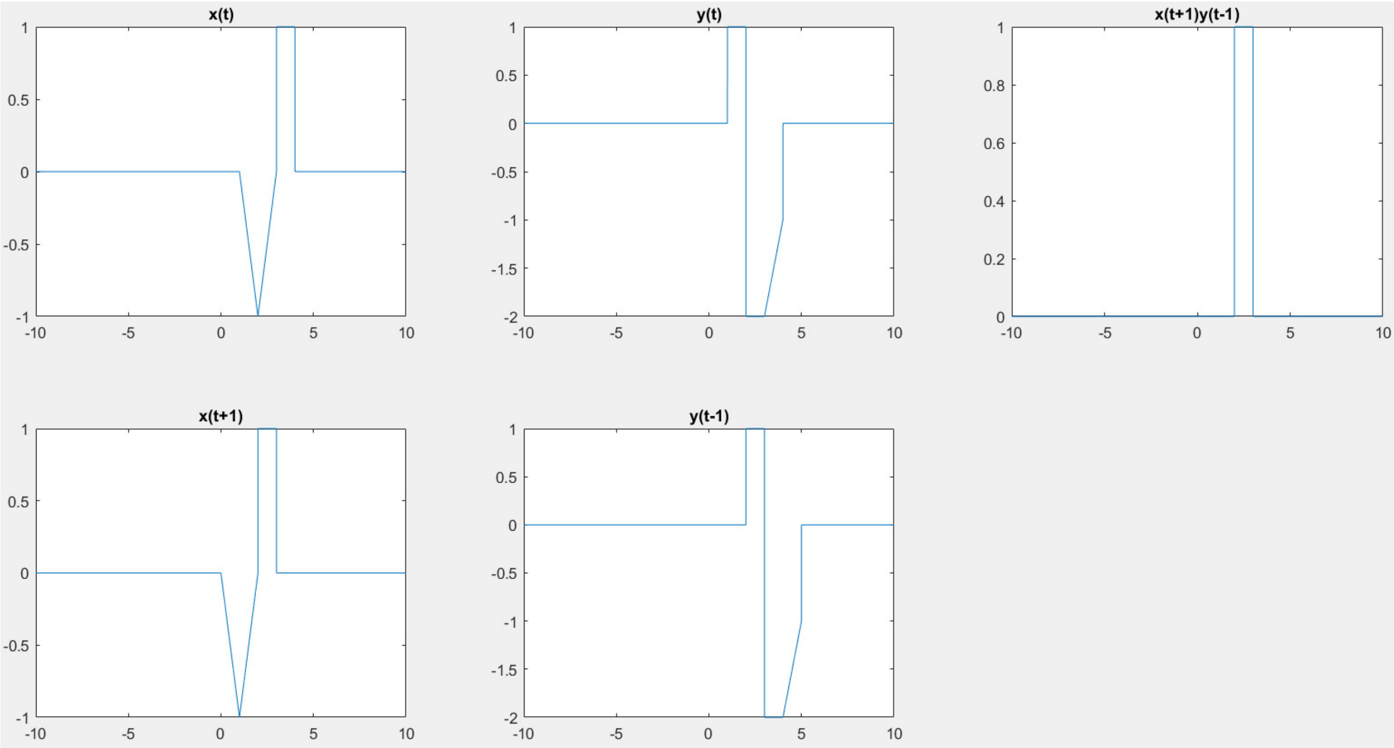
$$x(t) = \begin{cases} 0 & t < 1 \\ 1 - t & 1 \le t < 2 \\ -3 + t & 2 \le t < 3 \\ 1 & 3 \le t < 4 \\ 0 & \text{Otherwise} \end{cases} \qquad y(t) = \begin{cases} 0 & t < 1 \\ 1 & 1 \le t < 2 \\ -2 & 2 \le t < 3 \\ t - 5 & 3 \le t < 4 \\ 0 & \text{Otherwise} \end{cases}$$

We have to plot:

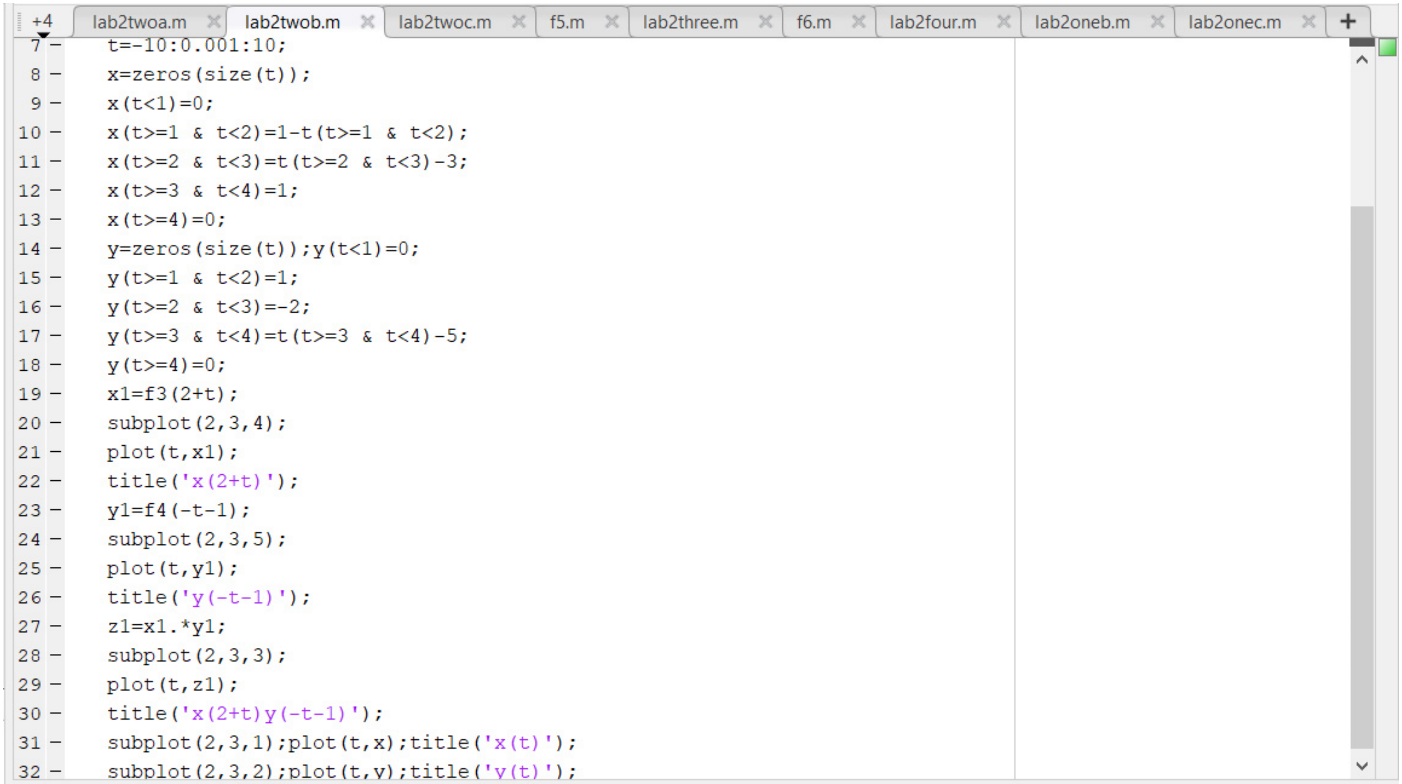
a) x(t+1) y(t-1), b) x(2+t)y(-1-t) and c) x(-2t - 4)y(-t)

a)

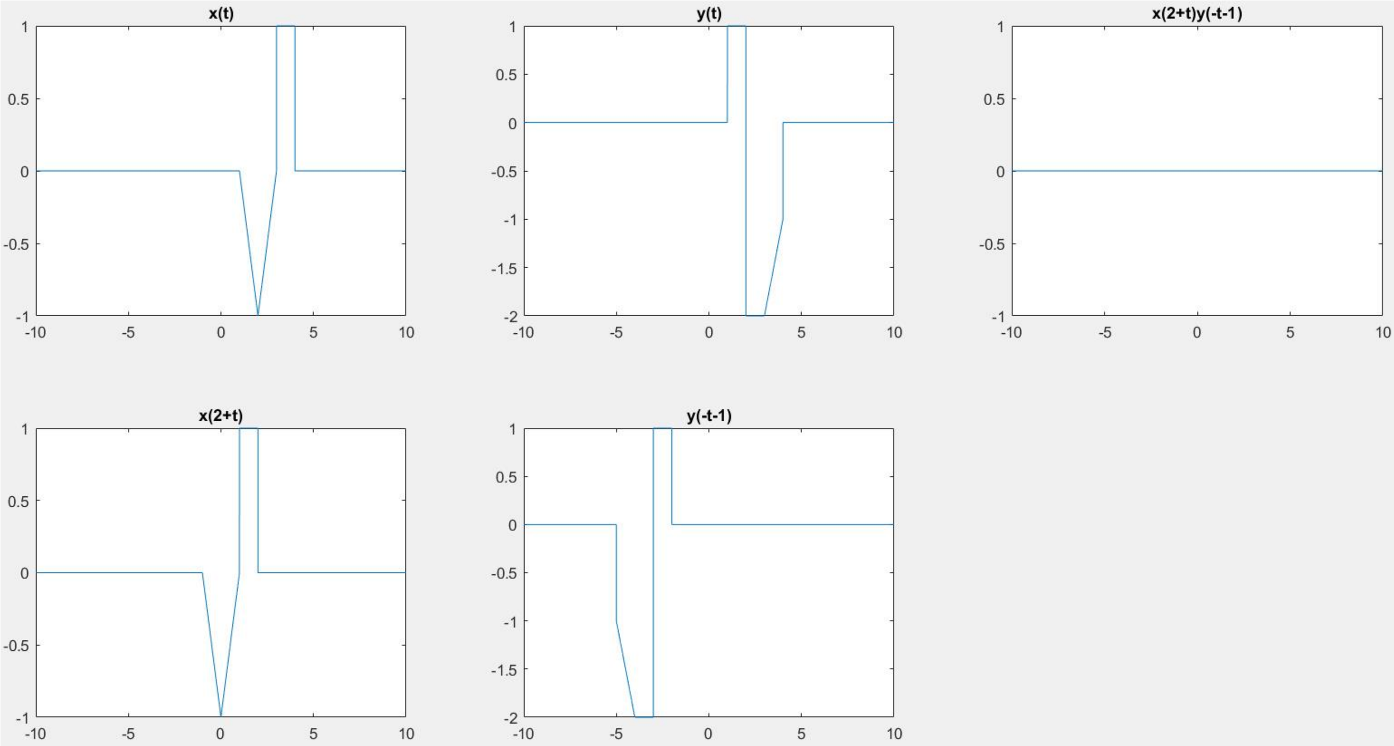
```
+4   lab2twoa.m   lab2twob.m   lab2twoc.m   f5.m   lab2three.m   f6.m   lab2four.m   lab2oneb.m   lab2onec.m
t=-10:0.001:10;
x=zeros(size(t));
x(t<1)=0;
x(t>=1 & t<2)=1-t(t>=1 & t<2);
x(t>=2 & t<3)=t(t>=2 & t<3)-3;
x(t>=3 & t<4)=1;
x(t>=4)=0;
y=zeros(size(t));y(t<1)=0;
y(t>=1 & t<2)=1;
y(t>=2 & t<3)=-2;
y(t>=3 & t<4)=t(t>=3 & t<4)-5;
y(t>=4)=0;
x1=f3(t+1);
subplot(2,3,4);
plot(t,x1);
title('x(t+1)');
y1=f4(t-1);
subplot(2,3,5);
plot(t,y1);
title('y(t-1)');
z1=x1.*y1;
subplot(2,3,3);
plot(t,z1);
title('x(t+1)y(t-1)');
subplot(2,3,1);plot(t,x);title('x(t)');
subplot(2,3,2);plot(t,y);title('y(t)');
```



b)



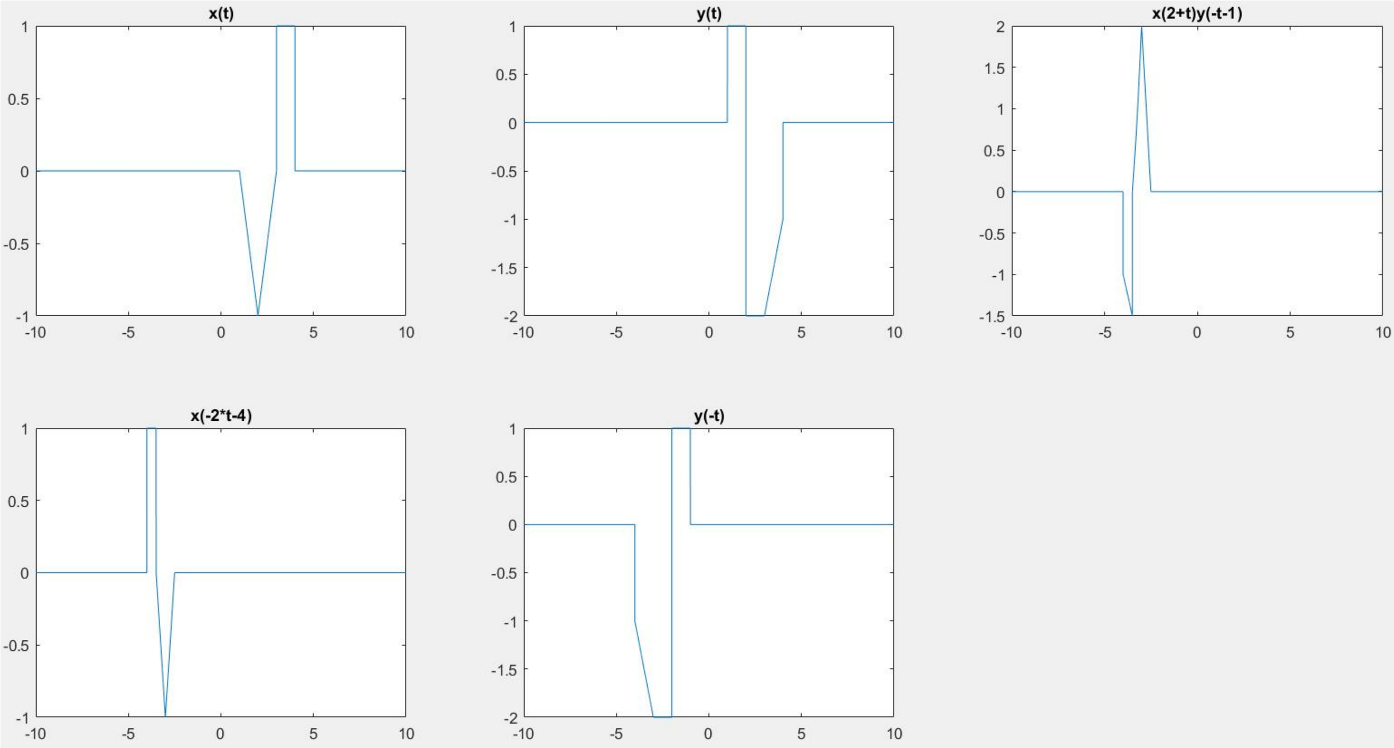

```
t=-10:0.001:10;
x=zeros(size(t));
x(t<1)=0;
x(t>=1 & t<2)=1-t(t>=1 & t<2);
x(t>=2 & t<3)=t(t>=2 & t<3)-3;
x(t>=3 & t<4)=1;
x(t>=4)=0;
y=zeros(size(t));y(t<1)=0;
y(t>=1 & t<2)=1;
y(t>=2 & t<3)=-2;
y(t>=3 & t<4)=t(t>=3 & t<4)-5;
y(t>=4)=0;
x1=f3(2+t);
subplot(2,3,4);
plot(t,x1);
title('x(2+t)');
y1=f4(-t-1);
subplot(2,3,5);
plot(t,y1);
title('y(-t-1)');
z1=x1.*y1;
subplot(2,3,3);
plot(t,z1);
title('x(2+t)y(-t-1)');
subplot(2,3,1);plot(t,x);title('x(t)');
subplot(2,3,2);plot(t,y);title('y(t)');
```



c)

+4 lab2twoa.m lab2twob.m lab2twoc.m f5.m lab2three.m f6.m lab2four.m lab2oneb.m lab2onec.m

```
t=-10:0.001:10;
x=zeros(size(t));
x(t<1)=0;
x(t>=1 & t<2)=1-t(t>=1 & t<2);
x(t>=2 & t<3)=t(t>=2 & t<3)-3;
x(t>=3 & t<4)=1;
x(t>=4)=0;
y=zeros(size(t));y(t<1)=0;
y(t>=1 & t<2)=1;
y(t>=2 & t<3)=-2;
y(t>=3 & t<4)=t(t>=3 & t<4)-5;
y(t>=4)=0;
x1=f3(-2*t-4);
subplot(2,3,4);
plot(t,x1);
title('x(-2*t-4)');
y1=f4(-t);
subplot(2,3,5);
plot(t,y1);
title('y(-t)');
z1=x1.*y1;
subplot(2,3,3);
plot(t,z1);
title('x(-2t-4)y(-t)');
subplot(2,3,1);plot(t,x);title('x(t)');
subplot(2,3,2);plot(t,y);title('y(t)');
```



<u>3. Given the discrete signal,</u>

x[n] = {2, − 2, 3, 4, − 4}

We have to plot:

a)x[n+1] b)x[n-2] c)x[3-n] d)x[3-2n] e)x[4n+5]

As discussed earlier, the process is almost similar in generating the resultant signal except here we have slightly different conditions of functions and we have to use the program 'stem' to plot the discrete signals. Here are the functions f5 & f6.

Editor - C:\Users\atharva deshpande\Documents\MATLAB\f5.m

+3 | lab2twob.m | lab2twoc.m | f5.m | lab2three.m | f6.m | lab2four.m | lab2oneb.m | lab2onec.m | f1.m | f2.m

```
function [x]=f5(n)
x=zeros(size(n));
x(n==0)=2;
x(n==1)=-2;
x(n==2)=3;
x(n==3)=4;
x(n==4)=-4;
end
```

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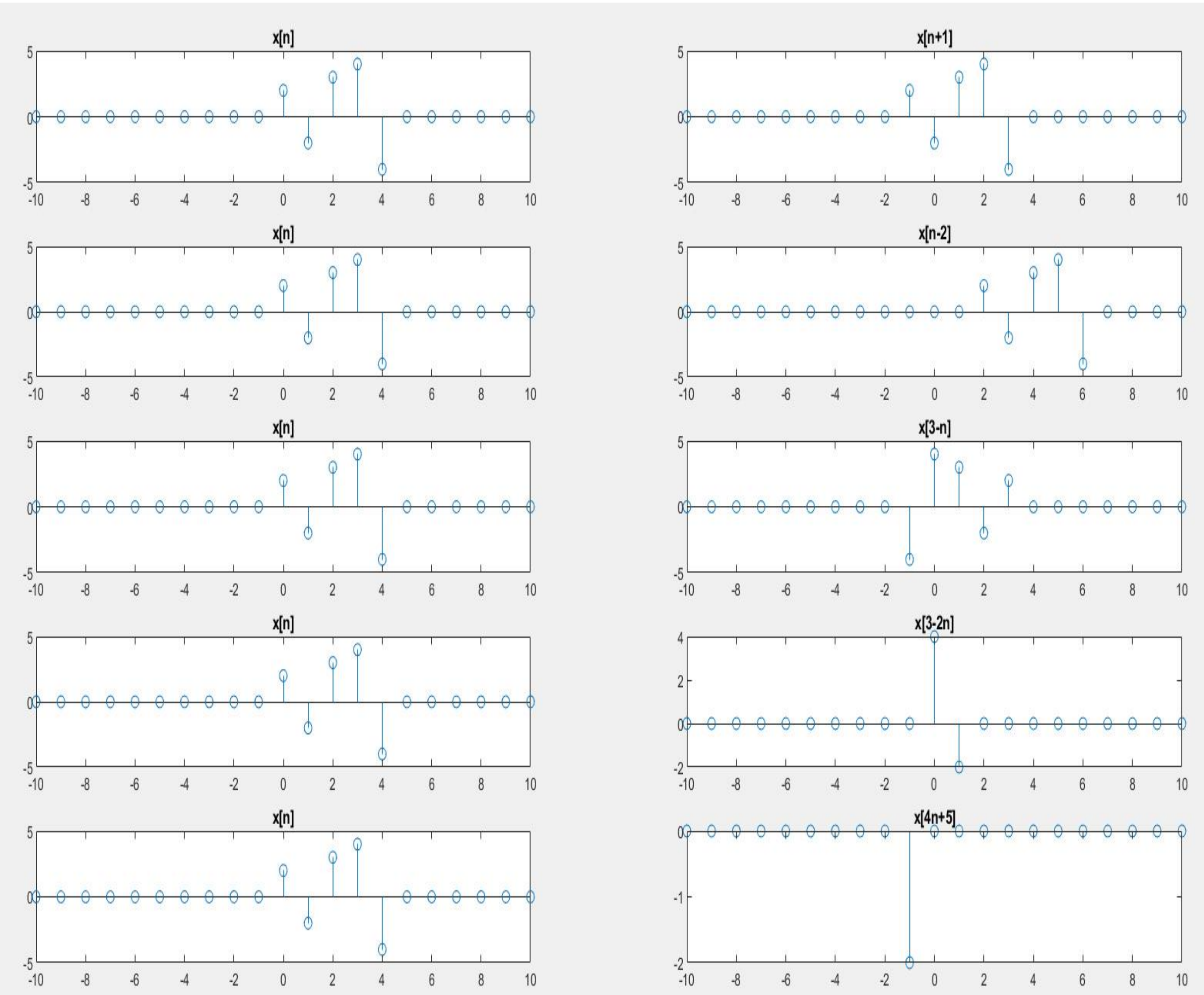
+3 | lab2twob.m | lab2twoc.m | f5.m | lab2three.m | f6.m | lab2four.m | lab2oneb.m | lab2onec.m | f1.m | f2.m

```
function [y]=f6(n)
y=zeros(size(n));
y(n==0)=-1;
y(n==1)=2;
y(n==2)=-3;
y(n==3)=-4;
y(n==4)=5;
end
```

```
clc
clear
close all

%

m=10;
n=-m:1:m;
x=zeros(size(n));
x1=f5(n);
subplot(5,2,1);stem(n,x1);title('x[n]');
x2=f5(n+1);subplot(5,2,2);stem(n,x2);title('x[n+1]');
subplot(5,2,3);stem(n,x1);title('x[n]');
x3=f5(n-2);subplot(5,2,4);stem(n,x3);title('x[n-2]');
subplot(5,2,5);stem(n,x1);title('x[n]');
x4=f5(3-n);subplot(5,2,6);stem(n,x4);title('x[3-n]');
subplot(5,2,7);stem(n,x1);title('x[n]');
x5=f5(3-2*n);subplot(5,2,8);stem(n,x5);title('x[3-2n]');
subplot(5,2,9);stem(n,x1);title('x[n]');
x6=f5(4*n+5);subplot(5,2,10);stem(n,x6);title('x[4n+5]');
```



<u>4. Given the discrete signal,</u>

x[n] = {-1, −2, -3, -4, 5}

We have to plot:

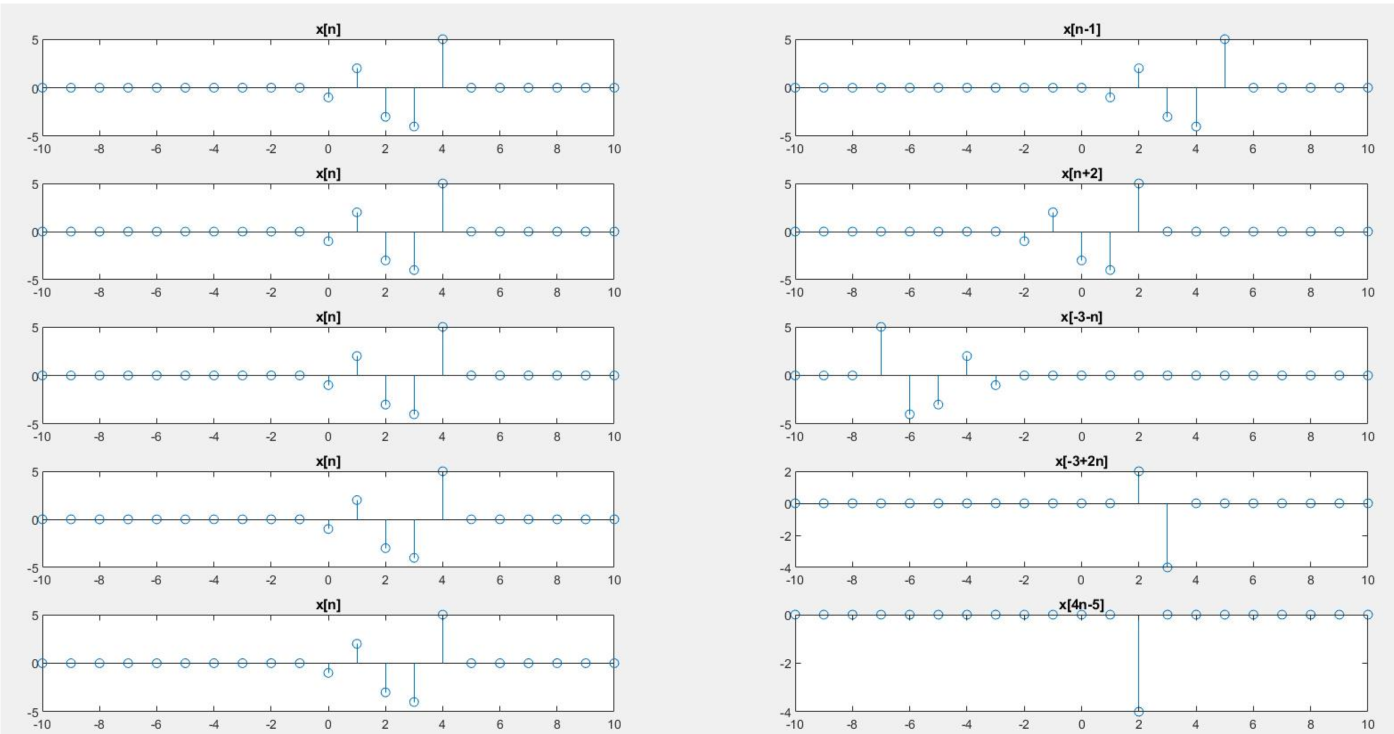
a)x[n-1] b)x[n+2] c)x[-3-n] d)x[-3+2n] e)x[4n-5]

+4 | lab2twoa.m | lab2twob.m | lab2twoc.m | f5.m | lab2three.m | f6.m | lab2four.m | lab2oneb.m | lab2onec.m | +

```
clc
clear
close all

%

m=10;
n=-m:1:m;
x=zeros(size(n));
x1=f6(n);
subplot(5,2,1);stem(n,x1);title('x[n]');
x2=f6(n-1);subplot(5,2,2);stem(n,x2);title('x[n-1]');
subplot(5,2,3);stem(n,x1);title('x[n]');
x3=f6(n+2);subplot(5,2,4);stem(n,x3);title('x[n+2]');
subplot(5,2,5);stem(n,x1);title('x[n]');
x4=f6(-3-n);subplot(5,2,6);stem(n,x4);title('x[-3-n]');
subplot(5,2,7);stem(n,x1);title('x[n]');
x5=f6(-3+2*n);subplot(5,2,8);stem(n,x5);title('x[-3+2n]');
subplot(5,2,9);stem(n,x1);title('x[n]');
x6=f6(4*n-5);subplot(5,2,10);stem(n,x6);title('x[4n-5]');
```



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