Lab 2 Digital Signal Processing

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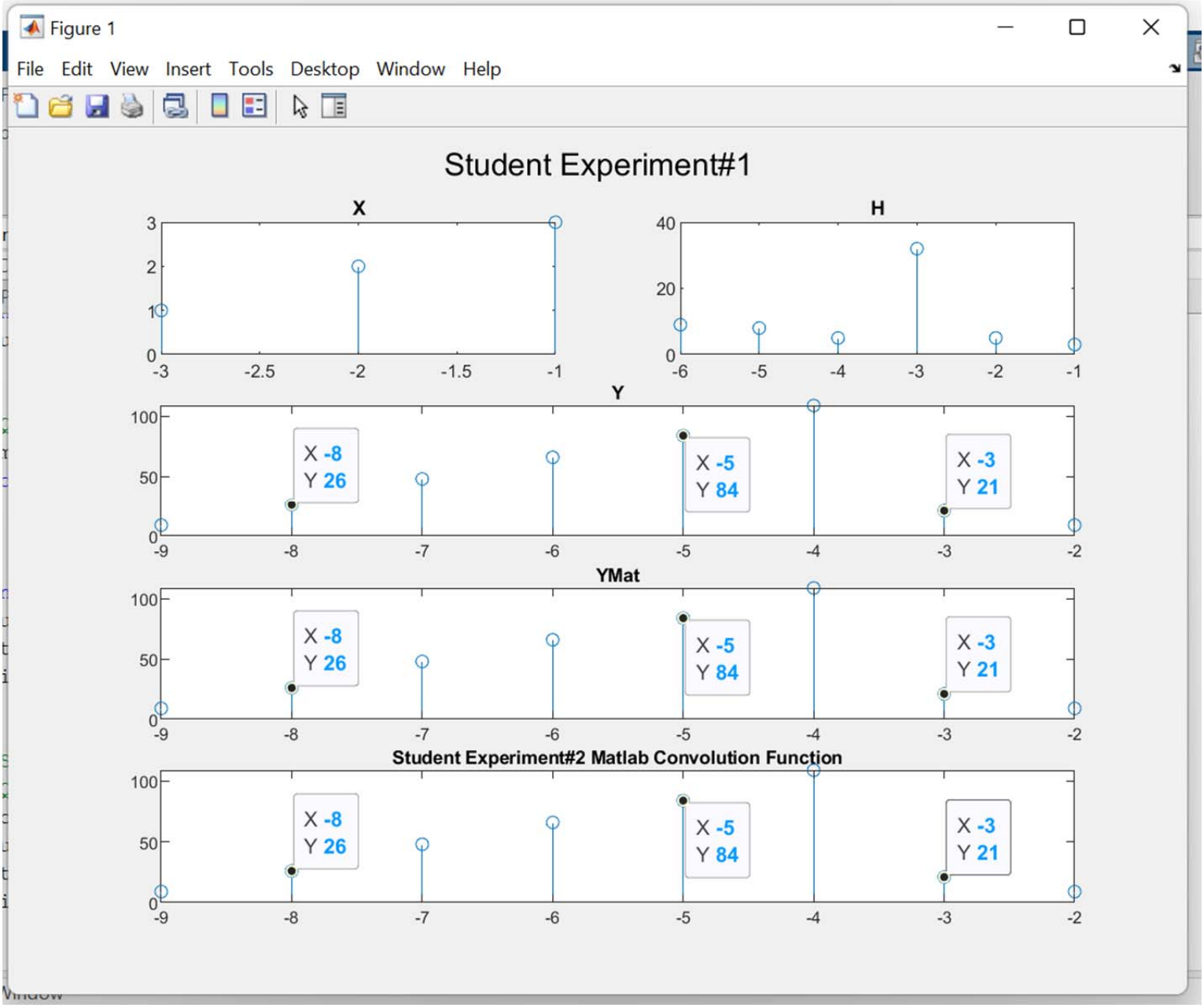
Student Experiment #1 & #2

Lab1DSP.m | Lab2DSP.m

```
%Student Experiment #1 :
%Question 1:
figure;     sgtitle("Student Experiment#1")
nx=[-3 -2 -1];
x=[1 2 3];
subplot(3,2,1);     stem(nx,x);     title("X");
nh=[-6 -5 -4 -3 -2 -1];
h=[9 8 5 32 5 3];
subplot(3,2,2);     stem(nh,h);     title("H");
M = length(x);
N = length(h);
ny = (nx(1) + nh(1)): (nx(end)+nh(end));
y = zeros(1,M+N-1)
for u= 1:N
    x1=h(u)*[zeros(1,u-1) x zeros(1,length(y)-M-(u-1))]; %Shifted version
    y=y+x1;
end
subplot(3,1,2);     stem(ny,y);     title("Y");
```

```
%Question 2:
ymat=zeros(1,M+N-1);
for n=1:M+N-1
    for k=max(1,n-N+1):min(n,M)
        ymat(n)=ymat(n)+x(k)*h(n-k+1);
    end
end
subplot(3,1,3);
stem(ny,ymat);
title("YMat");
```

```
%Student Experiment #2 :
%Question 1:
ycov = conv(x,h);
subplot(4,1,4);
stem(ny,ycov);
title("Student Experiment#2 Matlab Convolution Function")
```



Student Experiment #3

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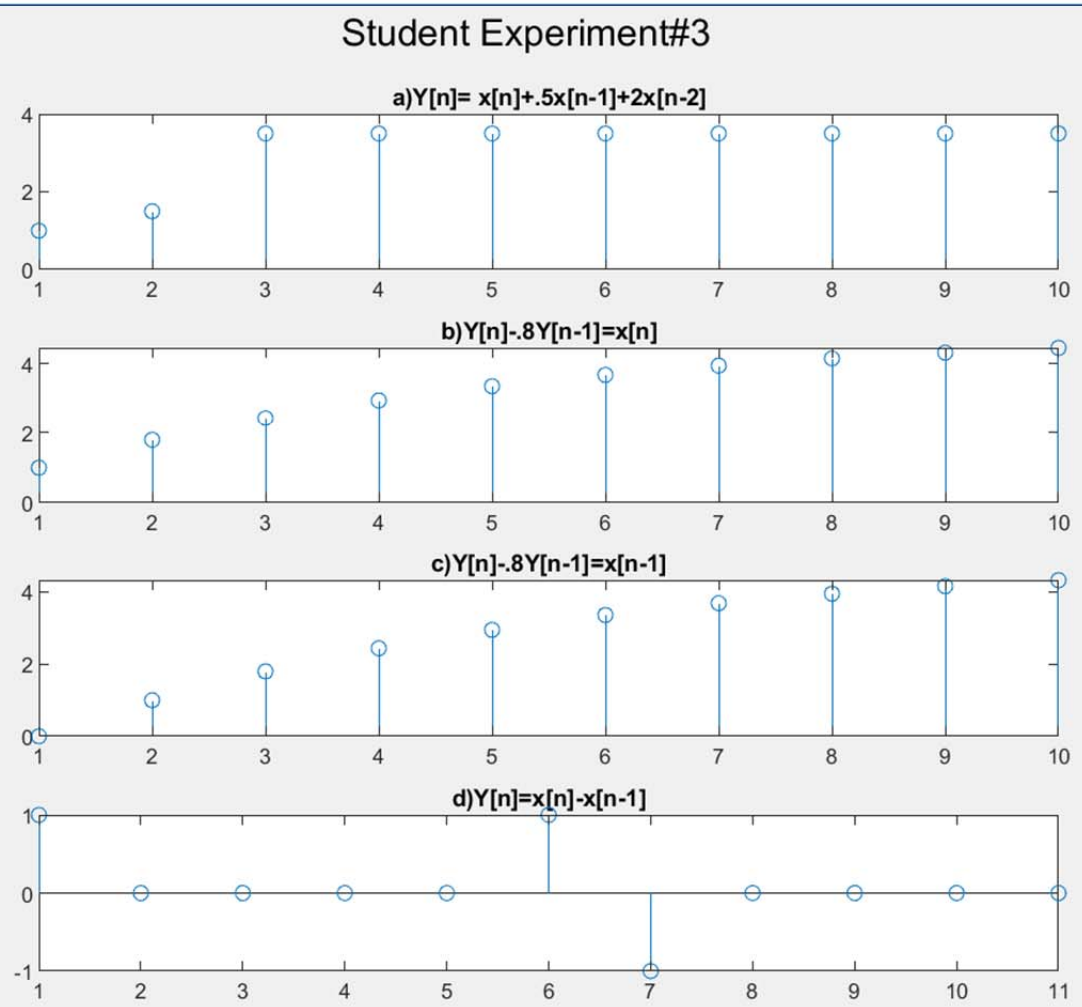
```
40    %Student Experiment #3: %A):
41 -  figure;     sgtitle("Student Experiment#3")
42 -  xk =ones(1,10);
43 -  Ay = [1];
44 -  Bx = [1 0.5 2];
45 -  Ya = filter(Bx,Ay,xk);
46 -  subplot(4,1,1);          stem(Ya);        title("a)Y[n]= x[n]+.5x[n-1]+2x[n-2]");
47    %B) :
48 -  Ay = [1 -0.8];
49 -  Bx = [1];
50 -  Yb = filter(Bx,Ay,xk);
51 -  subplot(4,1,2);          stem(Yb);        title("b)Y[n]-.8Y[n-1]=x[n]");
52    %C)
53 -  Ay = [1 -0.8];
54 -  Bx = [0 1];
55 -  Yc = filter(Bx,Ay,xk);
56 -  subplot(4,1,3);          stem(Yc);        title("c)Y[n]-.8Y[n-1]=x[n-1]");
57    %D)
58 -  xd = ones(1,11);         xd(6) =2;
59 -  Ay = [1];
60 -  Bx = [1 -1];
61 -  Yd = filter(Bx,Ay,xd);
62 -  subplot(4,1,4);          stem(Yd);        title("d)Y[n]=x[n]-x[n-1]");
```



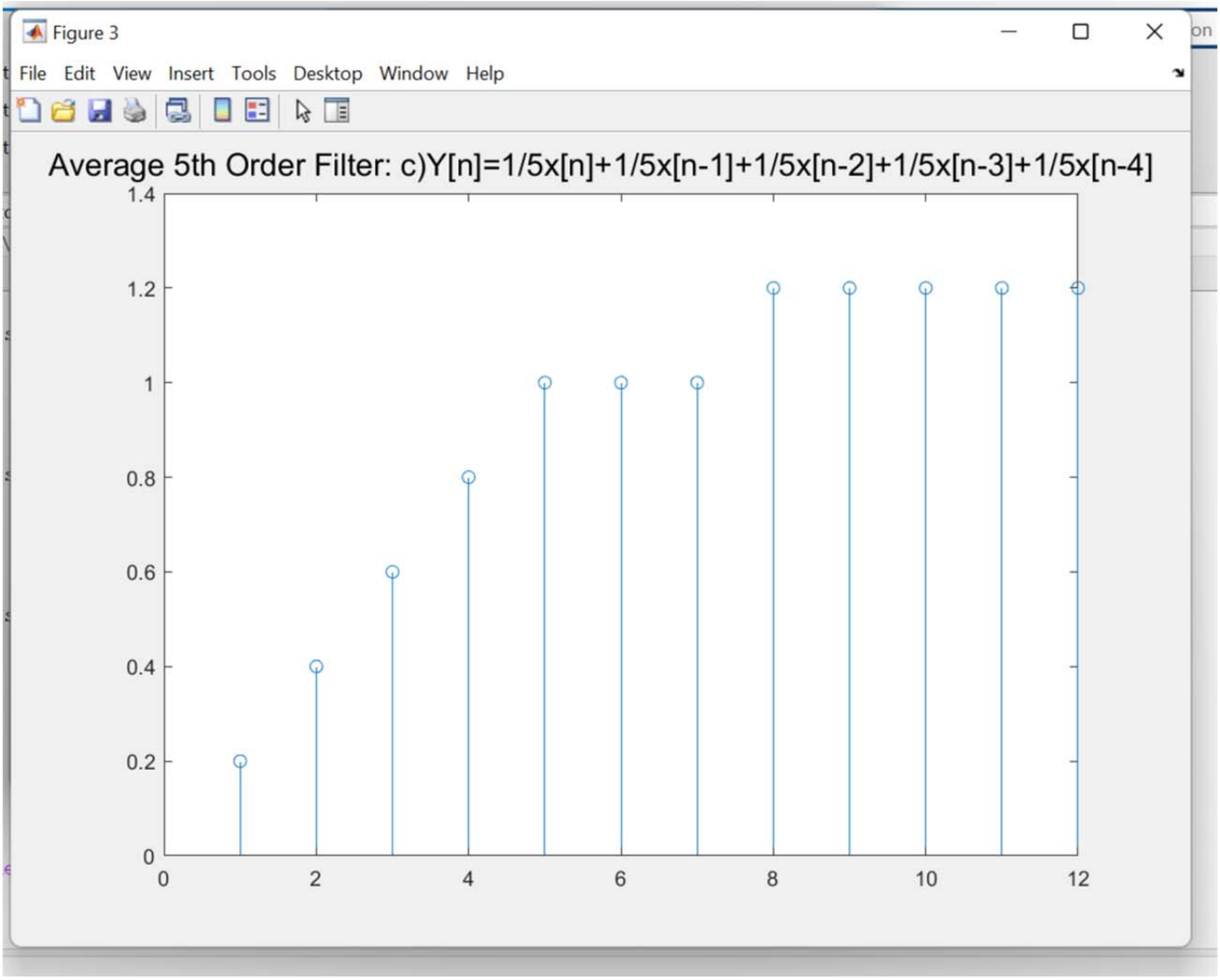
-The expected steady state output for 1st system is = 3.5

As 1+0.5+2 =3.5

-The relation between the 2nd and 3rd system is Yc[n]=Yb[n-1]

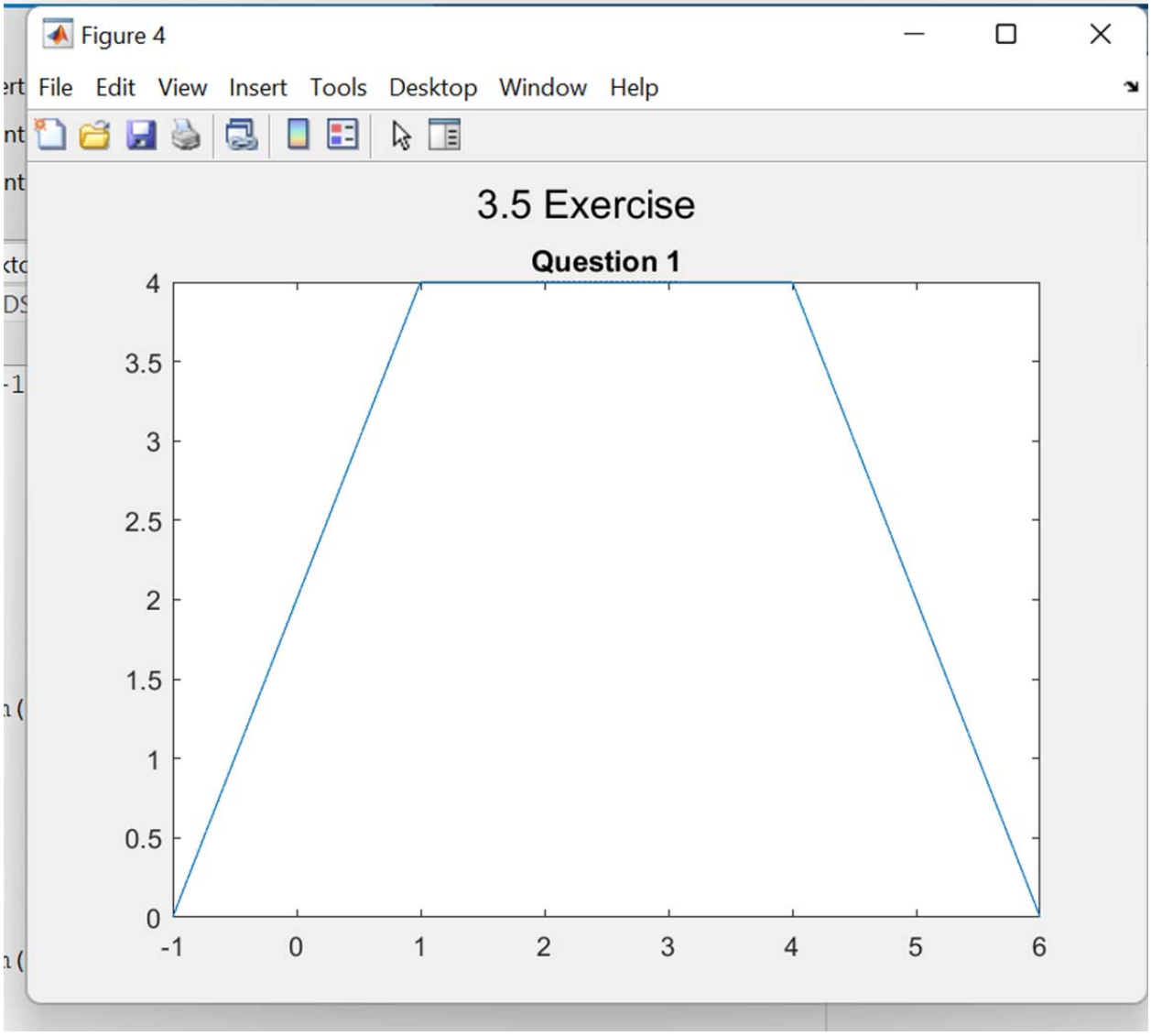
-Average Filter of order 5:

```
%Average Order 5 Filter
x5 = ones(1,12);
x5(8) =2 ;
Ay = [1];
Bx = (1/5)*ones(1,5);
Y5 = filter(Bx,Ay,x5);
figure;
stem(Y5);
sgtitle("Average 5th Order Filter: c)Y[n]=1/5x[n]+1/5x[n-1]+1/5x[n-2]+1/5x[n-3]+1/5x[n-4]");
```

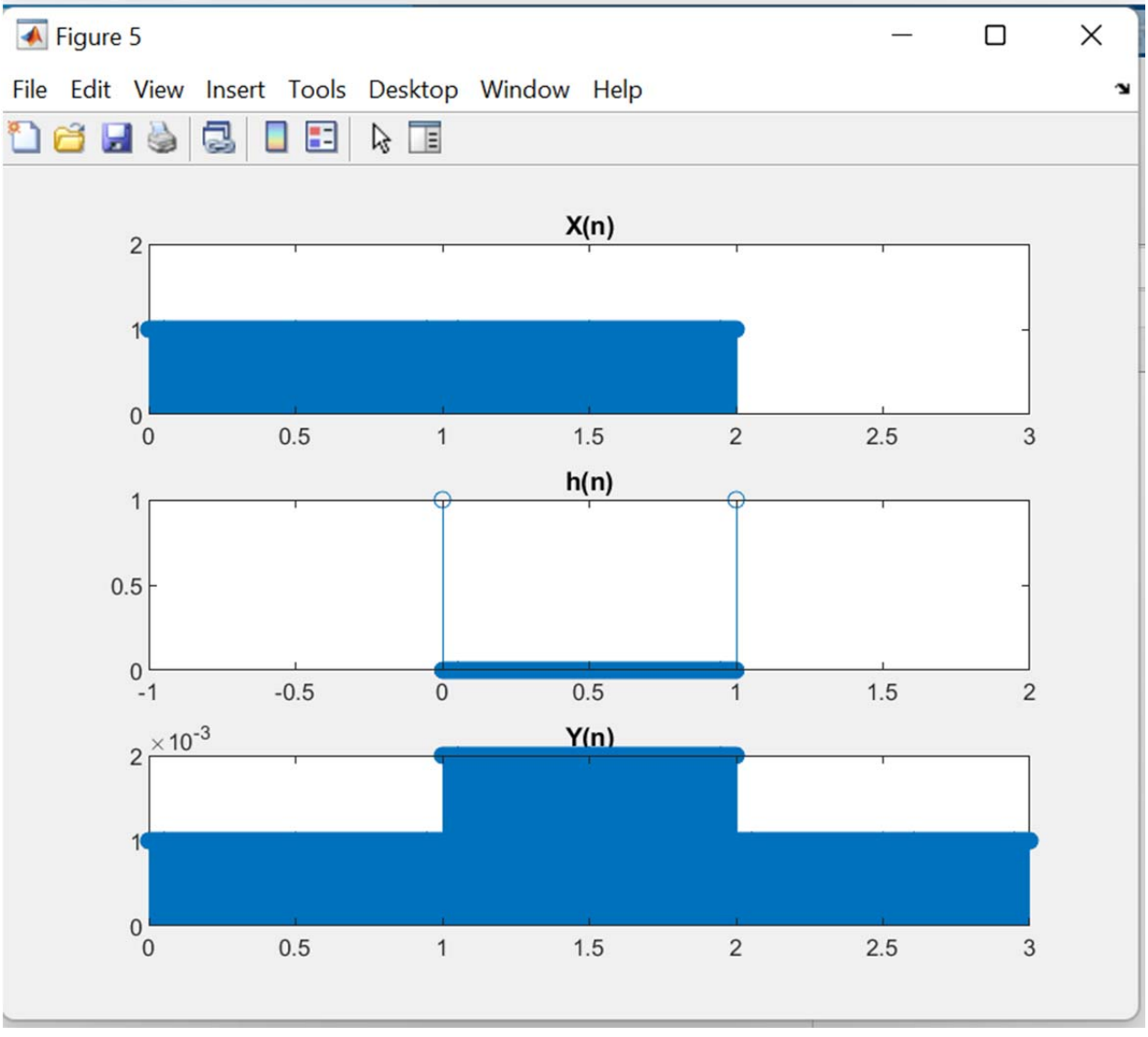


Exercises 3.5

```
%3.5 Exercise:
%1)
figure;     sgtitle("3.5 Exercise")
fs =1000;
Tx = 0:2;
X = ones(1,2*fs);
Th = -1:4;
H =2*ones(1,5*fs);
Ty = linspace(-1,6,7*fs-1);
Yc = (1/fs)*conv(X,H);
subplot(1,1,1);
plot(Ty,Yc);
title("Question 1")
```



```
%2)
figure;
Tx=0:.001:2;
Xn=ones(1,2001);
subplot(3,1,1);      stem(Tx,Xn);     title("X(n)");
xlim([0 3]);
ylim([0 2]);
Th=0:.001:1;
Hn=zeros(1,1001);
Hn(1)=1;
Hn(1001)=1;
subplot(3,1,2);      stem(Th,Hn);     title("h(n)");
xlim([-1 2]);
Ty=0:.001:3;
Yn=1/1000*conv(Xn,Hn);
subplot(3,1,3);      stem(Ty,Yn);     title("Y(n)");
```



```
106     %Last Question: Compute and Plot:
107     %A)
108 -   figure;
109 -   X1 =[1 2 4];
110 -   H1 =[1 1 1 1 1];
111 -   NX1 = 1:3;
112 -   NH1 = 1:5;
113 -   subplot(4,2,1);      stem(NX1,X1);      title("X1");
114 -   subplot(4,2,2);      stem(NH1,H1);      title("H1");
115 -   NY1 = (NX1(1) + NH1(1)): (NX1(end)+NH1(end));
116 -   Y1 = conv(X1,H1);
117 -   subplot(4,1,2);      stem(NY1,Y1);      title("Y1");
118     %B)
119 -   X2 =[0 1 -2 3 -4];
120 -   H2 =[0.5 1 2 1 0.5];
121 -   NX2 = 1:5;
122 -   NH2 = 1:5;
123 -   subplot(4,2,5);      stem(NX2,X2);      title("X2");
124 -   subplot(4,2,6);      stem(NH2,H2);      title("H2");
125 -   NY2 = (NX2(1) + NH2(1)): (NX2(end)+NH2(end));
126 -   Y2 = conv(X2,H2);
127 -   subplot(4,1,4);      stem(NY2,Y2);      title("Y2");
```

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```
28      %C)
29 -    figure;
30 -    X3 =[1 2 3 4];
31 -    H3 =[4 3 2 1];
32 -    NX3 = 1:4;
33 -    NH3 = 1:4;
34 -    subplot(4,2,1);      stem(NX3,X3);      title("X3");
35 -    subplot(4,2,2);      stem(NH3,H3);      title("H3");
36 -    NY3 = (NX3(1) + NH3(1)): (NX3(end)+NH3(end));
37 -    Y3 = conv(X3,H3);
38 -    subplot(4,1,2);      stem(NY3,Y3);      title("Y3");
39      %D)
40 -    X4=[1 2 3 4];
41 -    H4=[1 2 3 4];
42 -    NX4 = 1:4;
43 -    NH4 = 1:4;
44 -    subplot(4,2,5);      stem(NX4,X4);      title("X4");
45 -    subplot(4,2,6);      stem(NH4,H4);      title("H4");
46 -    NY4 = (NX4(1) + NH4(1)): (NX4(end)+NH4(end));
47 -    Y4 = conv(X4,H4);
48 -    subplot(4,1,4);      stem(NY4,Y4);      title("Y4");
```

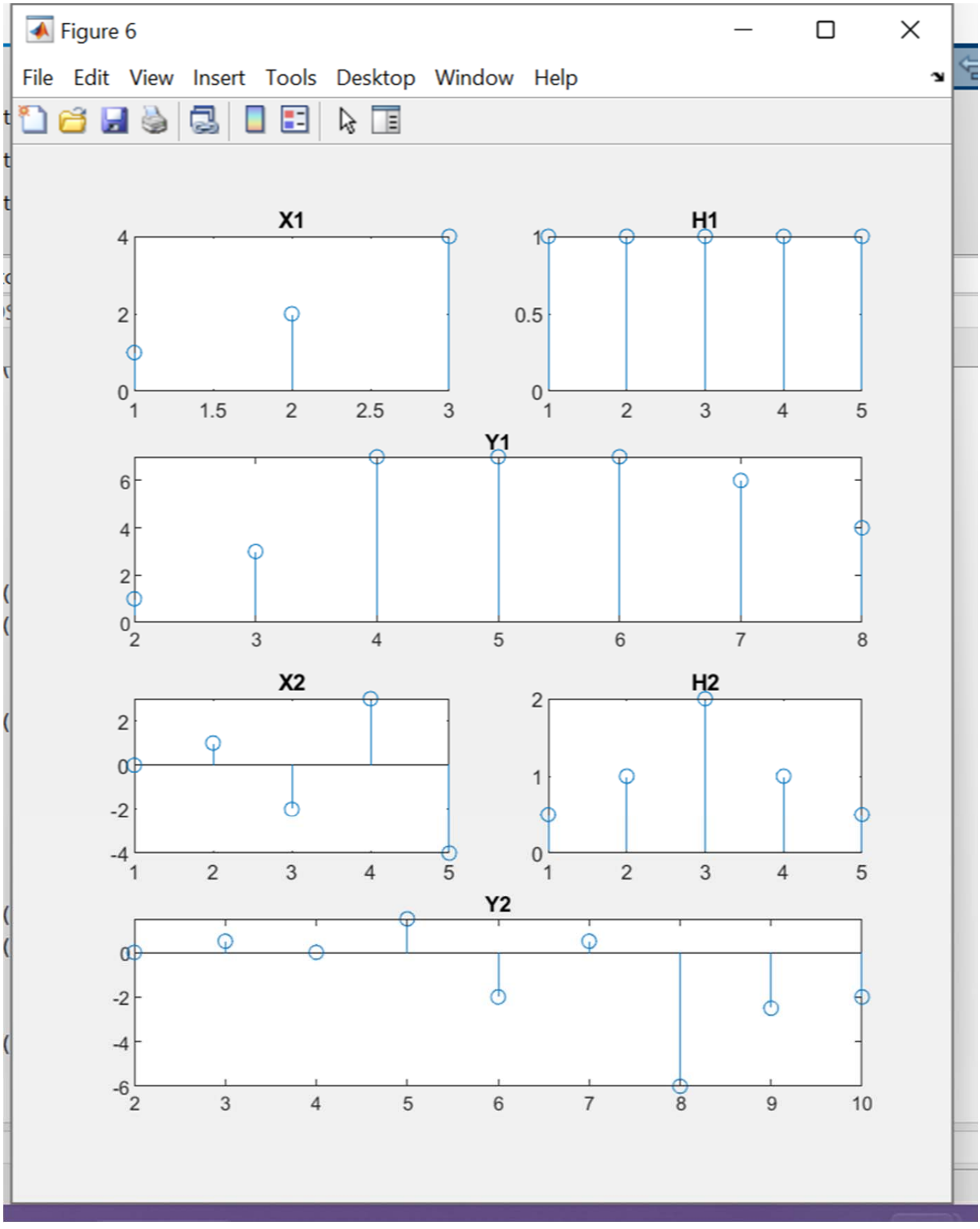
Figure 6
File Edit View Insert Tools Desktop Window Help
X1
H1
Y1
X2
H2
Y2

Figure 7

File Edit View Insert Tools Desktop Window Help