电子科技大学 格拉斯哥 学院

UOG-UESTC Joint School of UESTC

标 准 实 验 报 告

Lab Report

（实验）课程名称：信号与系统

(LAB) Course Name：Signals and Systems

电子科技大学教务处制表

UoG-UESTC Joint School

Lab-1 Report

Student Name：蓝心悦

Student No.：2017200601018

Instructor：许渤

Location：

Date：4/7/2019

一、 Laboratory name：

Signals and Systems

二、 Project name：

Represent convolution of signals and perform the properties of LTI systems using MATLAB

三、 Lab hours：4

四、 Theoretical background：

1. The basic concepts and properties of LTI systems arise in a variety of contexts. In this lab, I learnt how to represent, manipulate, and analyze LTI systems in MATLAB.
2. Some basic MATLAB commands for representing the LTI systems including conv, filter, step, impulse and lsim.

五、 Objective：

1. Be further familiar with the properties of linear time-invariant (LTI) systems.
2. Perform convolution using MATLAB.
3. Compute the output of causal LTI system characterized by linear constant-coefficient differential/ difference equations.

六、 Description：

1. Perform convolution. 2.1(a)(b)(c), 2.7(a)(b)(c)(d)(e)
2. Compute the the output of causal LTI system characterized by linear constant-coefficient difference equations . 2.2(a)(b)(c)(d)(e)(f)(g)
3. Compute the the output of causal LTI system characterized by linear constant-coefficient differential equations . 2.3(a)(b)
4. Further familiar with the properties of LTI systems. 2.4(a)(d), 2.5(d)(e)(f)(g)

七、 Required instruments：

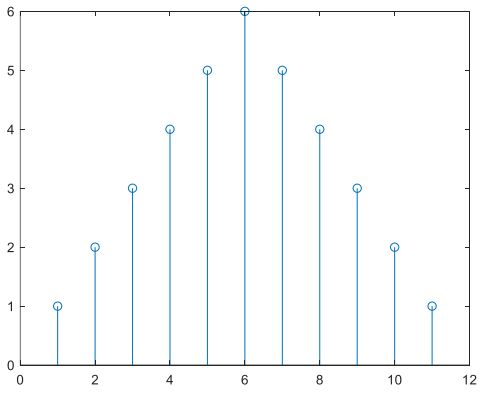
Computer, MATLAB

八、 Procedures, Analysis of Lab data & result and Conclusion：

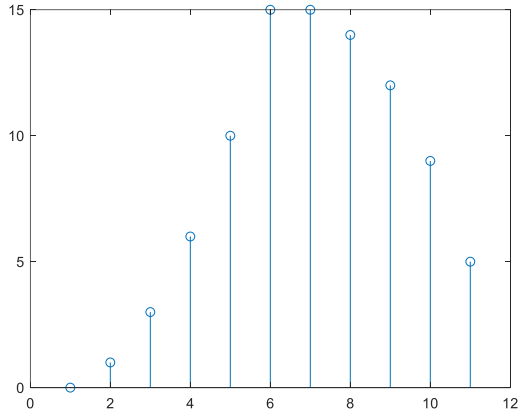
```
%2.1(a)
n=[0:5];
x=1;
h=1;
lim1=str2sym('n');
lim2=5;
a=x*h;
y=int(a,lim1,lim2)
%otherwise, y=0
```

```
>> a1

y =

5 - n
```

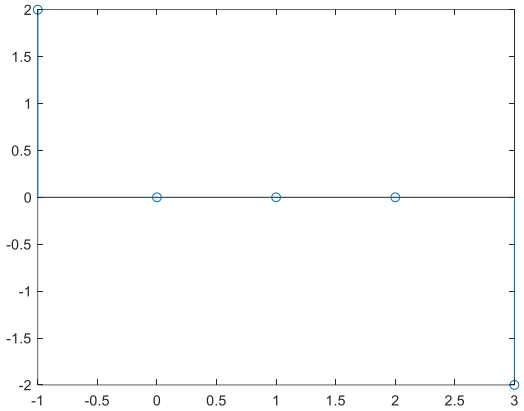
```
%2.1(b)
x=ones(1,6);
n=[0:5];
y=conv(x,x);
ny=[1:11];
stem(ny,y)
```



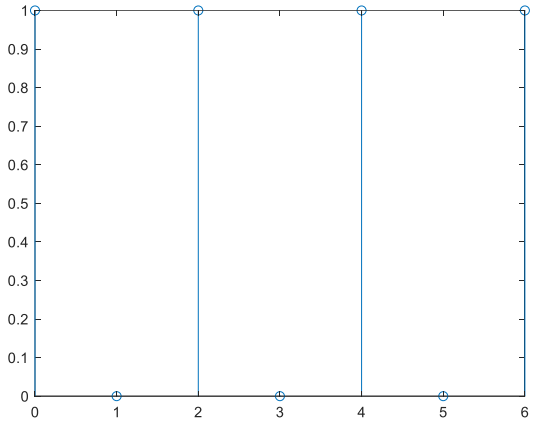

```
%2.1(c)
n=[0:5];
h=n;
x=ones(1,6);
y=conv(x,h);
ny=[1:11];
stem(ny,y)
```



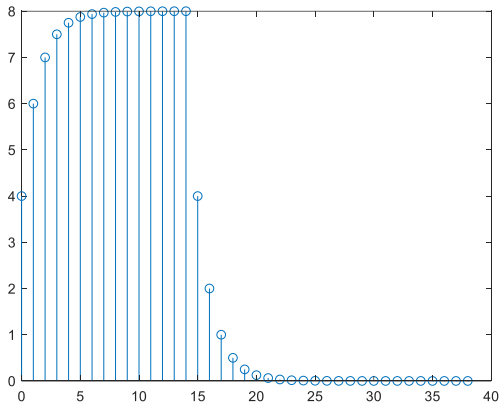

```
%2.7(a)
x=[1  0  1];
h=[2  0  -2];
y=conv(h,x);
ny=[-1:3];
stem(ny,y)
```



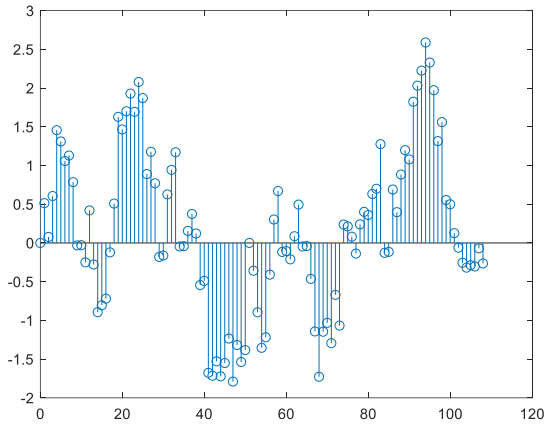

```
%2.7(b)
a=0;
N=3;
c=0;
M=5;
b=N-1;
d=M-1;
h=[1  zeros(1,b-a-1)  1];
x=[1  zeros(1,d-c-1)  1];
y=conv(h,x);
ny=[(a+c):(b+d)];
stem(ny,y)
```



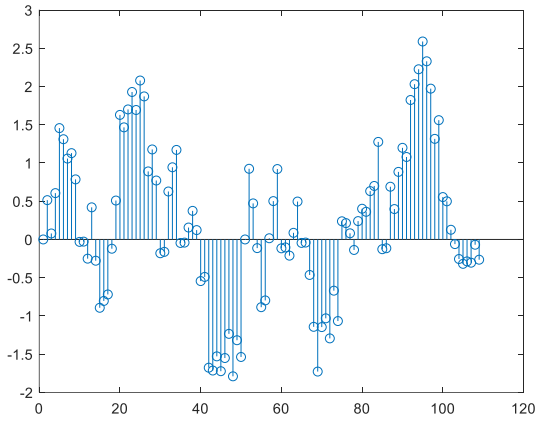

```
%2.7(c)
n=[0:24];
x=(0.5).^(n-2);
n=[0:14];
h=ones(1,15);
y=conv(h,x);
ny=[0:38];
stem(ny,y)
```




```
%2.7(d)
n=[0:9];
h=(0.9).^n;
n=[0:99];
x1=cos(n.^2);
x2=sin(pi*2*n/5);
x=x1.*x2;
ny=[0:108];
y=conv(h,x);
stem(ny,y)
```



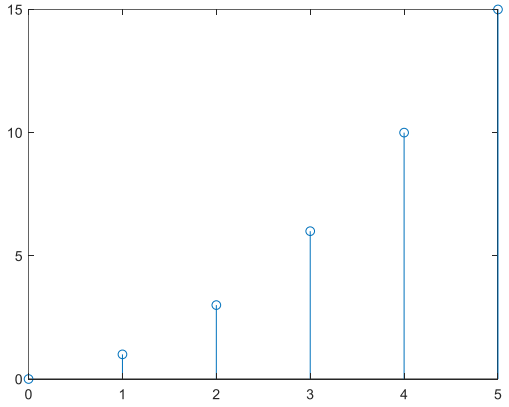

```
%2.7(e)
n=0:9;
h(n+1)=(0.9).^n;
n1=0:49;
x1(n1+1)=cos(n1.^2).*sin(2*pi/5.*n1);
n2=50:99;
x2(n2+1)=cos(n2.^2).*sin(2*pi/5.*n2);
y0=conv(h,x1);
y1=conv(h,x2);
y(1:59)=y0(1:59)+y1(1:59);
y(51:109)=y1(51:109);
stem(y)
```

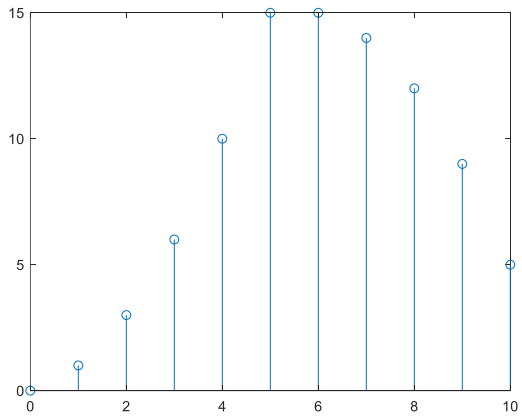



```
%2.2(a)(b)(c)(d)
x=[1 2 3 4];
a1=[1 0 0];
b1=[0.5 1 2];
a2=[1 -0.8];
b2=[2 0];
a3=[1 -0.8];
b3=[0 2];
y1=filter(b1,a1,x)
y2=filter(b2,a2,x)
y3=filter(b3,a3,x)
```

```
>> a22

y1 =

    0.5000    2.0000    5.5000    9.0000


y2 =

    2.0000    5.6000   10.4800   16.3840


y3 =

         0    2.0000    5.6000   10.4800
```

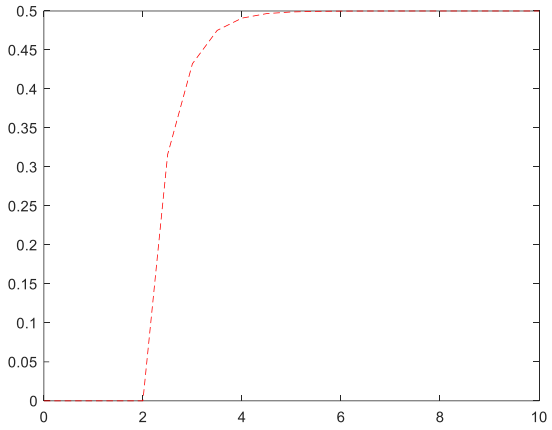
```
%2.2(e)(f)
n=[0:5];
h=n;
x=ones(1,6);
b=h;
a=1;
y=filter(h,1,x);
ny=[0:5];
stem(ny,y)
pause
x2=ones(1,11);
x2(7:10)=0;
y2=filter(h,1,x2);
stem([0:10],y2)
```



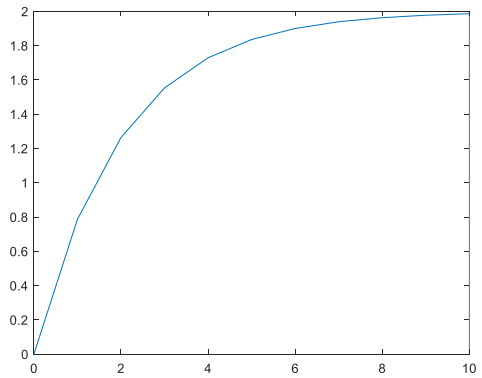


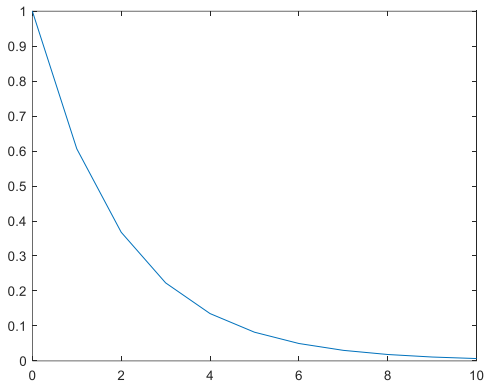

```
%2.3(a)
```

```
t=[0:0.5:10];
x=ones(1,length(t));
x(1:4)=0;
b=1;
a=[1 2];
s=lsim(b,a,x,t);
plot(t,x)
pause
plot(t,s,'r--')
```

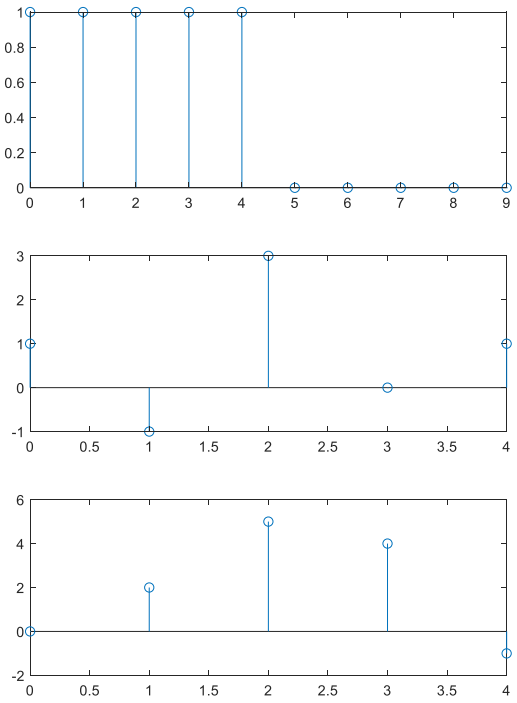



```
%2.3(b)
t=[0:10];
x=ones(1,length(t));
b=1;
a=[1 0.5];
s=step(b,a,t);
h=impulse(b,a,t);
plot(t,s)
pause
plot(t,h)
```



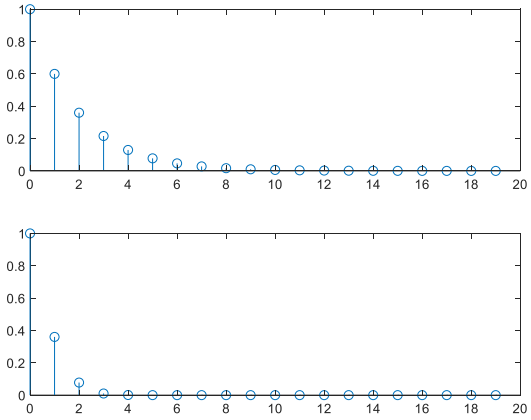


```
%2.4(a)(d)
x1(1:5)=1;
x1(6:10)=0;
h1=[1 -1 3 0 1];
h2=[0 2 5 4 -1];
nx1=[0:9];
nh1=[0:4];
subplot(3,1,1)
stem(nx1,x1)
subplot(3,1,2)
stem(nh1,h1)
subplot(3,1,3)
stem(nh1,h2)
w=conv(x1,h1);
yd1=conv(w,h2)
hs=conv(h1,h2);
yd2=conv(x1,hs)
```



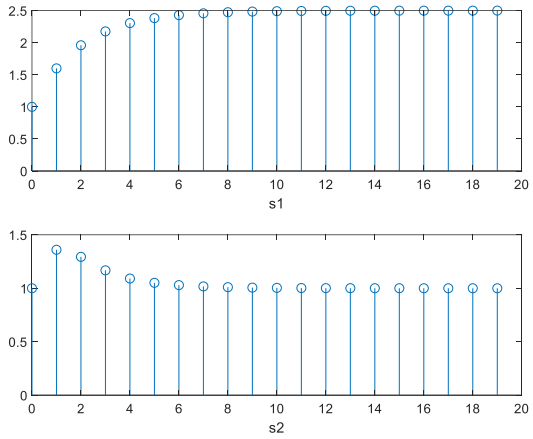
```
yd1 =

  Columns 1 through 8

     0     2     5    10    20    35    35    36

  Columns 9 through 16

    30    20     5     3    -1     0     0     0

  Columns 17 through 18

     0     0


yd2 =

  Columns 1 through 8

     0     2     5    10    20    35    35    36

  Columns 9 through 16

    30    20     5     3    -1     0     0     0

  Columns 17 through 18

     0     0
```

```
%2.5(d)
b1=1;
a1=[1 -3/5];
x(1)=1;
x(2:20)=0;
h1=filter(b1,a1,x);
h2(1)=1;
for n=[2:20]
    h2(n)=((3/5)^n).*h2(n-1)+x(n)
end
subplot(2,1,1)
stem((0:19),h1)
subplot(2,1,2)
stem((0:19),h2)
```

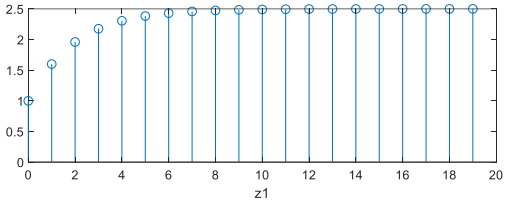


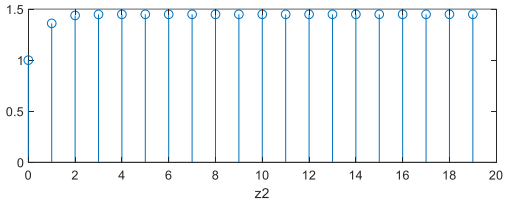

```
%2.5(e)
b1=1;
a1=[1 -3/5];
x(1:20)=1;
s1=filter(b1,a1,x)
s2(1)=1
for n=[2:20]
```

```
    s2(n)=((3/5)^n).*s2(n-1)+x(n)
end
subplot(2,1,1)
stem((0:19),s1)
xlabel('s1')
subplot(2,1,2)
stem((0:19),s2)
xlabel('s2')
```




```
%2.5(f)(g)
b1=1;
a1=[1 -3/5];
x=zeros(1,20);
x(1)=1;
h1=filter(b1,a1,x);
u=ones(1,20);
h2(1)=1;
for n=[2:20]
    h2(n)=((3/5)^n).*h2(n-1)+x(n);
end
z1=conv(h1,u);
z2=conv(h2,u);
subplot(2,1,1)
stem((0:19),z1(1:20))
xlabel('z1')
subplot(2,1,2)
stem((0:19),z2(1:20))
xlabel('z2')
```






```
The system 1 is linear, so I got the identical result with s1,
however, system 2 is not linear, so z2 does not equal to s2.
```

九、 Summary and comments：

From this lab, I learned the expressions of LTI systems in MATLAB. I got to know how to perform convolution and how to use conv, filter, step, impulse and lsim to represent a LTI system. I also found that I am not very familiar with the operations on MATLAB and the basic properties and applications of LTI systems, in which aspect I should make more effort.

十、 Suggestion for this lab：

I suggest to provide the solutions for the questions in the lab session after submission, so that we can correct our code and have further comprehension of knowledge.

Score:

Instructor: