LAB1 MATLAB Programming

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目录

Introduction

in this lab assignment, we learned about：

1.Use MATLAB to represent discrete-time signals.

2.Use MATLAB to represent unit impulse signal and unit step signal.

3. Use MATLAB to verify discrete-time systems' properties such as linearity, time invariance, stability, causality, and invertibility.

4.Use MATLAB to represent a discrete-time system which is basis on the first-order autoregression equation.

5.Explore the effect of simple transformations of the independent variable, such as delaying the signal or reversing its time axis.

Results and Analysis

1.4

(a)

For these problems, you are told which property a given system does not satisfy, and the input sequence or sequences that demonstrate clearly how the system violates the property. For each system, define MATLAB vectors representing the input(s) and output(s). Then, make plots of these signals, and construct a well reasoned argument explaining how these figures demonstrate that the system fails to satisfy the property in question.

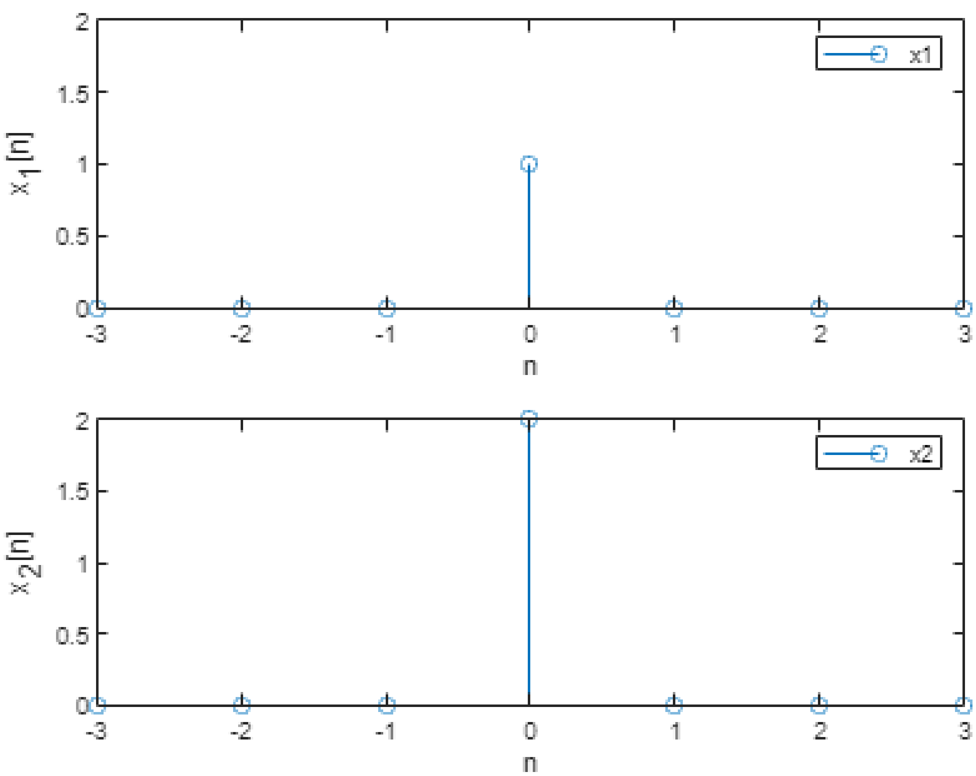
(a). The system $y[n] = \sin((\pi/2)x[n])$ is not linear. Use the signals $x_1[n] = \delta[n]$ and $x_2[n] = 2\delta[n]$ to demonstrate how the system violates linearity.

Initialize.

```
clear; clc; close all;
```

Create two vectors x1 and x2 and plot them

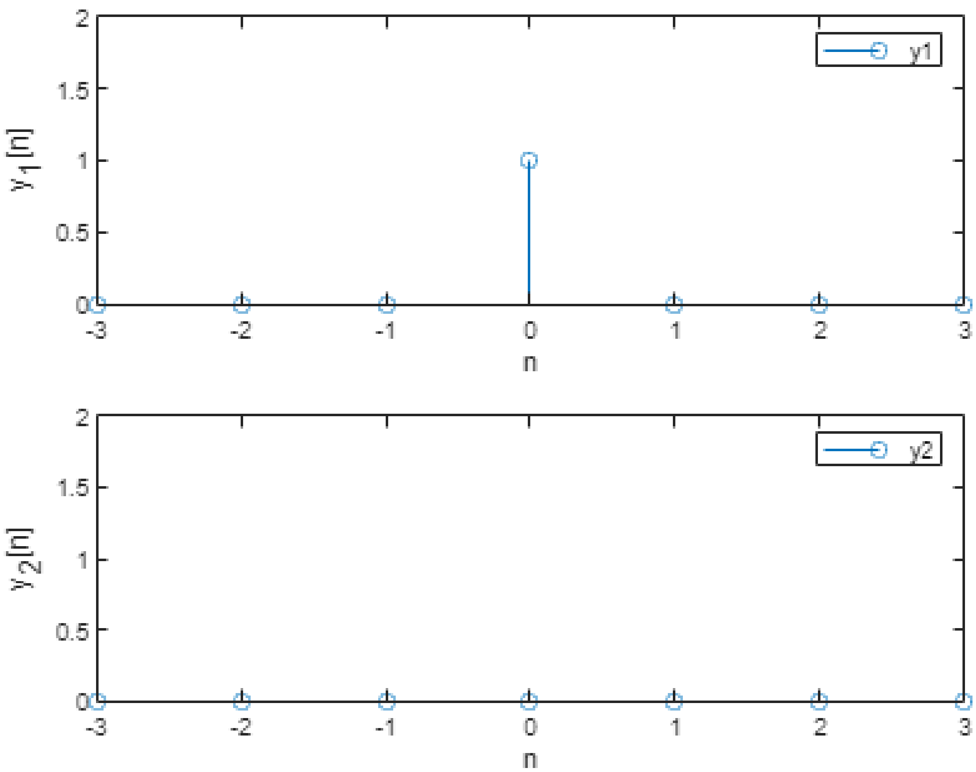
```
n=-3:3;
x1=(n==0);
x2=2*x1;
figure;
subplot(2,1,1);
stem(n,x1);
xlabel('n');ylabel('x_1[n]');
legend('x1');
axis([xlim,0 2])
subplot(2,1,2);
stem(n,x2);
xlabel('n');ylabel('x_2[n]');
legend('x2');
axis([xlim,0 2]);
```



Calculate y1 and y2 and plot them

```
y1=sin(pi*x1/2);
y2=sin(pi*x2/2);
figure;
subplot(2,1,1);
stem(n,y1);
xlabel('n');ylabel('y_1[n]');
legend('y1');
```

```
axis([xlim,0 2]);
subplot(2,1,2);
stem(n,y2);
xlabel('n');ylabel('y_2[n]');
legend('y2');
axis([xlim,0 2]);
```



From the two figures, we can see that x2 = 2x1,but y2 ≠ 2y1..

According to the definition, the system is not linear

(b)

(b). The system $y[n] = x[n] + x[n+1]$ is not causal. Use the signal $x[n] = u[n]$ to demonstrate this. Define the MATLAB vectors **x** and **y** to represent the input on the interval $-5 \leq n \leq 9$, and the output on the interval $-6 \leq n \leq 9$, respectively.

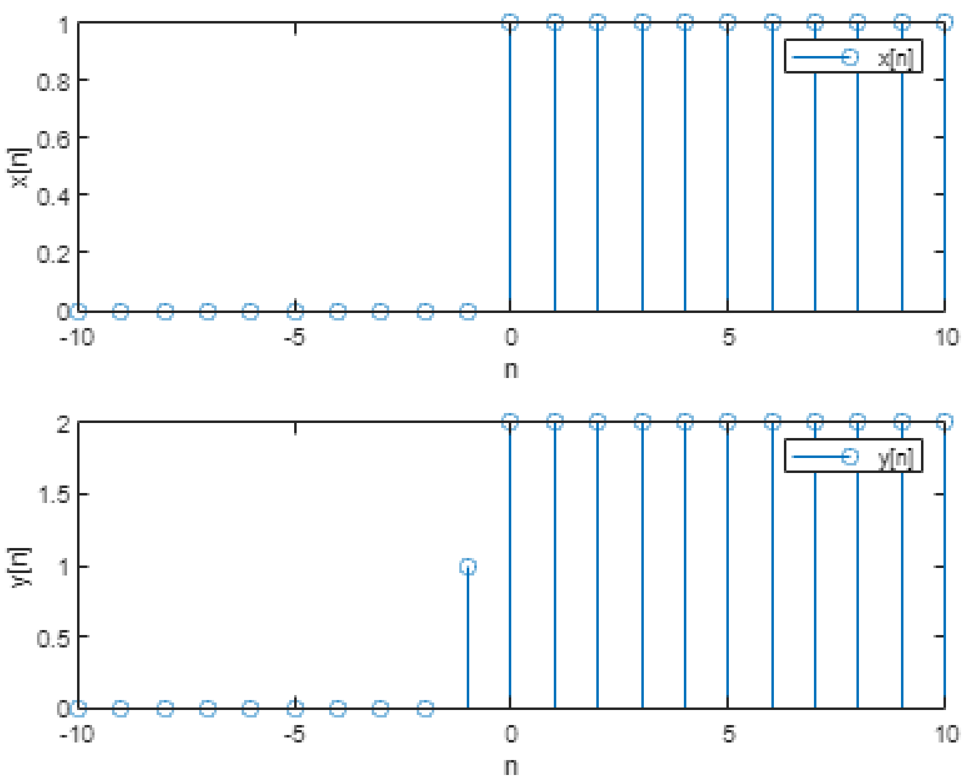
Initialize.

```
clear; clc; close all;
```

Create x[n] ,x[n+1] and y[n] and plot x[n] and y[n]

```
n=-10:10;
x1=(n>=0);
x2=(n>=-1);
```

```
y=x1+x2;
subplot(2,1,1);
stem(n,x1);
xlabel('n');ylabel('x[n]')
legend('x[n]')
subplot(2,1,2);
stem(n,y);
xlabel('n');ylabel('y[n]')
legend('y[n]')
```



As can be seen from the above figure, the signal at n=-1 is affected by n=0,

According to the definition, the system is not causal.

(c)(d)

For these problems, you will be given a system and a property that the system does not satisfy, but must discover for yourself an input or pair of input signals to base your argument upon. Again, create MATLAB vectors to represent the inputs and outputs of the system and generate appropriate plots with these vectors. Use your plots to make a clear and concise argument about why the system does not satisfy the specified property.

(c). The system $y[n] = \log(x[n])$ is not stable.

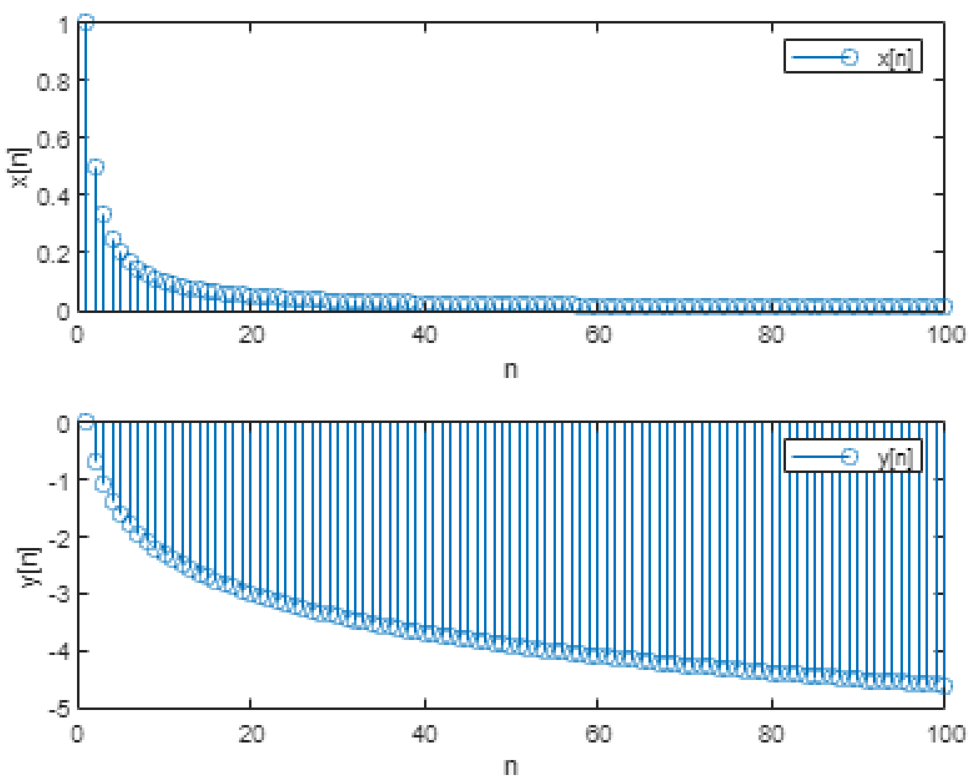
(d). The system given in Part (a) is not invertible.

Initialize.

```
clear; clc; close all;
```

(c) We choose x[n]=$\frac{1}{n}$ as the input function. Then we create x[n] and calculate y[n] and plot them

```
n=1:100;
x=1./n;
y=log(x);
subplot(2,1,1);
stem(n,x);
xlabel('n');ylabel('x[n]')
legend('x[n]');
subplot(2,1,2);
stem(n,y);
xlabel('n');ylabel('y[n]');
legend('y[n]')
```



When x[n] tends to 0, y[n] tends to negative infinity,

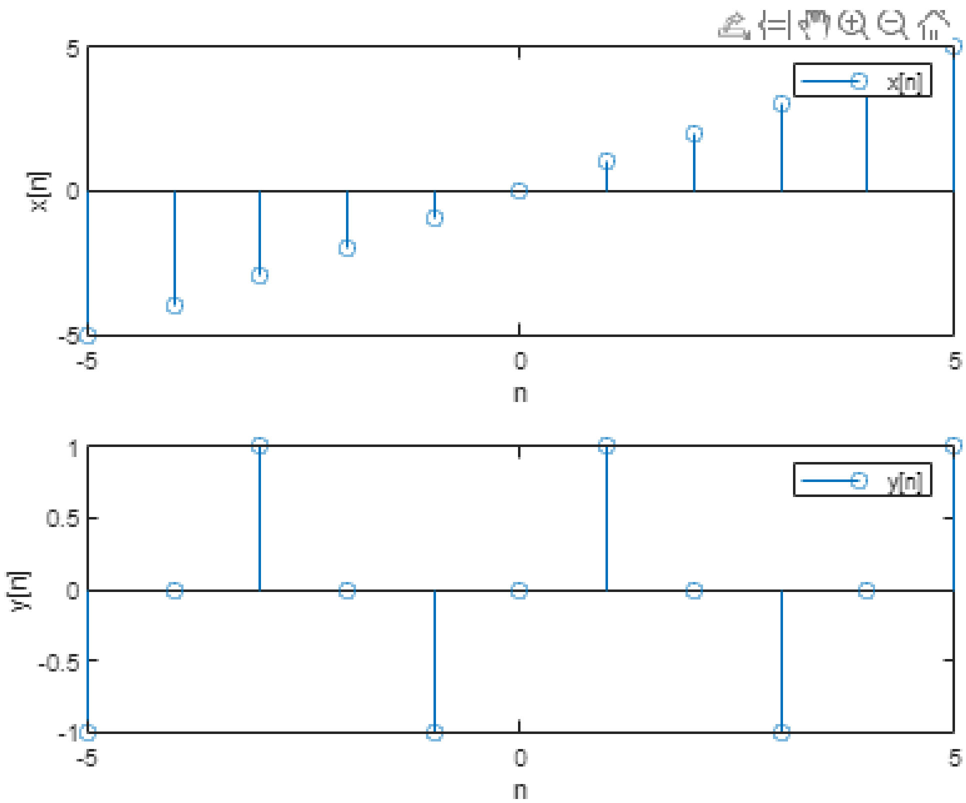
According to the definition, the system is unstable.

Initialize.

```
clear; clc; close all;
```

(d)We choose x[n]=n as the input function.Then we create x[n] and calculate y[n] and plot them.

```
n=-5:5;
x=n;
y=sin(pi*x/2);
subplot(2,1,1);
stem(n,x);
xlabel('n');ylabel('x[n]');
legend('x[n]');
subplot(2,1,2);
stem(n,y);
xlabel('n');ylabel('y[n]');
legend('y[n]');
```



The same output corresponds to more than one input,

According to the definition, the system is irreversible.

1.5

(a)

(a). Write a function `y=diffeqn(a,x,yn1)` which computes the output $y[n]$ of the causal system determined by Eq. (1.6). The input vector `x` contains $x[n]$ for $0 \leq n \leq N-1$ and `yn1` supplies the value of $y[-1]$. The output vector `y` contains $y[n]$ for $0 \leq n \leq N-1$. The first line of your M-file should read

```
function y = diffeqn(a,x,yn1)
```

Hint: Note that $y[-1]$ is necessary for computing $y[0]$, which is the first step of the autoregression. Use a `for` loop in your M-file to compute $y[n]$ for successively larger values of n, starting with $n = 0$.

Initialize.

```
clear; clc; close all;
```

We construct a function y, and use yn1 to replace y[-1] to get y[0]. Then we use a for loop to get all y[n].

```
% function y = diffeqn(a,x,yn1)
% N = length(x);
% y = zeros(1,N);
% y(1) = a * yn1 + x(1);
% for n = 2:N
%     y(n) = a * y(n-1) + x(n);
% end
% end
```

(b)

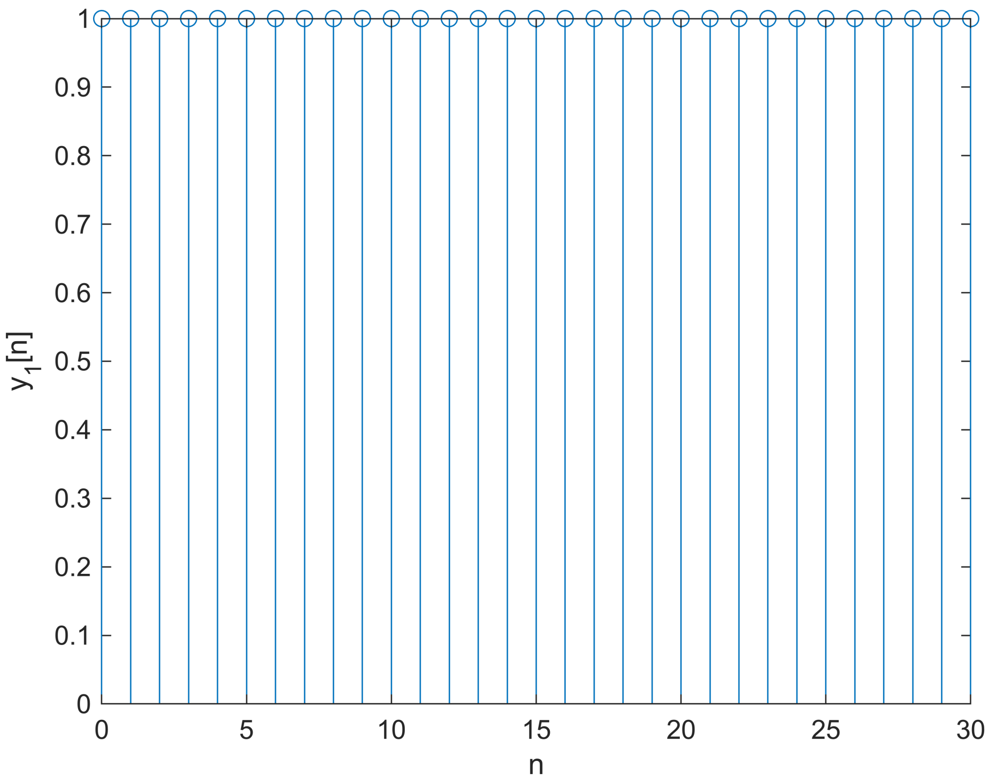
(b). Assume that $a = 1$, $y[-1] = 0$, and that we are only interested in the output over the interval $0 \leq n \leq 30$. Use your function to compute the response due to $x_1[n] = \delta[n]$ and $x_2[n] = u[n]$, the unit impulse and unit step, respectively. Plot each response using `stem`.

Initialize.

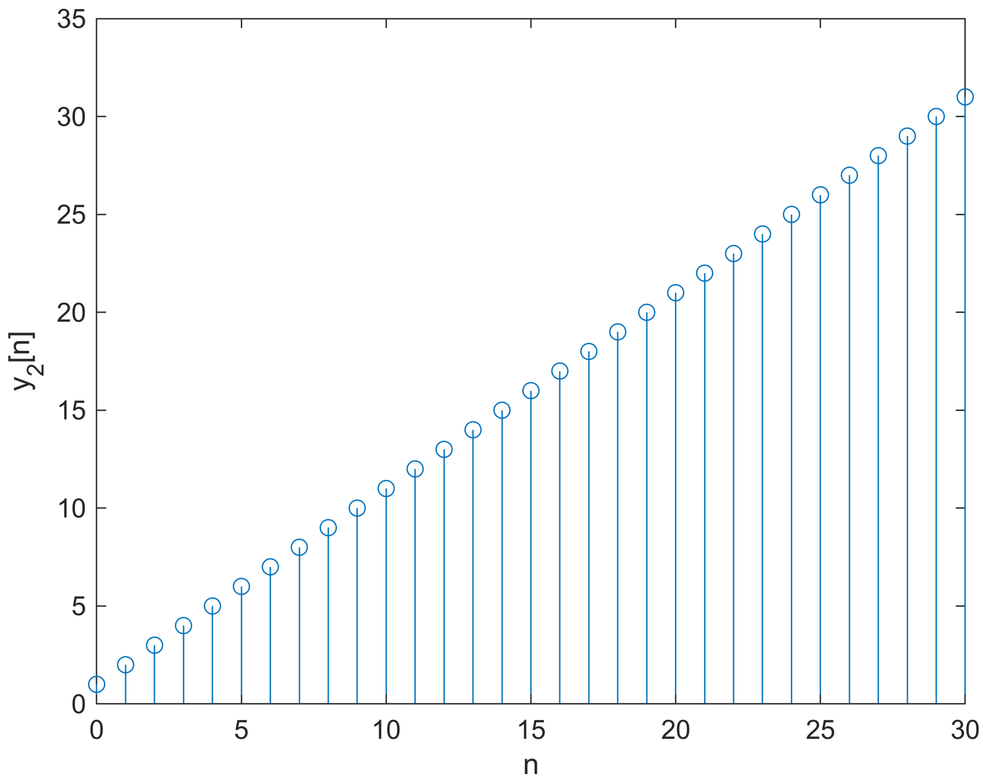
```
clear; clc; close all;
```

Using the function of (a), when a=1, yn1=0, the plots of y1[n] and y2[n] are shown.

```
n=0:30;
x1=(n==0);
yn1=0;a=1;
y1=diffeqn(a,x1,yn1);
stem(n,y1);
xlabel('n')
ylabel('y_1[n]')
```




```
x2=(n>=0);
y2=diffeqn(a,x2,yn1);
stem(n,y2);
xlabel('n')
ylabel('y_2[n]')
```



(c)

(c). Assume again that $a = 1$, but that $y[-1] = -1$. Use your function to compute $y[n]$ over $0 \leq n \leq 30$ when the inputs are $x_1[n] = u[n]$ and $x_2[n] = 2\,u[n]$. Define the outputs produced by the two signals to be $y_1[n]$ and $y_2[n]$, respectively. Use **stem** to display both outputs. Use **stem** to plot $(2\,y_1[n] - y_2[n])$. Given that Eq. (1.6) is a linear difference equation, why isn't this difference identically zero?

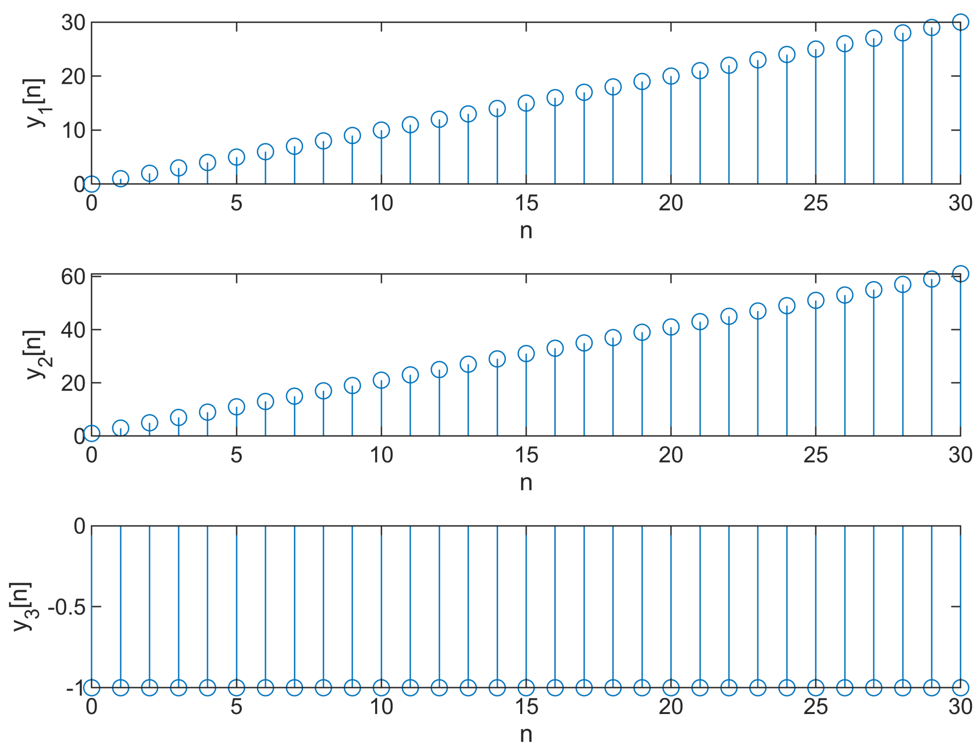
Initialize.

```
clear; clc; close all;
```

Using the function of(a), when a=1, yn1=-1, x1[n]=u[n] and x2[n]=2u[n]. We can plot y1[n], y2[n] and (2y1[n]-y2[n]).

```
n=0:30;
a=1;yn1=-1;
x1=(n>=0);
x2=2*x1;
y1=diffeqn(a,x1,yn1);
y2=diffeqn(a,x2,yn1);
y3=2*y1-y2;
subplot(3,1,1);
```

```
stem(n,y1);
xlabel('n');
ylabel('y_1[n]')
subplot(3,1,2);
stem(n,y2);
xlabel('n');
ylabel('y_2[n]')
subplot(3,1,3);
stem(n,y3);
xlabel('n');
ylabel('y_3[n]')
```



When y[-1]=-1 and x1[n]=u[n], y[0]=0. When x2[n]=2u[n], y[0]=1. On the basis of y[n]=ay[n-1]+x[n]. When x1[n]=u[n], y1[n]=n. When x2[n]=2u[n], y2[n]=2n+1. So 2y1[n]-y2[n]=-1 instead of 0.

Function

```
function y = diffeqn(a,x,yn1)
N = length(x);
y = zeros(1,N);
y(1) = a * yn1 + x(1);
for n = 2:N
    y(n) = a * y(n-1) + x(n);
end
end
```

Expeience

(1)We deepened our understanding of matlab and became proficient in its basic syntax and used it to draw diagrams

(2)We learned to use functions to answer questions

(3)We were able to debug our own code based on Matlab's prompts.

(4)We had a primer on matlab code representation of signals and systems and deepened understanding of unit impulse functions and unit step functions.

(5)We also learned more about the characteristics of the system as we wrote the code.

(6)In real-time scripts, functions go at the end of the line.

(7)Collaboration is important, and discussions with peers lead to more accurate answers.

(8)Use github to manage group code for easy team cooperation.