DIGITAL SIGNAL PROCESSING LAB MANUAL 11

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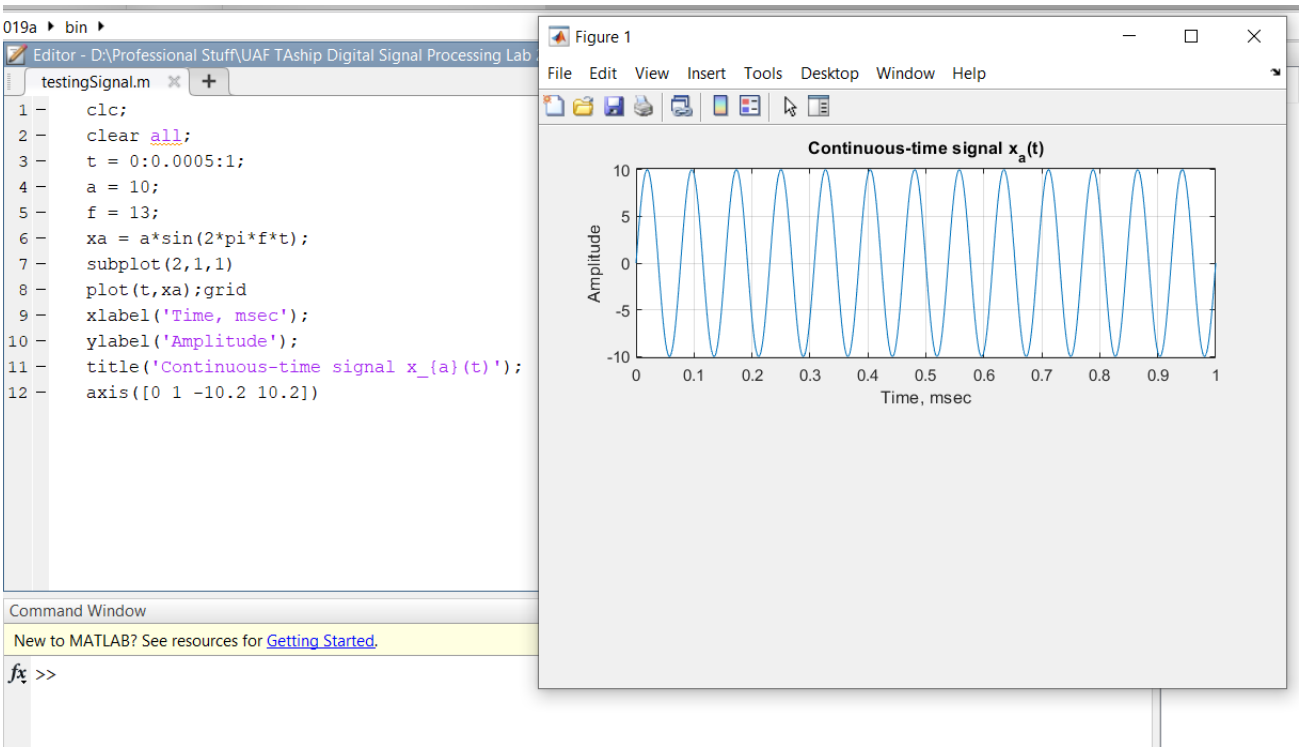
Generation of Signals

Example 1

Plot continuous time signal by writing MATLAB code.



Exercise 1

Plot continuous time signal by writing MATLAB code.

```
clear all;
Finput = 1000;
Fsampling = 5000000;
Tsampling = 1 / Fsampling;
 Nsample = Fsampling/ Finput;
N = 0:5*Nsample-1;
x=sin(2 * pi * Finput * Tsampling * N);
plot(x); title('Sine Wave Generation');
xlabel('Time -- >');
ylabel('Amplitude-- >');
grid on;
```

Example 2

Plot digital time signal by writing MATLAB code.

Editor - D:\Professional Stuff\UAF TAship Digital Signal Process

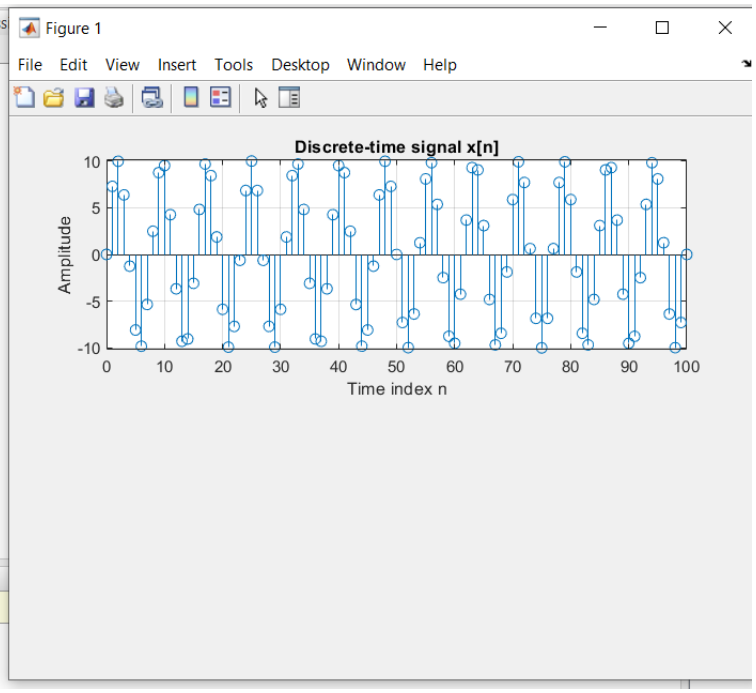
testingSignal.m | digitalsignal.m

```
a = 10;
f = 13;
T = 0.01;
n = 0:T:1;
xs = a*sin(2*pi*f*n);
k = 0:length(n)-1;
stem(k,xs);
grid
xlabel('Time index n');
ylabel('Amplitude');
title('Discrete-time signal x[n]');
axis([0 (length(n)-1) -10.2 10.2])
```

Command Window

New to MATLAB? See resources for Getting Started.

```
>> digitalsignal
digitalsignal
```



Example 3

Plot basic time signals by writing MATLAB code.

testingSignal.m | digitalsignal.m | basicSignals.m

```
% program for generation of unit sample
clc;clear all;close all;
t = -3:1:3;
y = [zeros(1,3),ones(1,1),zeros(1,3)];
subplot(2,2,1);stem(t,y);
ylabel('Amplitude------>');
xlabel('(a)n ------>');
title('Unit Impulse Signal');
% program for genration of unit step of sequence [u(n)- u(n)-N]
t = -4:1:4;
y1 = ones(1,9);
subplot(2,2,2);stem(t,y1);
ylabel('Amplitude------>');
xlabel('(b)n ------>');
title('Unit step');
% program for generation of ramp signal
n1 = input('Enter the value for end of the seqeuence '); %n1 = <any value>7 %
x = 0:n1;
subplot(2,2,3);stem(x,x);
ylabel('Amplitude------>');
xlabel('(c)n ------>');
title('Ramp sequence');
% program for generation of exponential signal
n2 = input('Enter the length of exponential seqeuence '); %n2 = <any value>7 %
t = 0:n2;
a = input('Enter the Amplitude'); %a=1%
y2 = exp(a*t);
```

```
28 -    subplot(2,2,4);stem(t,y2);
29 -    ylabel('Amplitude------>');
30 -    xlabel('(d)n ------>');
31 -    title('Exponential sequence');
32 -    disp('Unit impulse signal');y
33 -    disp('Unit step signal');y1
34 -    disp('Unit Ramp signal');x
35 -    disp('Exponential signal');x
```

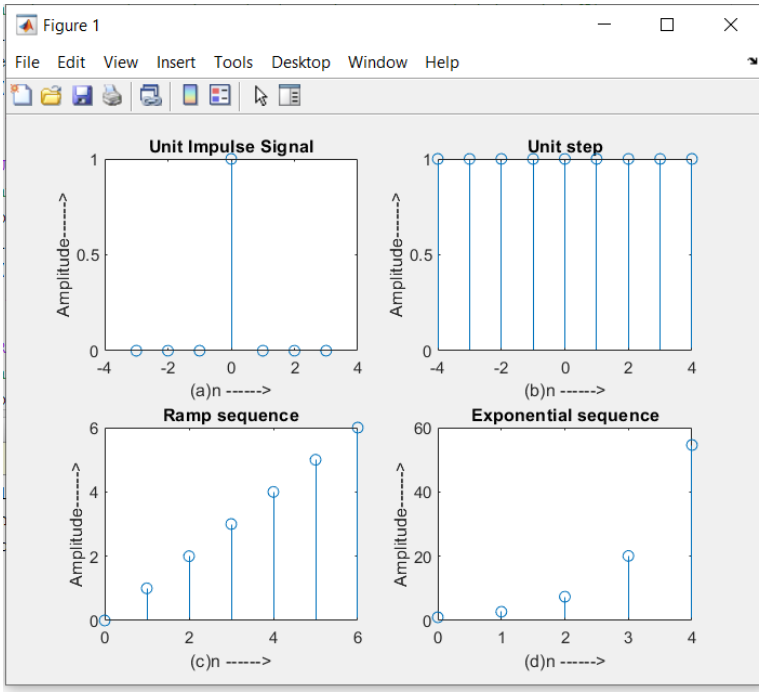
Entering Inputs

Command Window

New to MATLAB? See resources for Getting Started.

```
Enter the value for end of the seqeuence 6
Enter the length of exponential seqeuence 4
Enter the Amplitude 1
Unit impulse signal

y =

     0     0     0     1     0     0     0

Unit step signal

y1 =

     1     1     1     1     1     1     1     1     1

Unit Ramp signal

x =

     0     1     2     3     4     5     6

Exponential signal

x =

     0     1     2     3     4     5     6
```

Displaying Output for above input



Basic Operations on Signals

To develop program for some basic operations like addition, subtraction, shifting and folding on signal.

Basic Operations

Signal Adding:

This is a sample-by-sample addition given by and the length of $x_1(n)$ and $x_2(n)$ must be the same

$$\{x_1(n)\} + \{x_2(n)\} = \{x_1(n) + x_2(n)\}$$

Signal Multiplication:

This is a sample-by-sample multiplication (or "dot" multiplication) given by

$$\{x_1(n)\} \bullet \{x_2(n)\} = \{x_1(n)x_2(n)\}$$

and the length of $x_1(n)$ and $x_2(n)$ must be the same.

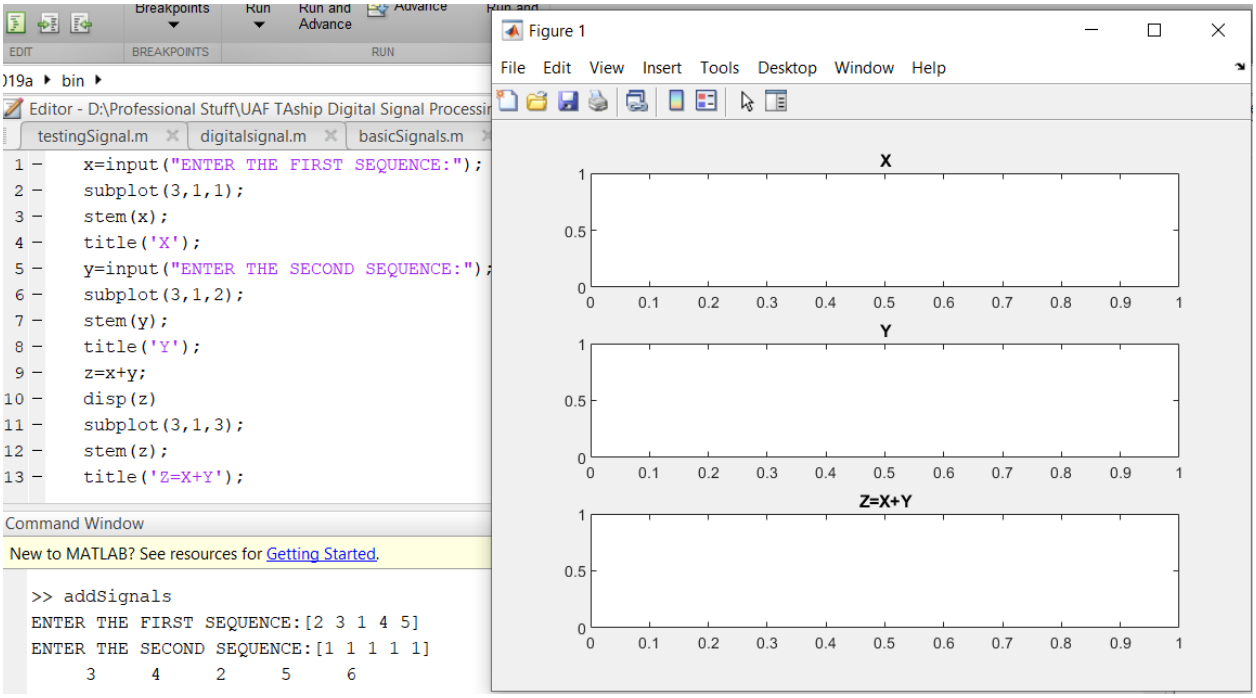
- **Scaling:**
  In this operation each sample is multiplied by a scalar α
  $$\alpha \ \{x(n)\} = \{\alpha \ x(n)\}$$

- **Shifting:**
  In this operation each sample of $x(n)$ is shifted by an amount k to obtain a shifted sequence $y(n)$.
  $$y(n) = \{x(n-k)\}$$

- **Folding**:
  In this operation each sample of $x(n)$ is flipped around $n = 0$ to obtain a folded sequence $y(n)$. (Matlab function for folding is "**fliplr**")
  $$y(n) = \{x(-n)\}$$

Example 4: Addition of Signals

Take two signals from input and add them by writing MATLAB code.



Exercise 2:

1. Take following two signals from input and add them by writing MATLAB code and display their output.
   a. [1 2 3 4 5]
      [-1 1 0 1 -1]

   b. [3 5 2 10 6]
      [2 1 0 4 7]

   c. [3 1 2 4 5]
      [-2 1 0 1 -3]

   d. [1 9 2 2 -3]
      [2 -5 5 1 -1]

Example 5: Subtraction of Signals

Take two signals from input and subtract them by writing MATLAB code.

Editor - D:\Professional Stuff\UAF TAship Digital Signal Processing Lab 2022\BS CS & IT 5th DSP\codes\subSignals.m

testingSignal.m | digitalsignal.m | basicSignals.m | addSignals.m | subSignals.m

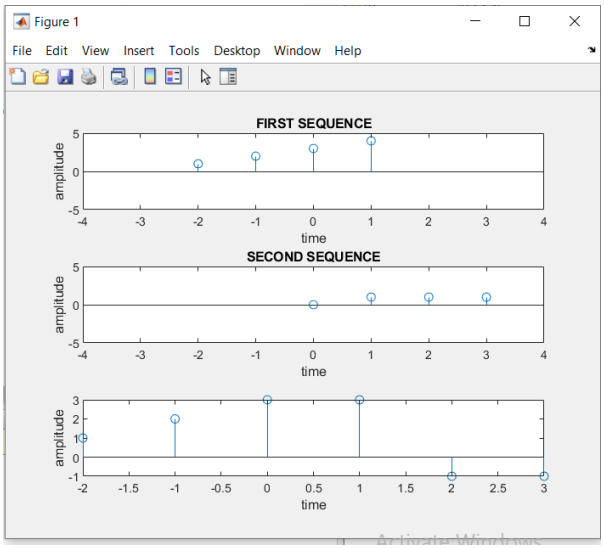
```
clc;
clear all;
close all;
n1=-2:1;
x=input('ENTER THE FIRST SEQUENCE:');
n2=0:3;
y=input('ENTER THE SECOND SEQUENCE:');
subplot(3,1,1);
stem(n1,x);
xlabel ('time')
ylabel ('amplitude')
title('FIRST SEQUENCE') ;
axis([-4 4 -5 5]);
subplot(3,1,2);
stem(n2,y);
xlabel ('time')
ylabel ('amplitude')
title('SECOND SEQUENCE');
axis([-4 4 -5 5]);
n3 =min (min(n1) ,min( n2 ) ) : max ( max ( n1 ) , max ( n2 ) ); % finding the duration of outpu
s1 =zeros(1,length (n3) );
s2 =s1;
```

```
  s1 (find ( ( n3>=min( n1 ) ) & ( n3 <=max ( n1 ) )==1 ) )=x;
  % signal x with the duration of output signal 'sub'
  s2 (find ( ( n3>=min ( n2 ) ) & ( n3 <=max ( n2 ))==1) )=y;
  % signal y with the duration of output signal 'sub'
  sub=s1 - s2; % subtraction
  disp('subtracted sequence')
  disp(sub)
  subplot(3,1,3)
  stem(n3,sub)
  xlabel ('time')
  ylabel ('amplitude')
```

Command Window

New to MATLAB? See resources for Getting Started.

```
ENTER THE FIRST SEQUENCE:[1 2 3 4]
ENTER THE SECOND SEQUENCE:[0 1 1 1]
subtracted sequence
     1     2     3     3    -1    -1
```



Exercise 3:

Take following two signals from input and subtract them by writing MATLAB code and display their output.

a. [1 2 3 4]
   [1 1 0 1]

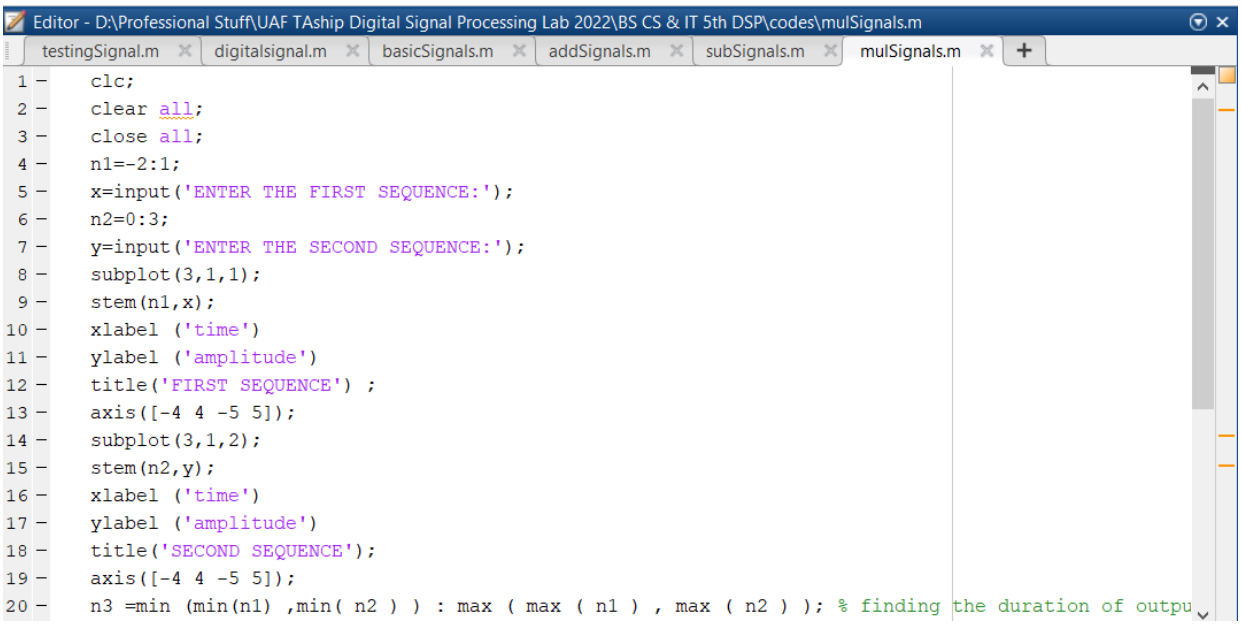
b. [3 5 2 10]
   [2 1 0 4]

c. [3 1 2 4]
   [-2 1 0 1]

d. [1 9 2 2]
   [2 -5 5 1]

Example 6: Multiplication of Signals

Take two signals from input and multiply them by writing MATLAB code.

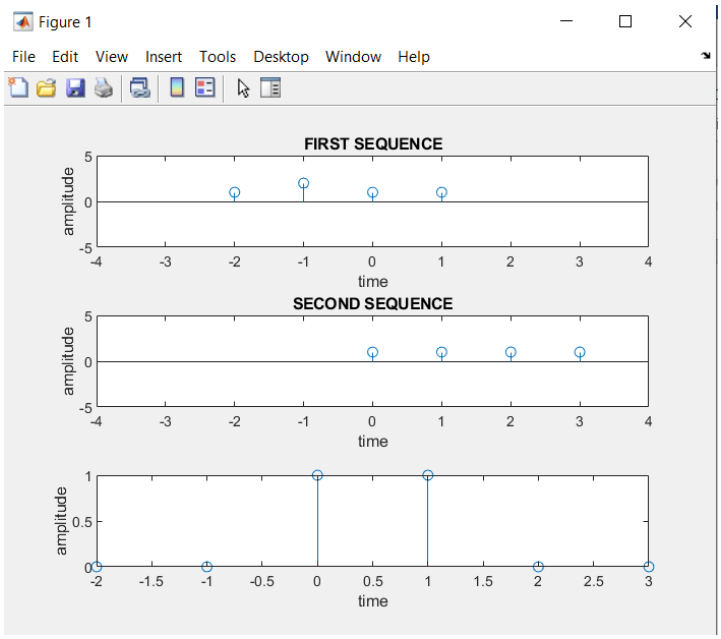


```
21 -    s1 =zeros(1,length (n3) );
22 -    s2 =s1;
23 -    s1 (find ( ( n3>=min( n1 ) ) & ( n3 <=max ( n1 ) )==1 ) )=x;
24      % signal x with the duration of output signal 'mul'
25 -    s2 (find ( ( n3>=min ( n2 ) ) & ( n3 <=max ( n2 ))==1) )=y;
26      % signal y with the duration of output signal 'mul'
27 -    mul=s1 .* s2; % multiplication
28 -    disp('MULTIPLIED SEQUENCE')
29 -    disp(mul)
30 -    subplot(3,1,3)
31 -    stem(n3,mul)
32 -    xlabel ('time')
33 -    ylabel ('amplitude')
```

Command Window

New to MATLAB? See resources for Getting Started.

```
ENTER THE FIRST SEQUENCE:[1 2 1 1]
ENTER THE SECOND SEQUENCE:[1 1 1 1]
MULTIPLIED SEQUENCE
     0     0     1     1     0     0
```



Exercise 4:

Take following two signals from input and multiply them by writing MATLAB code and display their output.

a. [1 2 3 4]
   [1 1 0 1]

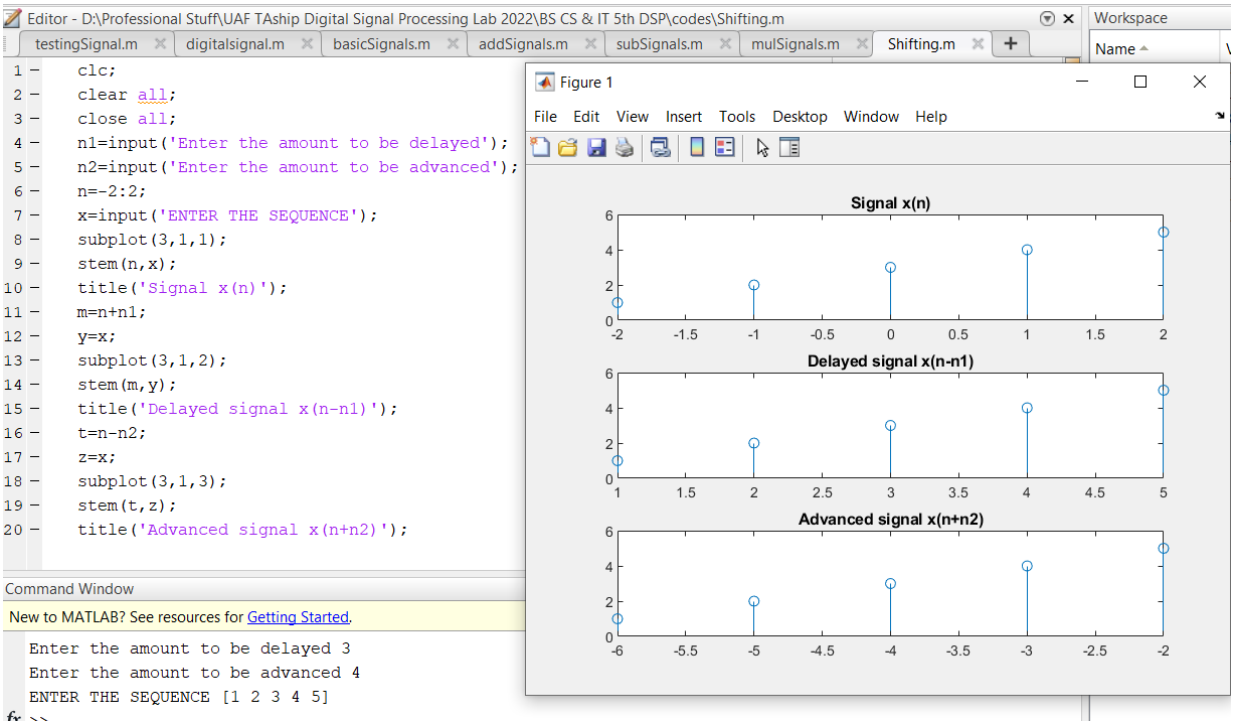
b. [3 5 2 10]
   [2 1 0 4]

c. [3 1 2 4]
[-2 1 0 1]

d. [1 9 2 2]
[2 -5 5 1]

Example 7: Shifting of Signal

Take signal from input and shift it by writing MATLAB code.



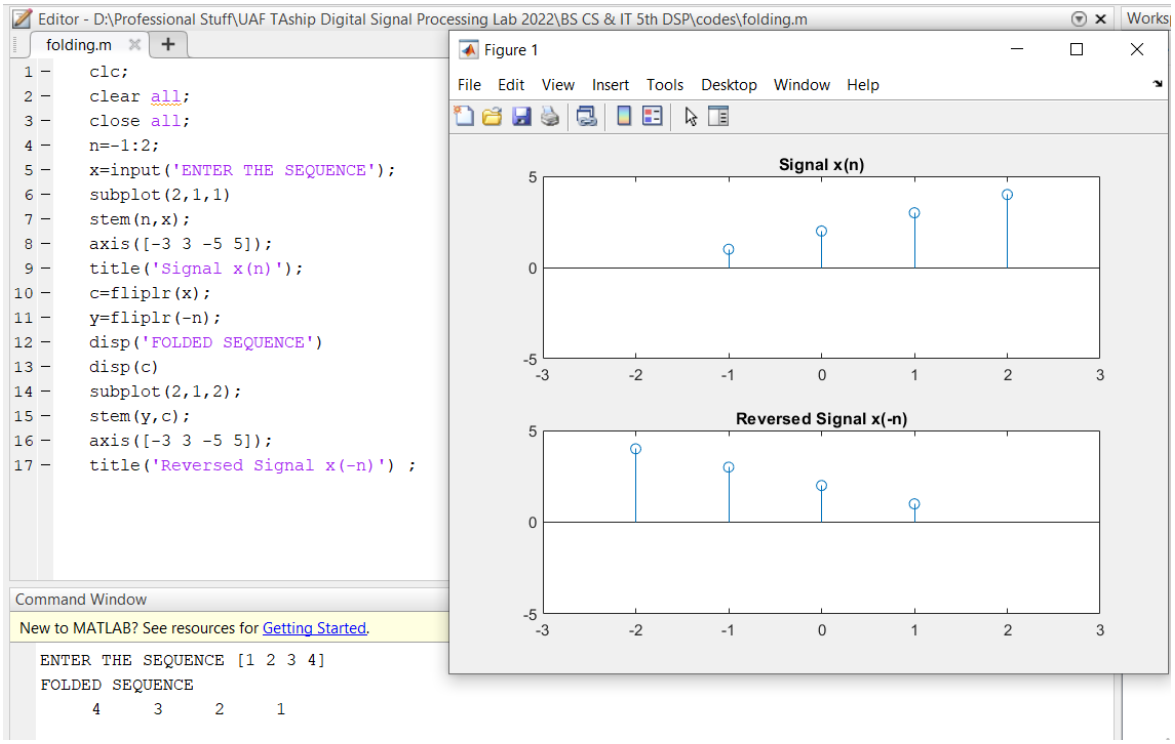
Exercise 5:

Take following signals from input and shift them by writing MATLAB code and display their output.

A. [5 4 3 2 1] Delay: 3 Advance: 3
B. [1 1 1 1 1] Delay: 2 Advance: 4
C. [2 5 3 4 6] Delay: 1 Advance: 2
D. [0 2 1 0 2] Delay: 4 Advance: 1

Example 8: Folding/reversing of Signal

Take signal from input and fold it by writing MATLAB code.



Exercise 6:

Take following signals from input and fold them by writing MATLAB code and display their output.

A. [5 4 3 2]
B. [1 1 1 1]
C. [2 5 3 4]
D. [0 2 1 0]