BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

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DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

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REPORT

On

"SIGNAL PROCESSING OPERATIONS USING MATLAB"

Date: 27-08-2022

Submitted By

USN	Name of the Student	Marks Awarded Max Marks: 05
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Signature of faculty		

Course: Signals and Systems

Course Code: 18EC45

Course Outcome: Perform in a group to write and execute codes for basic signal processing operations using modern tools.

POs Addressed: PO2, PO5, PO9, PO10,PO12

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<u>Z - TRANSFORMS</u>

1. 1 AIM OF THE EXPERIMENT

To find Z – Transforms

The MATLAB symbolic toolbox command `ztrans(f)` returns the ZT of the scalar symbolic object f with the default independent variable n.

Find Z –Transforms of :

a. f1(n) = u(n)

b. f2(n) = a n u(n)

c. f3(n) = cos(an)u(n)

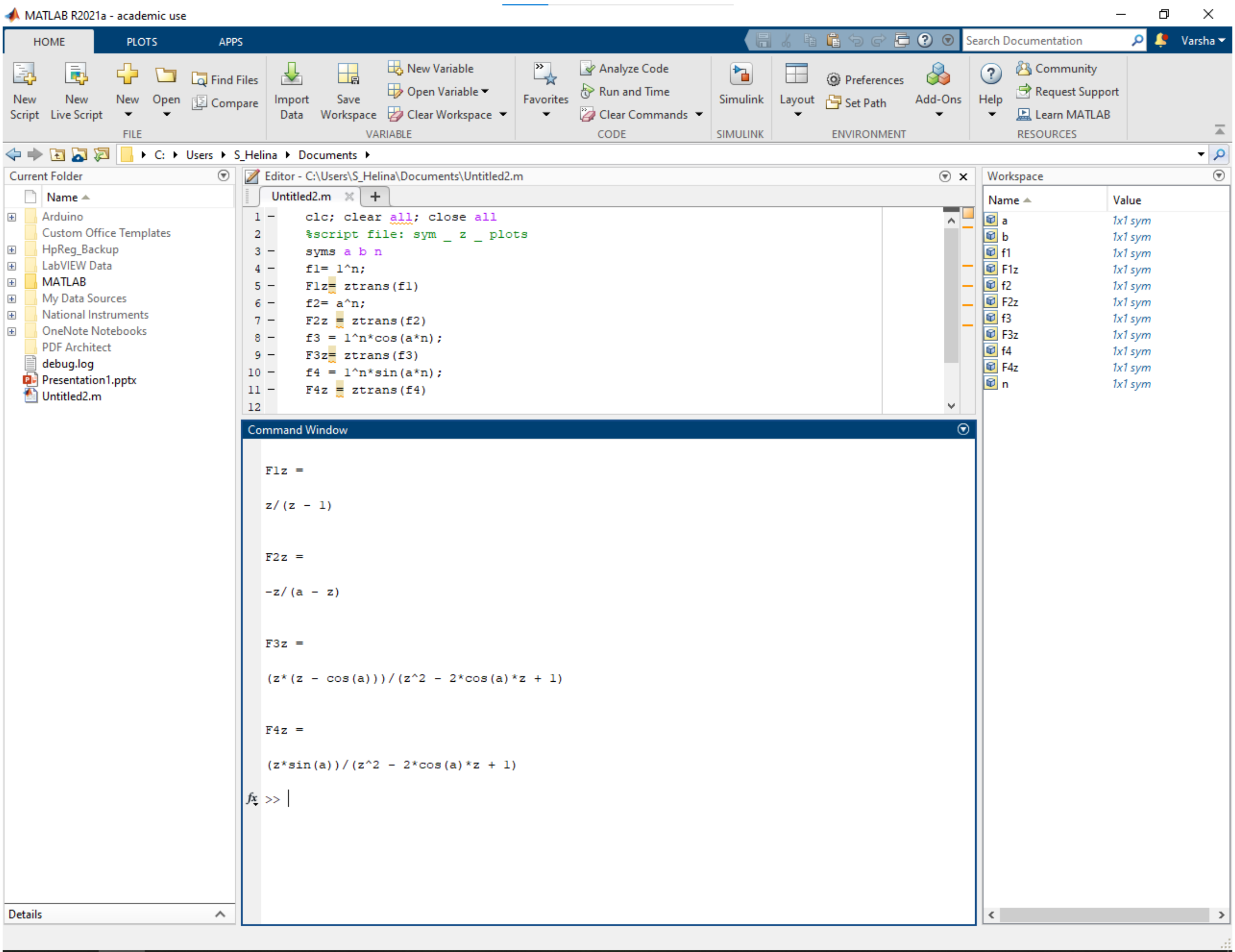
d. f4(n) = sin(an)u(n)

1.2.1 PROGRAM 1

```
clc; clear all; close all
%script file: sym _ z _ plots
syms a b n
f1= 1^n;
F1z= ztrans(f1)
f2= a^n;
F2z = ztrans(f2)
f3 = 1^n*cos(a*n);
F3z= ztrans(f3)
f4 = 1^n*sin(a*n);
F4z = ztrans(f4)
```

1.2.2 OUTPUT

```
F1z =
z/(z - 1)

F2z =
-z/(a - z)

F3z =
(z*(z - cos(a)))/(z^2 - 2*cos(a)*z + 1)

F4z =
(z*sin(a))/(z^2 - 2*cos(a)*z + 1)
```

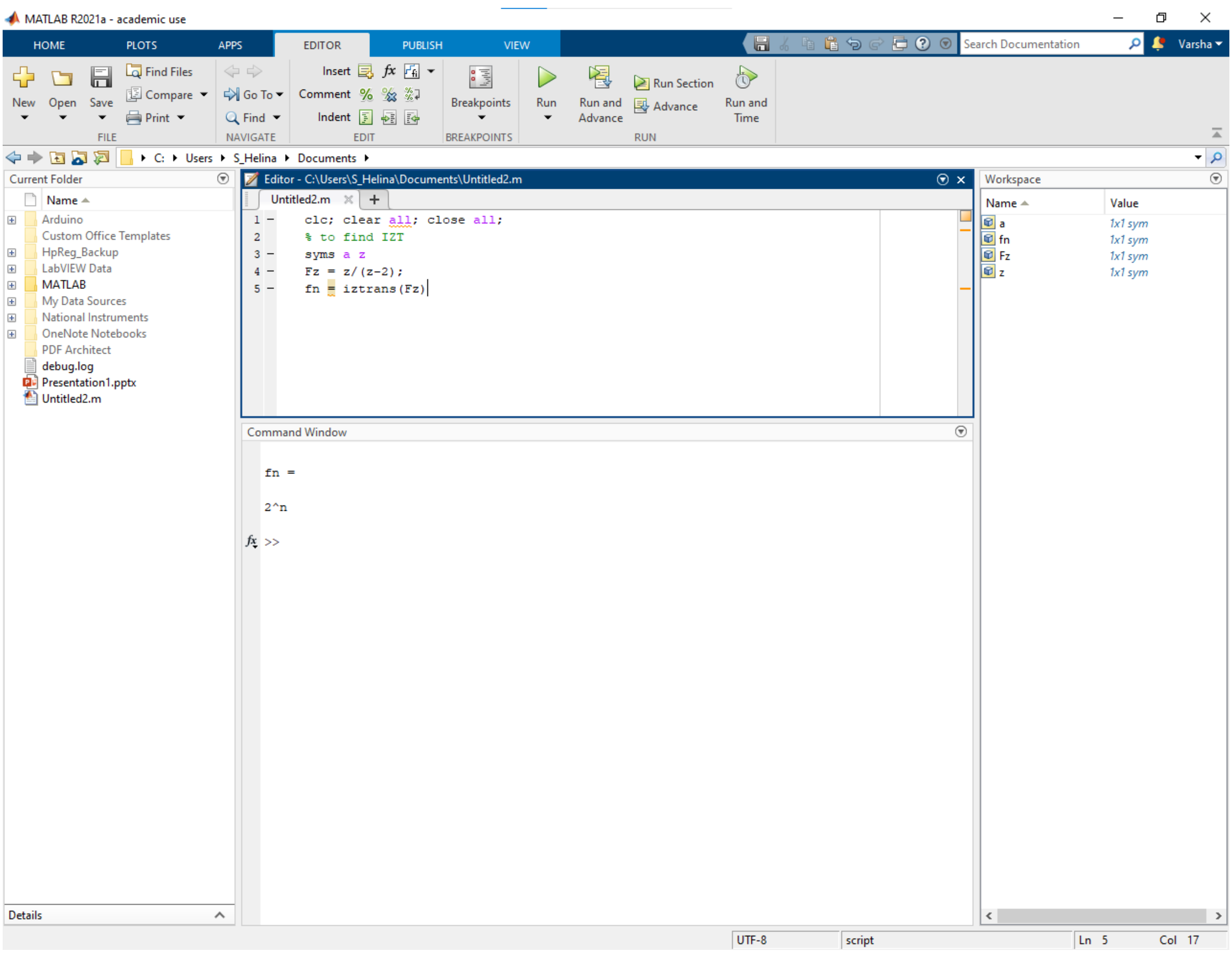


1.3.1 PROGRAM 2

```
clc; clear all; close all;
% to find IZT
syms a z
Fz = z/(z-2);
fn = iztrans(Fz)
```

1.3.2 OUTPUT

```
fn =
2^n
```



1.4 SUMMARY

- The Z-transform converts a discrete-time signal, which is a sequence of real or complex numbers into a complex frequency-domain (z-domain or z-plane) representation.
- They are applied in mathematics and signal processing.
- In this experiment we find the z transforms of different functions using MATLAB.
- MATLAB helps in faster calculation of z transform by using symbolic toolbox which returns the ZT of the scalar symbolic object f with the default independent variable n.
- `syms` is used to create symbolic scalar variables, functions, and matrix variables.
- By using `syms` we define variables a and z and use them to find z transforms of various functions.
- By using `ztrans(f)`, Z-Transform of various functions is found.
- By default, the independent variable is n and the transformation variable is z.
- Hence MATLAB, a modern tool is an efficient way to calculate Z – transforms.

IMPULSE RESPONSE

2.1 AIM OF THE EXPERIMENT

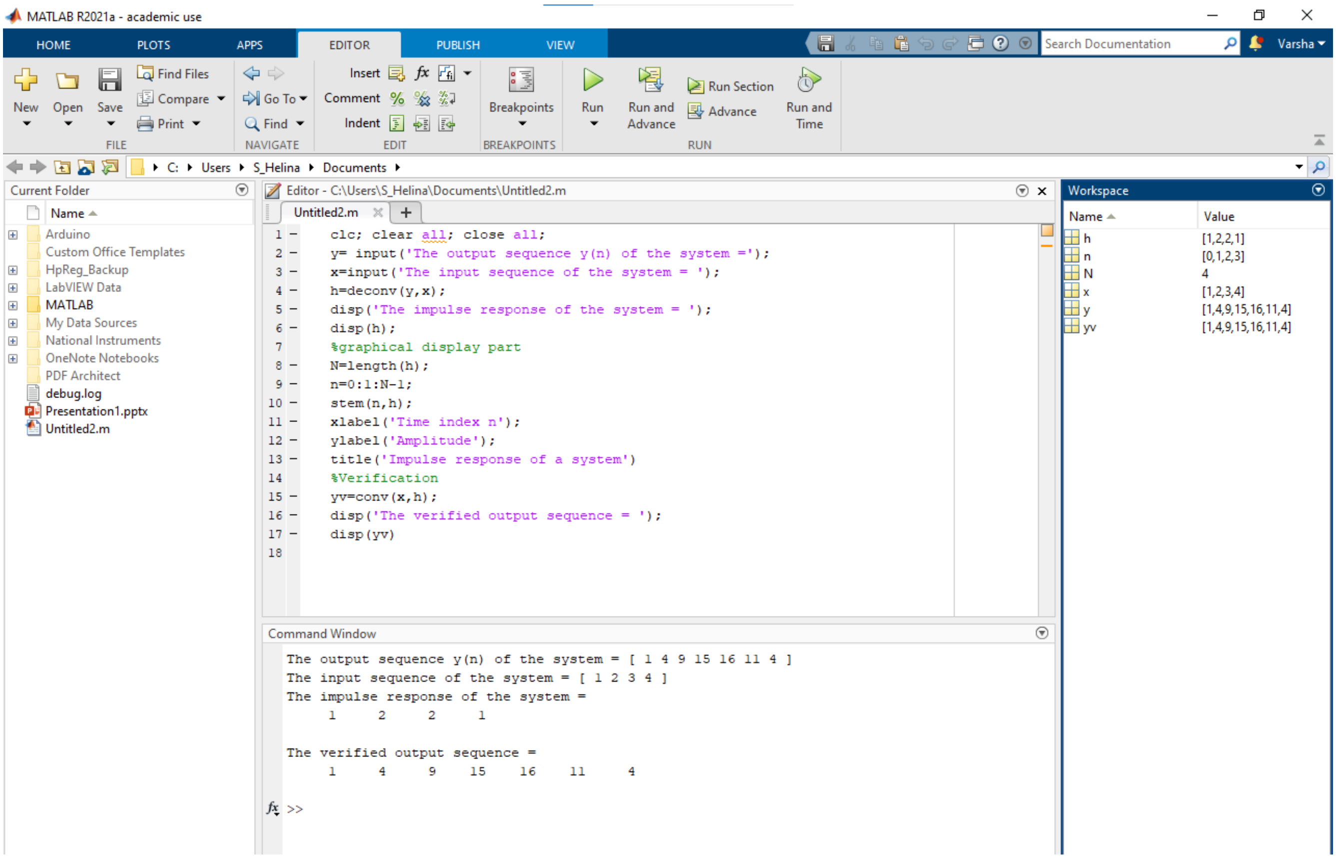
To find impulse response of the system

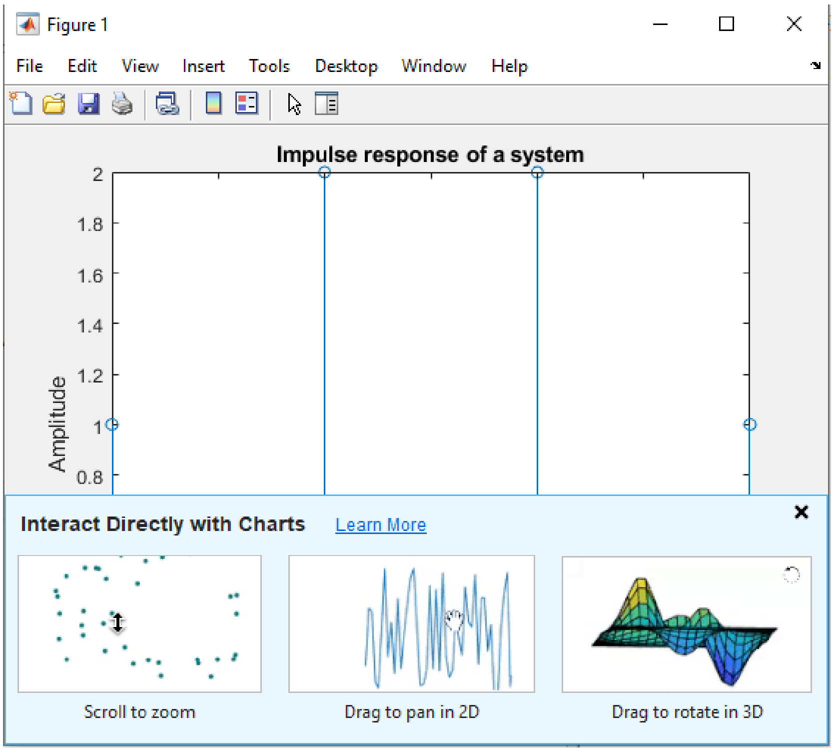
2.2 PROGRAM

```
clc; clear all; close all;

y= input('The output sequence y(n) of the system =');

x=input('The input sequence of the system = ');

h=deconv(y,x);

disp('The impulse response of the system = ');

disp(h);

%graphical display part

N=length(h);

n=0:1:N-1;

stem(n,h);

xlabel('Time index n');

ylabel('Amplitude');

title('Impulse response of a system')

%Verification

yv=conv(x,h);

disp('The verified output sequence = ');

disp(yv)
```

2.3 OUTPUT

```
The output sequence y(n) of the system = [ 1 4 9 15 16 11 4 ]
The input sequence of the system = [ 1 2 3 4 ]
The impulse response of the system =
     1     2     2     1

The verified output sequence =
     1     4     9    15    16    11     4
```





2.4 SUMMARY

- In signal processing, the impulse response of a system is its output when presented with an input signal, called an impulse. It is the reaction of any dynamic system in response to some external change.
- In this experiment we find the impulse response of the system.
- The output sequence and input sequence of the system are given as inputs and the impulse response of the system is received as output.
- This is performed by using the function `deconv(u,v)` which deconvolutes the given inputs.
- The output is displayed as a stem chart using the function `stem(u,v)`.
- Then for verification, the impulse response and input sequence are convoluted using the function `conv(x,h)` to get the output sequence given as input.
- Hence MATLAB, a modern tool is an efficient way to convolute and deconvolute input sequences and find impulse response of the system.

ELEMENTARY SIGNALS

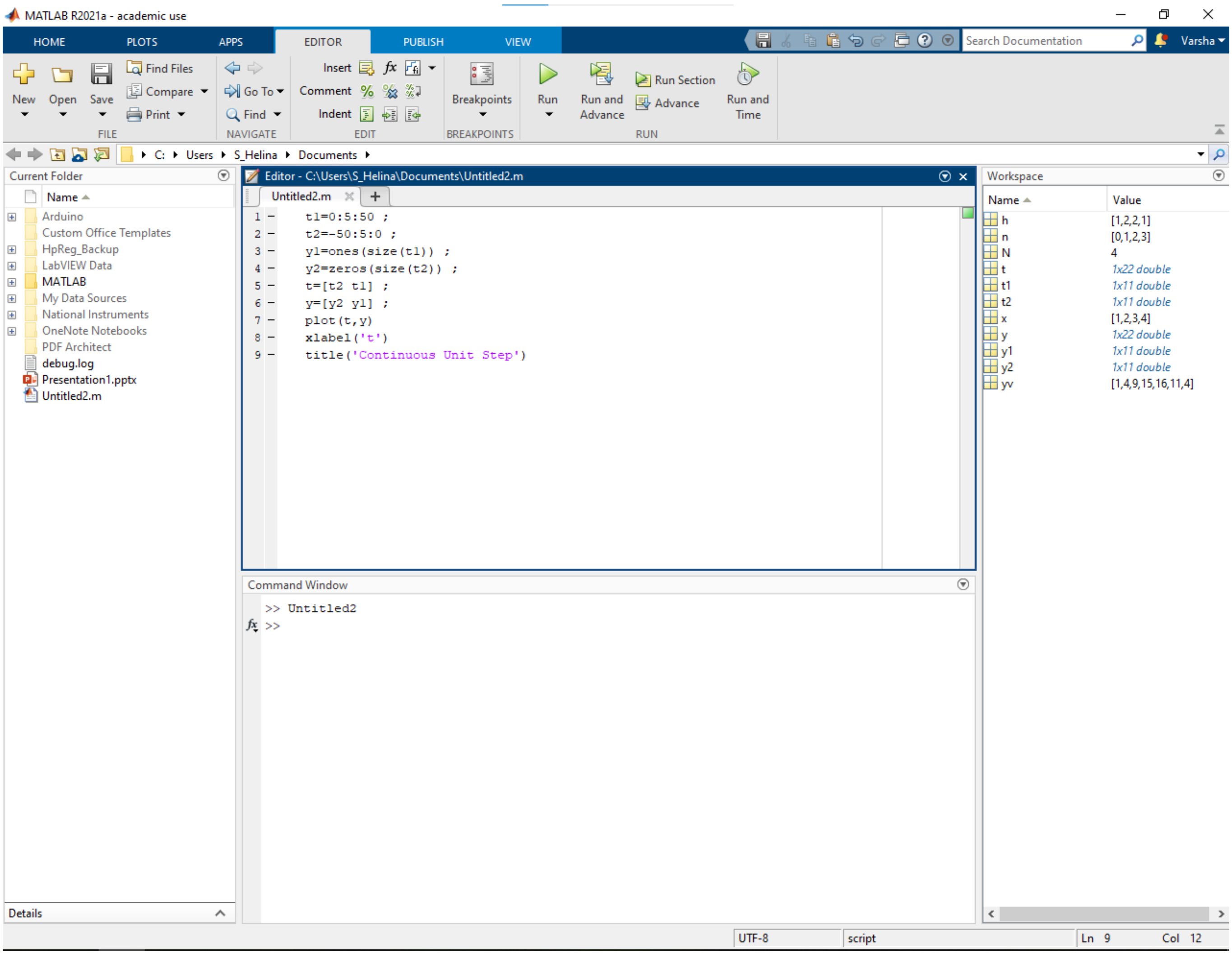
3.1 AIM OF THE EXPERIMENT

To generate elementary signals

3.2.1 PROGRAM 1 : CONTINUOUS UNIT STEP SIGNAL

```
t1=0:5:50 ;

t2=-50:5:0 ;

y1=ones(size(t1)) ;

y2=zeros(size(t2)) ;

t=[t2 t1] ;

y=[y2 y1] ;

plot(t,y)

xlabel('t')

title('Continuous Unit Step Signal')
```

3.2.2 OUTPUT


MATLAB R2021a - academic use
Editor - C:\Users\S_Helina\Documents\Untitled2.m
t1=0:5:50 ;
t2=-50:5:0 ;
y1=ones(size(t1)) ;
y2=zeros(size(t2)) ;
t=[t2 t1] ;
y=[y2 y1] ;
plot(t,y)
xlabel('t')
title('Continuous Unit Step')
Command Window
>> Untitled2
>>

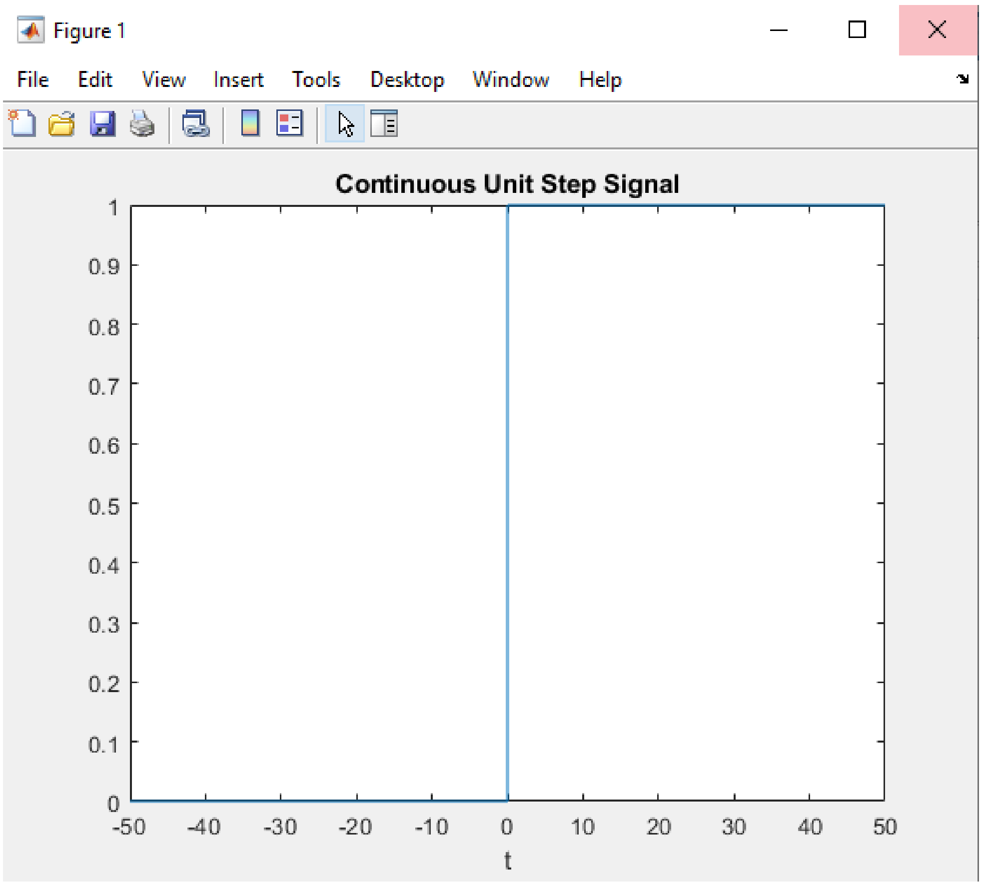


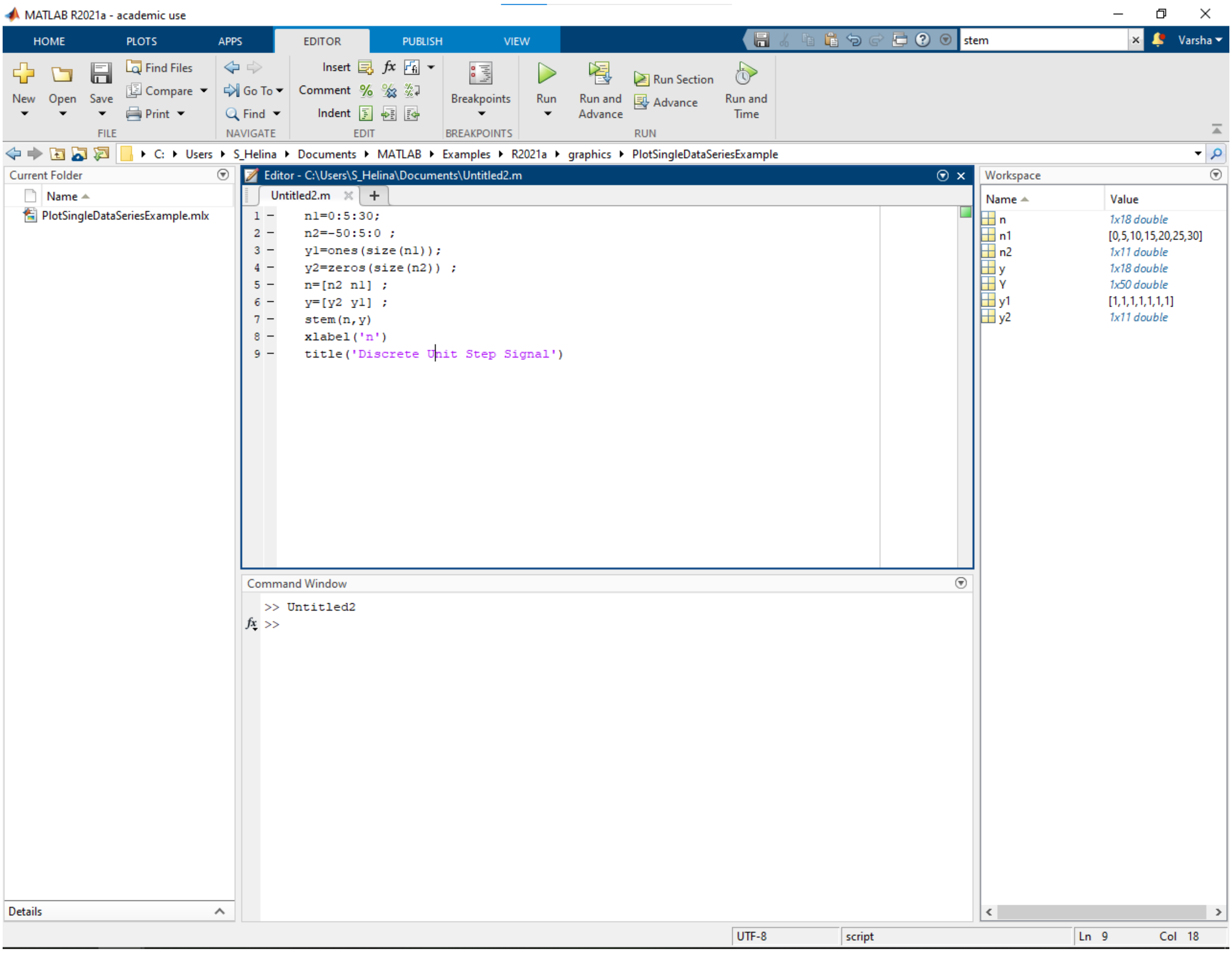
Figure 1
Continuous Unit Step Signal
t

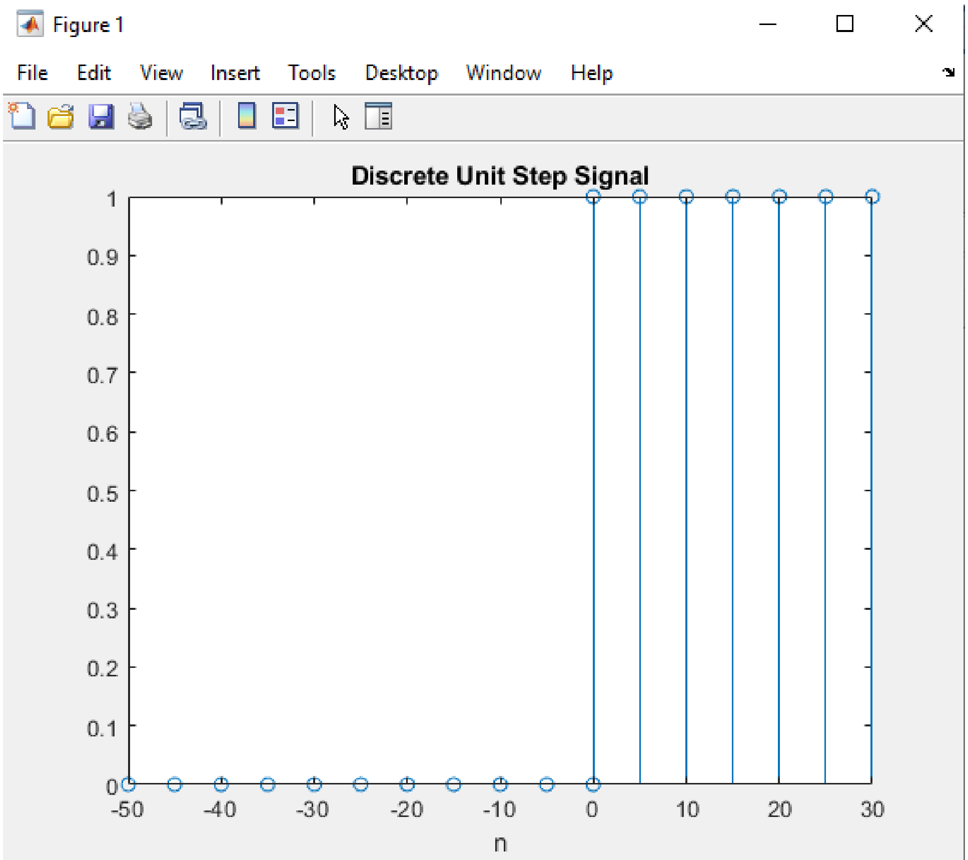
3.3.1 PROGRAM 2 : DISCRETE UNIT STEP SIGNAL

```
n1=0:5:30;

n2=-50:5:0 ;

y1=ones(size(n1));

y2=zeros(size(n2)) ;

n=[n2 n1] ;

y=[y2 y1] ;

stem(n,y)

xlabel('n')

title('Discrete Unit Step Signal')
```

3.3.2 OUTPUT

```
Enter the value of N = 10
```



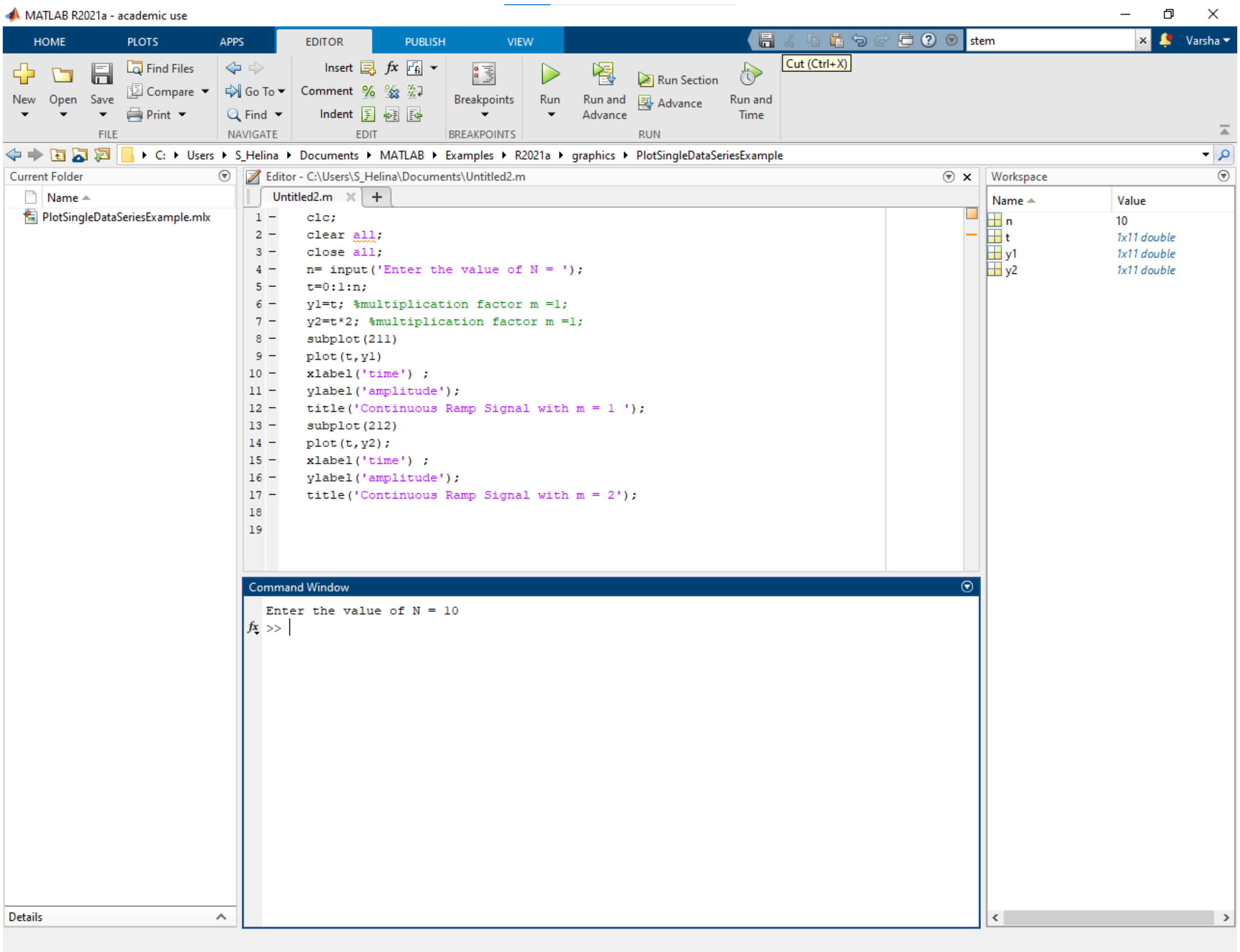


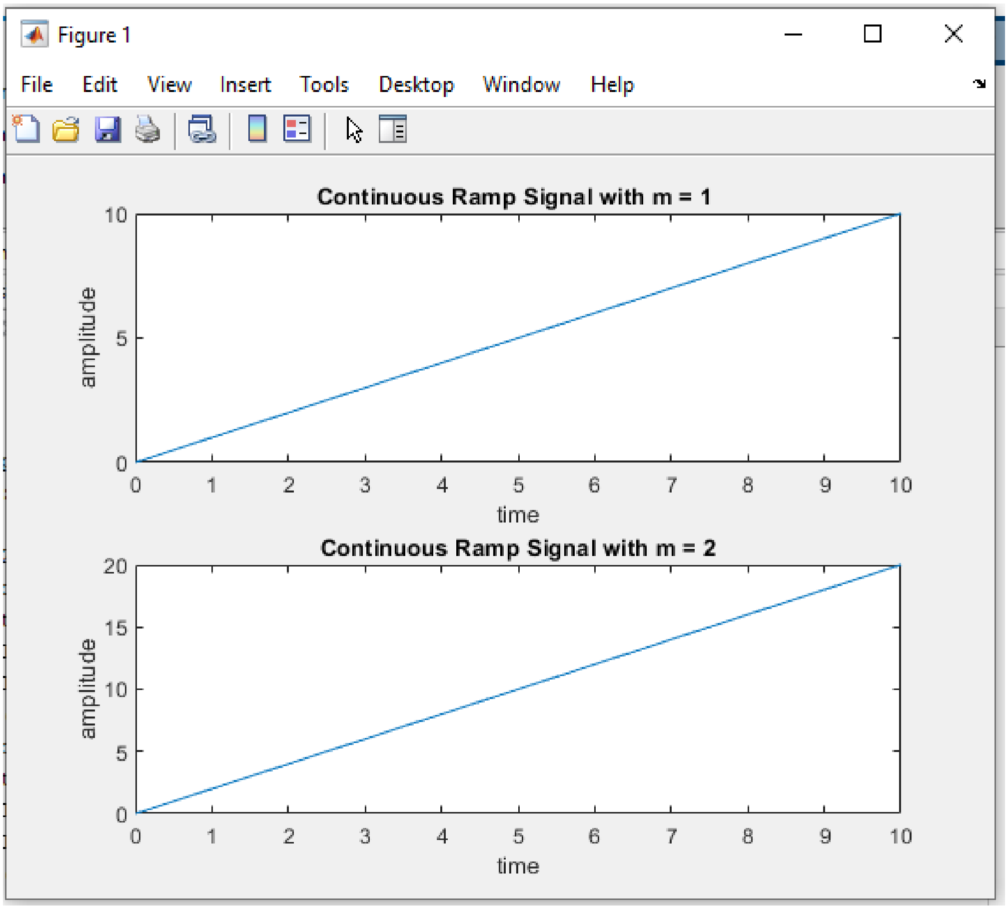
3.4.1 PROGRAM 3 : CONTINUOUS RAMP SIGNAL

```
clc;

clear all;

close all;

n= input('Enter the value of N = ');

t=0:1:n;

y1=t; %multiplication factor m =1;

y2=t*2; %multiplication factor m =1;

subplot(211)

plot(t,y1)

xlabel('time') ;

ylabel('amplitude');

title('Continuous Ramp Signal with m = 1 ');

subplot(212)

plot(t,y2);

xlabel('time') ;

ylabel('ampitude');

title('Continuous Ramp Signal with m = 2');
```

3.4.2 OUTPUT

```
Enter the value of N = 10
```



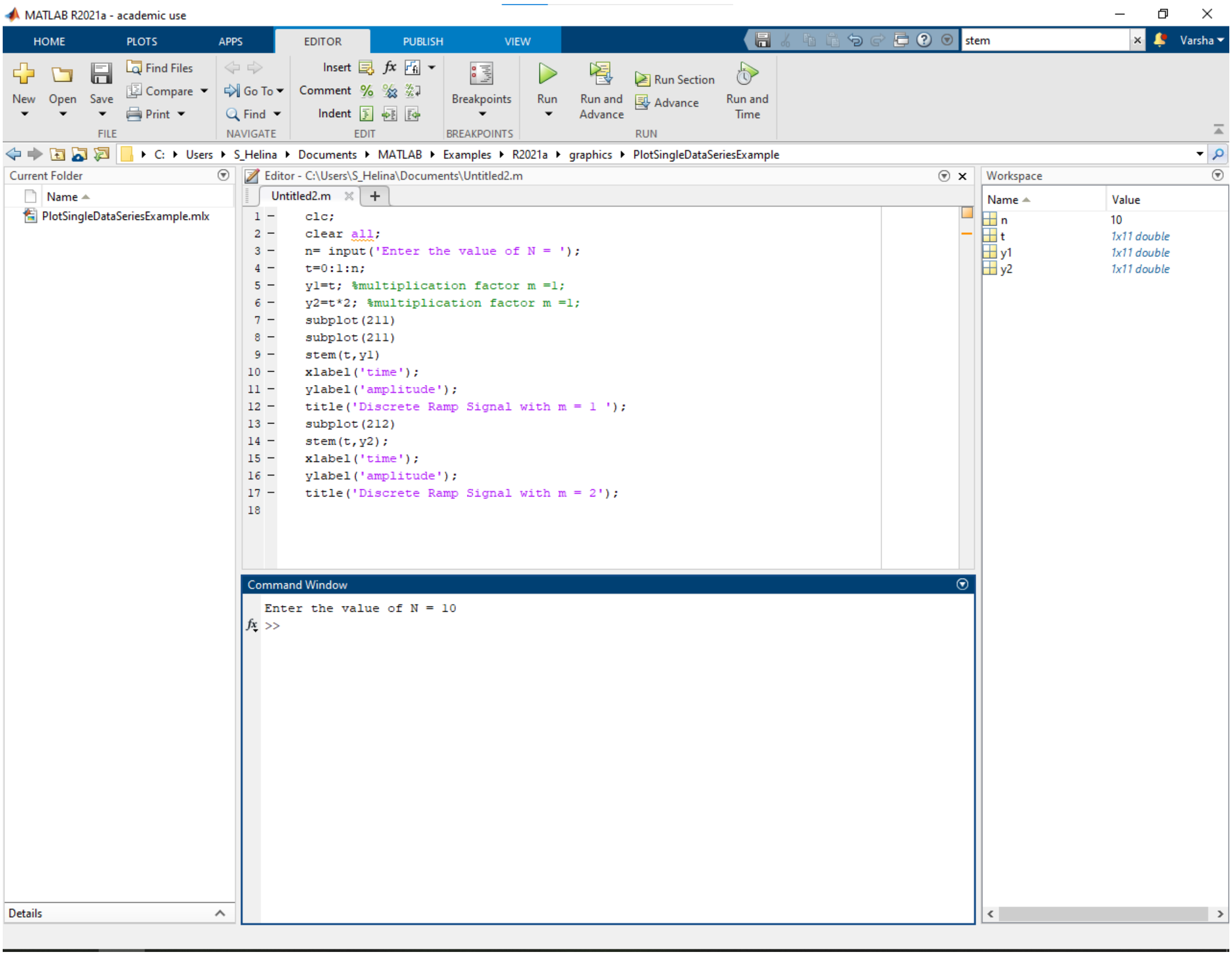


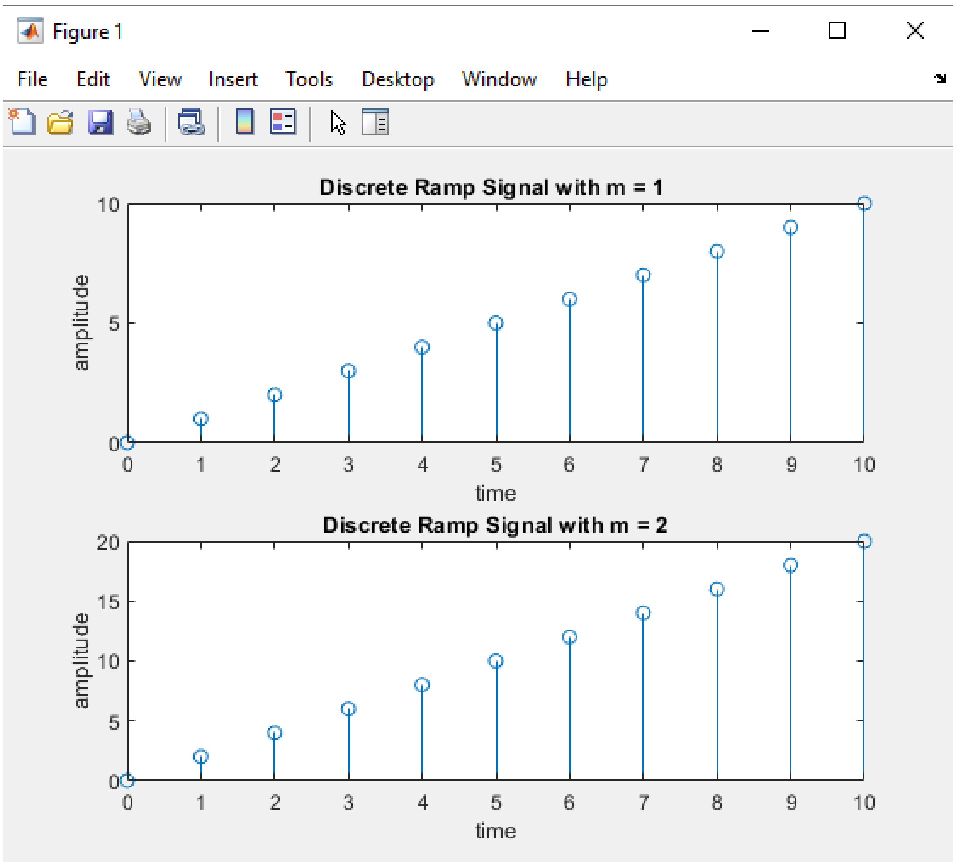
3.5.1 PROGRAM 4 : DISCRETE RAMP SIGNAL

```
clc;

clear all;

n= input('Enter the value of N = ');

t=0:1:n;

y1=t; %multiplication factor m =1;

y2=t*2; %multiplication factor m =1;

subplot(211)

subplot(211)

stem(t,y1)

xlabel('time');

ylabel('amplitude');

title('Discrete Ramp Signal with m = 1 ');

subplot(212)

stem(t,y2);

xlabel('time');

ylabel('amplitude');

title('Discrete Ramp Signal with m = 2');
```

3.5.2 OUTPUT

```
Enter the value of N = 10
```



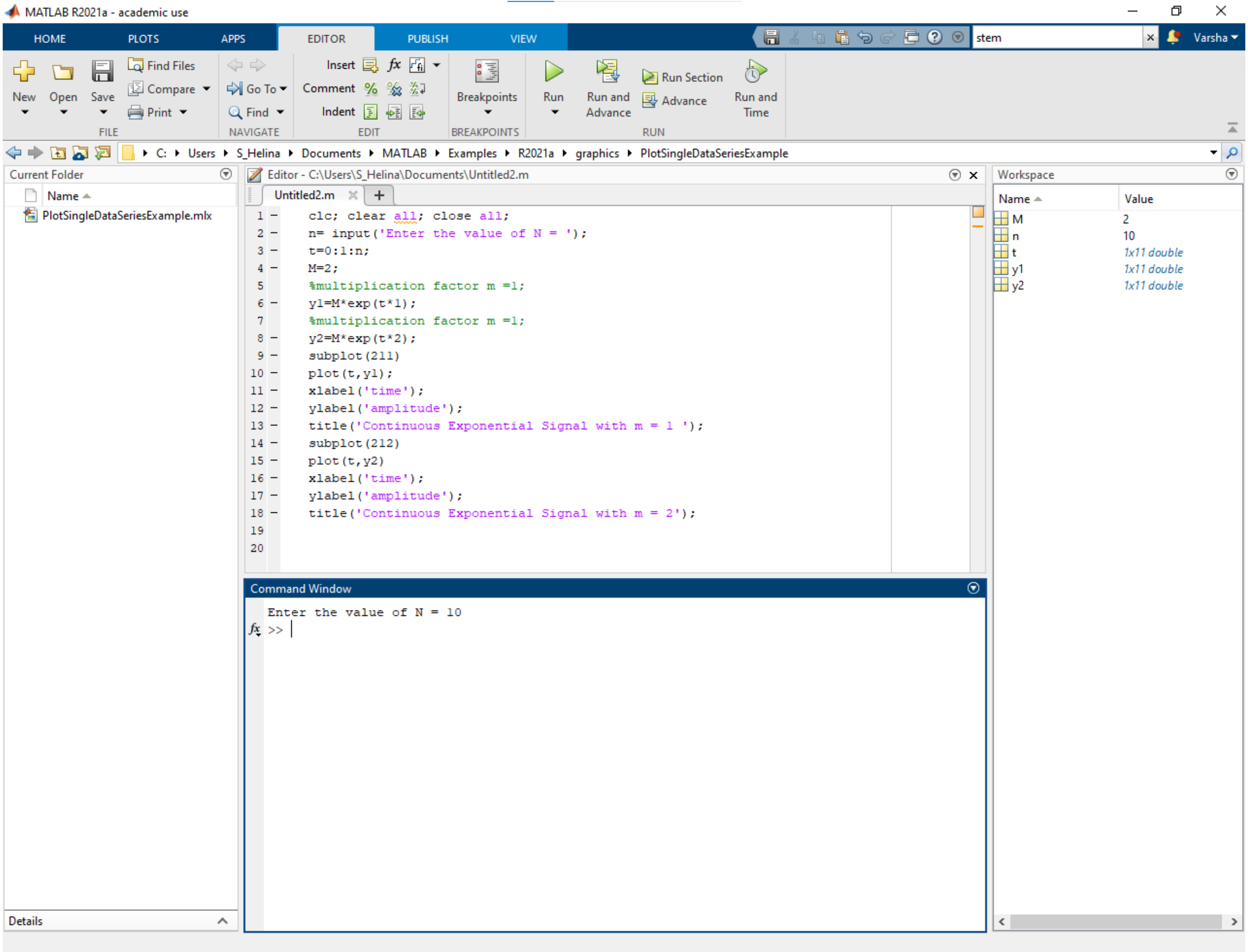


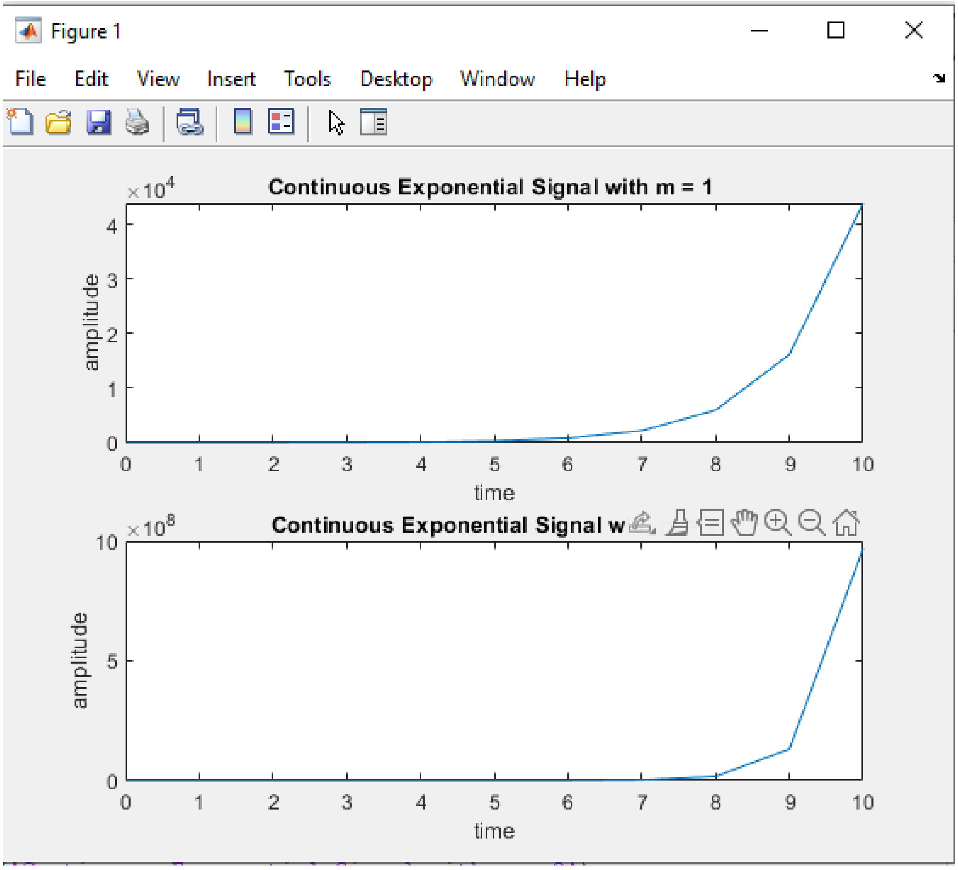
3.6.1 PROGRAM 5 : CONTINUOUS EXPONENTIAL SIGNAL

```
clc; clear all; close all;

n= input('Enter the value of N = ');

t=0:1:n;

M=2;

%multiplication factor m =1;

y1=M*exp(t*1);

%multiplication factor m =1;

y2=M*exp(t*2);

subplot(211)

plot(t,y1);

xlabel('time');

ylabel('amplitude');

title('Continuous Exponential Signal with m = 1 ');

subplot(212)

plot(t,y2)

xlabel('time');

ylabel('amplitude');

title('Continuous Exponential Signal with m = 2');
```

3.6.2 OUTPUT

```
Enter the value of N = 10
```



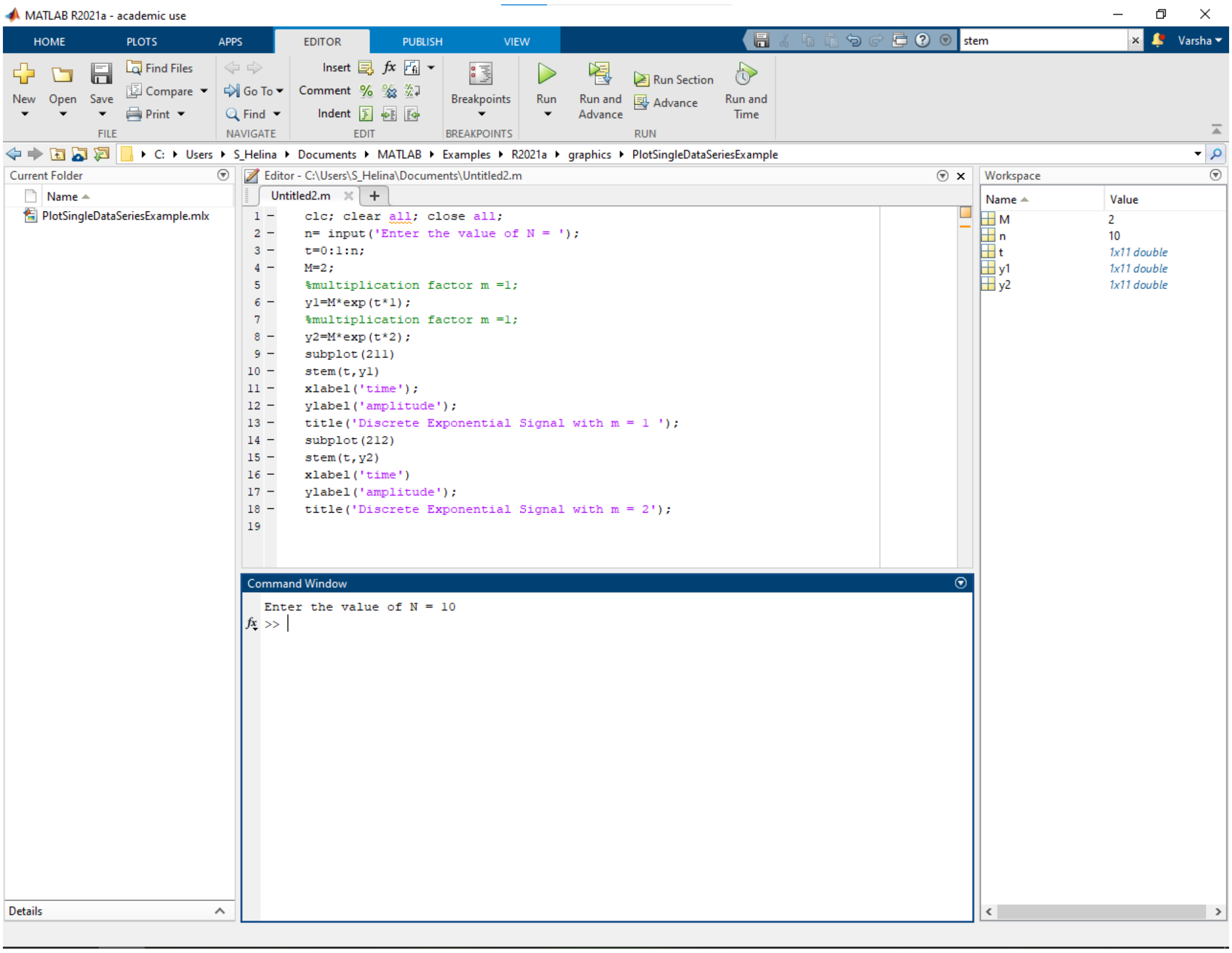


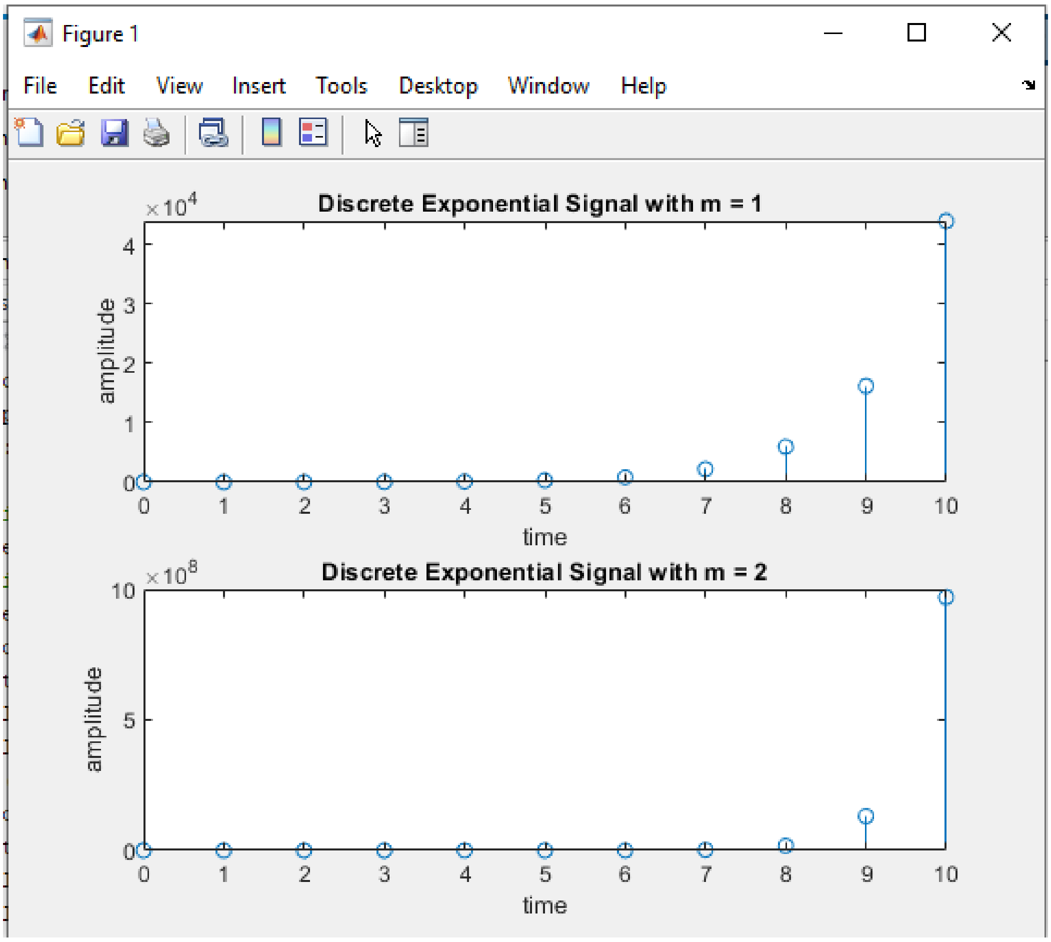
3.7.1 PROGRAM 6 : DISCRETE EXPONENTIAL SIGNAL

```
clc; clear all; close all;

n= input('Enter the value of N = ');

t=0:1:n;

M=2;

%multiplication factor m =1;

y1=M*exp(t*1);

%multiplication factor m =1;

y2=M*exp(t*2);

subplot(211)

stem(t,y1)

xlabel('time');

ylabel('amplitude');

title('Discrete Exponential Signal with m = 1 ');

subplot(212)

stem(t,y2)

xlabel('time')

ylabel('amplitude');

title('Discrete Exponential Signal with m = 2');
```

3.7.2 OUTPUT

```
Enter the value of N = 10
```





3.8 SUMMARY

- In this experiment the following elementary signals are generated
    1. Continuous unit step signal
    2. Discrete unit step signal
    3. Continuous ramp signal
    4. Discrete ramp signal
    5. Continuous exponential signal
    6. Discrete exponential signal
- The step signal or step function is that type of standard signal which exists only for positive time and it is zero for negative time.
- A ramp function or ramp signal is a type of standard signal which starts at t = 0 and increases linearly with time.
- An exponential signal or exponential function is a function that represents an exponentially increasing or decreasing series.
- A discrete-time signal is a sequence of values that correspond to particular instant in time. A continuous time signal is a function that is continuous, with no breaks in the signal.
- These are implemented using MATLAB by using basic formulae to construct these signals.
- Then they are plotted using the `plot`, `subplot` and `stem` functions.
- The plots are given labels using `title`, `xlabel`, `ylabel` functions.
- Hence MATLAB, a modern tool is an efficient way to generate various elementary signals.