SOMAIYA VIDYAVIHAR UNIVERSITY

K. J. Somaiya College of Engineering, Mumbai -77

(A Constituent College of Somaiya Vidyavihar University)

Batch: B1 Roll No.: 16010121045
Experiment No. 2

Title: Represent discrete time signals and perform different operations on them.

Objective: To familiarize the beginner to MATLAB by introducing the basic features and commands of the program.

Expected Outcome of Experiment:

CO	Outcome
CO1	Identify various discrete time signals and systems and perform signal manipulation

Books/ Journals/ Websites referred:

1. A.Nagoor Kani "Digital Signal Processing", 2nd Edition, TMH Education.

Pre Lab/ Prior Concepts:
Using MATLAB we can easily generate all basic functions such as unit step, ramp, growing and decaying exponential, etc.

1. Unit Step Signal

The step signal is defined as

U[n] = k ; if n>=0

= 0 ; otherwise

When k=1 it is called as unit step signal.

2. Ramp Signal

The ramp signal is defined as r[n] = n ; if n>=0

- 0 ; otherwise

3. Exponential Signal

The exponential signal is defined as

X[n] =a^n

When ‘a’ is greater than 1 it is **increasing** exponential

When ‘a’ is less than 1 it is **decaying** exponential.

4. Impulse Signal

The impulse signal is defined as d[n] = k ; if n=0

= 0 ; otherwise

When k=1 it is called as unit impulse

The functions used in this program are:

a. Ones

This function is used to create an array of all ones
Syntax: Y=ones (m, n)

Description:

Y=ones (n) returns an n-by-n matrix of 1's.

An error message appears if n is not a scalar.

Y=ones (m, n) or Y=ones([m n]) returns an m-by-n matrix of ones.

b. Zeros

This function is used to create an array of all zeros

Syntax: Y=zeros(m,n)

Description:

Y=zeros(n) returns an n-by-n matrix of 0's.

An error message appears if n is not a scalar.

Y=zeros (m,n) or Y=ones([m n]) returns an m-by-n matrix of Zeros.

c. EXP

This function is used to plot exponential signals

Syntax: Y=exp(X)

Description:

The exp function is an elementary function that operates element-wise on arrays. Its domain includes complex numbers.

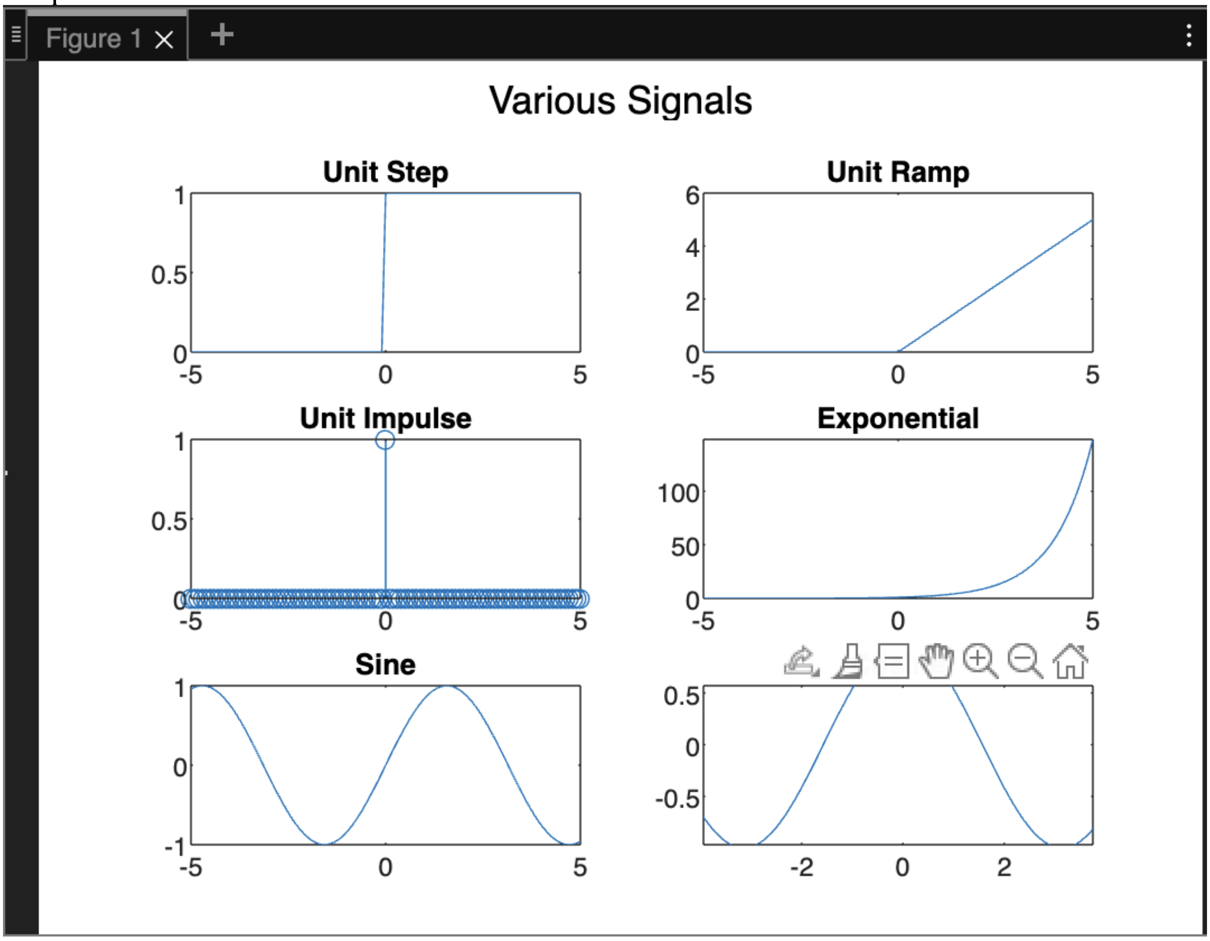
Y=exp(X) returns the exponential for each element of X. For complex, it returns the complex exponential.

Discrete time signals types:
Plotting various signals using matlab

Code:

```
t = -5:0.1:5;
u = @(t) (t >= 0);
r = @(t) t .* u(t);

delta = @(t) t == 0;

expo = @(t) exp(t);

sinusoidal = @(t) sin(t);
cosinusoidal = @(t) cos(t);

subplot(3, 2, 1);
plot(t, u(t));
title('Unit Step');

subplot(3, 2, 2);
plot(t, r(t));
title('Unit Ramp');

subplot(3, 2, 3);
stem(t, delta(t));
title('Unit Impulse');

subplot(3, 2, 4);
plot(t, expo(t));
title('Exponential');

subplot(3, 2, 5);
plot(t, sinusoidal(t));
title('Sine');

subplot(3, 2, 6);
plot(t, cosinusoidal(t));
title('Cosine');
sgtitle('Various Signals');
```

Output:



Operations on Signals:

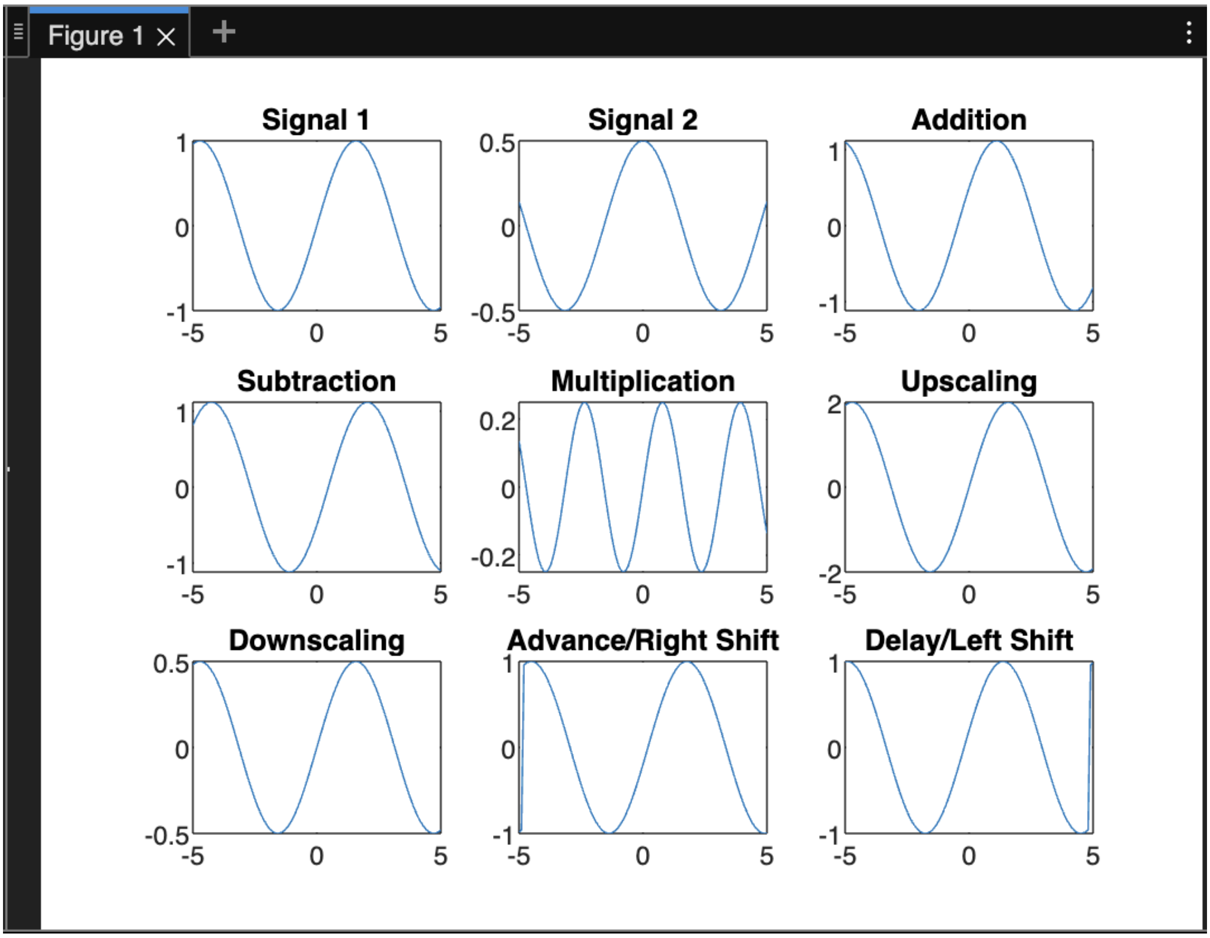
1. Addition of signals.
2. Subtraction of signals.
3. Multiplication of two signals.
4. Scaling – Upscaling & Downscaling.
5. Shift operation – Advance/Right shift & Delay/Left shift.
6. Folding

Code:

```
t = -5:0.1:5;


signal1 = sin(t);
signal2 = 0.5 * cos(t);


addition_result = signal1 + signal2;


subtraction_result = signal1 - signal2;


multiplication_result = signal1 .* signal2;


upscaling_factor = 2;
downscaling_factor = 0.5;


upscaled_signal = upscaling_factor * signal1;
downscaled_signal = downscaling_factor * signal1;


shift_amount = 2;


advanced_signal = circshift(signal1, shift_amount);
delayed_signal = circshift(signal1, -shift_amount);


folded_signal = fliplr(signal1);
subplot(3, 3, 1);
plot(t, signal1);
title('Signal 1');


subplot(3, 3, 2);
plot(t, signal2);
title('Signal 2');


subplot(3, 3, 3);
plot(t, addition_result);
title('Addition');


subplot(3, 3, 4);
plot(t, subtraction_result);
title('Subtraction');


subplot(3, 3, 5);
plot(t, multiplication_result);
title('Multiplication');


subplot(3, 3, 6);
```

```
plot(t, upscaled_signal);
title('Upscaling');

subplot(3, 3, 7);
plot(t, downscaled_signal);
title('Downscaling');

subplot(3, 3, 8);
plot(t, advanced_signal);
title('Advance/Right Shift');

subplot(3, 3, 9);
plot(t, delayed_signal);
title('Delay/Left Shift');
```

OutPut:



Conclusion:-

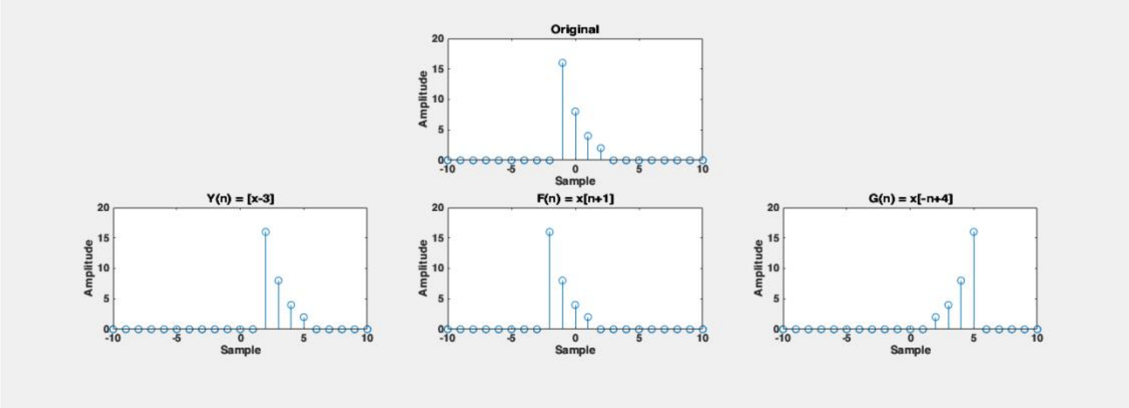
With help of Matlab we were able to represent discrete time signals and perform different operations on them

Post Lab Questions

1. **Let x(n) = $8(0.5)^n$ (u[n+1] - u[n-3]). Sketch the following signals**

I.Y(n) = [x-3]
II.F(n) = x[n+1]
III.G(n) = x[-n+4]

```
u = @(n) 1.*(n>=0);
x = @(n) 8.*((0.5).^n).*(u(n+1) - u(n-3));

n = -10:1:10;

X = x(n);
subplot(3,3,2);
stem(n,X)
xlabel("Sample");
ylabel("Amplitude");
title("Original");

Y = x(n-3);
subplot(3,3,4);
stem(n,Y);
xlabel("Sample");
ylabel("Amplitude");
title("Y(n) = [x-3]");

F = x(n+1);
subplot(3,3,5);
stem(n,F);
xlabel("Sample");
ylabel("Amplitude");
title("F(n) = x[n+1]");

G = x(-n+4);
subplot(3,3,6);
stem(n,G);
xlabel("Sample");
ylabel("Amplitude");
title("G(n) = x[-n+4]");
```



2. The process of conversion of continuous time signal into discrete time signal is known as Sampling

3. Which of the following is example of deterministic signal?

a. Step

b. Ramp

c. Exponential

d. All of the above

Ans: c. Exponential

4. For energy signals the energy will be finite and the average power will be 0

5. In a signal x(n), if 'n' is replaced by 'n/3' the it is called Expansion

6. The system y(n)=sin[x(n)] is

a. Stable

b. BIBO stable

c. Unstable

d. None of the above

Ans: d. None of the above