B.TECH. (2020-24)
Artificial Intelligence

Lab File

on

BASIC SIMULATION LAB
[ES204]

Submitted To

Mr. Lala Bhaskar

Submitted By

HITESH

A023119820027

4CSE11 (AI)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
AMITY SCHOOL OF ENGINEERING AND TECHNOLOGY
AMITY UNIVERSITY UTTAR PRADESH
NOIDA (U.P)

EXPERIMENT- 1

AIM

(A) Creating a One-Dimensional Array (Row / Column Vector)
(B) Creating a Two-Dimensional Array (Matrix of given size)
(C) Performing Arithmetic Operations - Addition, Subtraction, Multiplication and Exponentiation
(D) Performing Matrix operations - Inverse, Transpose and Rank.

SOFTWARE USED

Octave Online - https://octave-online.net/

THEORY

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning.

MATLAB is an abbreviation for "**MAT**rix **LAB**oratory." While other programming languages mostly work with numbers one at a time, MATLAB is designed to operate primarily on whole matrices and arrays.

All MATLAB variables are multidimensional arrays, no matter what type of data. A matrix is a two-dimensional array often used for linear algebra.

(I) Creating a One-Dimensional Array (Row / Column Vector)

To create a 1D Array, you need to assign a list of numbers separated with comma (,) or space ( ), to any variable say (A) for a row vector or separated with semi-colon (;) for a column vector.

For instance, to create an array with four elements in a single row, separate the elements with either a comma (,) or a space.

```
A = [1 2 3 4]
```

This type of array is a row vector.

To create a column vector with 3 elements, separate the (row) elements with semicolons.

```
B = [1; 2; 7]
```

(II) Creating a Two-Dimensional Array (Matrix of given size)

To create a 2D array or matrix of given size (say 3x3) that has multiple rows, separate the rows with semicolons.

```
C = [1 3 5; 2 4 6; 7 8 10]
```

(III) Performing Arithmetic Operations - Addition, Subtraction, Multiplication and Exponentiation

MATLAB allows you to process all the values in a matrix using a single arithmetic operator or function.

Consider that A and B are two 3x3 matrices,

1. **Addition**: Using operator (+) as such $C = A + B$, adds arrays A and B by adding corresponding elements. If one input is a string array, then plus appends the corresponding elements as strings. The sizes of A and B must be the same or be compatible.

Alternatively, using MATLAB command plus() as such $C = plus(A, B)$ to execute A + B.

2. **Subtraction**: Using operator (-) as such $C = A - B$, subtracts array B from array A by subtracting corresponding elements. The sizes of A and B must be the same or be compatible.

   Alternatively, using MATLAB command minus() as such $C = minus(A, B)$ to execute A – B.

3. **Multiplication**: Using operator (*) as such $C = A * B$ for the matrix product of A and B. If A is an m-by-p and B is a p-by-n matrix, then C is an m-by-n matrix defined by

$$C(i, j) = \sum_{k=1}^{p} A(i, k)B(k, j)$$

   Alternatively, using MATLAB command mtimes() as such $C = mtimes(A, B)$ to execute A*B.

4. **Hadamard Product (Element-wise Multiplication):** Using operator (.*) as such $C = A.* B$, multiplies arrays A and B by multiplying corresponding elements. The sizes of A and B must be the same or be compatible.

   Alternatively, using MATLAB command times() as such $C = times(A, B)$ to execute A.*B.

5. **Division**: Using operator (./) as such $x = A./B$, divides each element of A by the corresponding element of B. The sizes of A and B must be the same or be compatible.

   Alternatively, using MATLAB commands rdivide() for right divide and ldivide() for left divide as such $x = rdivide(A, B)$ and $y = ldivide(B, A)$ to divide A by B.

6. **Element-by-element Exponentiation**: Using MATLAB command exp() as such $Y = exp(X)$, returns the exponential e^x for each element in array X.

7. **Matrix Exponentiation**: Using MATLAB command expm() as such $Y = expm(X)$, computes the matrix exponential of X. Although it is not computed this way, if X has a full set of eigenvectors V with corresponding eigenvalues D, then [V,D] = eig(X) and expm(X) = V*diag(exp(diag(D)))/V.

   It returns the result of matrix exponential e^{At}, i.e,

$$e^{At} = \sum_{n=0}^{\infty} \frac{t^n A^n}{n!}$$

(IV) Performing Matrix operations - Inverse, Transpose and Rank.

1. **Inverse**: Using operator {^(-1)} as such $Y = X\text{^}(-1)$, computes the inverse of square matrix X.

   Alternatively, using MATLAB command inv() as such $Y = inv(X)$ to get the inverse of square matrix X.

2. **Transpose**: Using operator (.') as such $B = A.'$, returns the nonconjugate transpose of A, that is, interchanges the row and column index for each element.

   Alternatively, using MATLAB command transpose() as such $B = transpose(A)$ to compute the nonconjugate transpose of A.

3. **Rank**: Using MATLAB command rank() as such $k = rank(A)$, returns the rank of matrix A.

PROGRAM CODE

```
%CREATION OF MATRIX
A = [1 2 3] %Row Vector
B = [1;2;3] %Column Vector
C = [1 2 3;4,6,6;7,8,9]
D = [0,0,0;4,5,6;7,8,9]
E = [1,2,4,5,3;1,2,4,5,6;5,6,4,3,3;1,2,4,5,5]

%ADDITION
F = C + D
G = plus(C,D)
%SUBTRACTION
H = C - D
I = minus(C,D)
%MULTIPLICATION
H = A * B
s = mtimes(A,B)
%ELEMENT WISE MULTIPLICATION (Hadamard Product)
I = C .* D
J = times(C,D)
%DIVISION
K = [2 4 6 8; 3 5 7 9]
L = [10,10,10,10;10,10,10,10]
M = K./L
N = rdivide(K,L)
O = ldivide(L,K)
```

```
%EXPONENTIAL
p = [1 1 0; 0 0 2; 0 0 -1]
q = exp(p)
r = expm(p)

%Transpose of matrix
s = C.'
t = transpose(C)

%DETERMINANT OF matrix
u = det(C)

%Inverse of matrix
v = C^(-1)
w = inv(C)
x = v*C
y = w*C

%Rank of matrix
z = rank(C)

%ones
zz = 10 * ones(2,3)
zzz = zeros(2,4)
```

RESULTS

```
A =

   1   2   3

B =

   1
   2
   3

C =

   1   2   3
   4   6   6
   7   8   9

D =

   0   0   0
```

```
H = 14
s = 14
I =

    0    0    0
   16   30   36
   49   64   81

J =

    0    0    0
   16   30   36
   49   64   81

K =

   2   4   6   8
   3   5   7   9
```

```
   2.7183   1.7183
1.0862
         0   1.0000
1.2642
         0         0
0.3679

s =

   1   4   7
   2   6   8
   3   6   9

t =

   1   4   7
   2   6   8
   3   6   9
```

```
   4   5   6
   7   8   9

E =

   1   2   4   5   3
   1   2   4   5   6
   5   6   4   3   3
   1   2   4   5   5

F =

    1    2    3
    8   11   12
   14   16   18

G =

    1    2    3
    8   11   12
   14   16   18

H =

   1   2   3
   0   1   0
   0   0   0

I =

   1   2   3
   0   1   0
   0   0   0
```

```
L =

   10   10   10   10
   10   10   10   10

M =

   0.2000   0.4000
0.6000   0.8000
   0.3000   0.5000
0.7000   0.9000

N =

   0.2000   0.4000
0.6000   0.8000
   0.3000   0.5000
0.7000   0.9000

O =

   0.2000   0.4000
0.6000   0.8000
   0.3000   0.5000
0.7000   0.9000

p =

   1   1   0
   0   0   2
   0   0  -1

q =

   2.7183   2.7183
1.0000
   1.0000   1.0000
7.3891
   1.0000   1.0000
0.3679

r =
```

```
u = -12.000
v =

  -0.5000  -0.5000
0.5000
  -0.5000   1.0000  -
0.5000
   0.8333  -0.5000
0.1667

w =

  -0.5000  -0.5000
0.5000
  -0.5000   1.0000  -
0.5000
   0.8333  -0.5000
0.1667

x =

   1.0000        0
0.0000
   0.0000   1.0000  -
0.0000
   0.0000   0.0000
1.0000

y =

   1.0000        0
0.0000
   0.0000   1.0000  -
0.0000
   0.0000   0.0000
1.0000

z = 3
zz =

   10   10   10
   10   10   10

zzz =

   0   0   0   0
   0   0   0   0
```

DISCUSSION and CONCLUSION

The several MATLAB commands have been explored and successfully used to create a One-Dimensional Array (Row / Column Vector), a Two-Dimensional Array (Matrix of given size) and perform the required Arithmetic Operations and Matrix Operations on the Octave Online platform.

PRECAUTIONS

- Don't forget to save the code after every change you make.
- Use MATLAB properly.
- MATLAB requires a stable network connection.
- Save the file after compiling the code and take the required notes and screenshots, so that you don't have to open octave and do everything again.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		

EXPERIMENT- 2

AIM

Performing Matrix Manipulations – Concatenating, Indexing, Sorting, Shifting, Reshaping, Resizing and Flipping about a Vertical Axis / Horizontal Axis; Creating Arrays X & Y of given size (1 x N) and Performing

(A) Relational Operations – (>, <, ==, <=, >=, ~=)

(B) Logical Operations – (~, &, |, XOR)

SOFTWARE USED

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THEORY

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

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All MATLAB variables are multidimensional arrays, no matter what type of data. A matrix is a two-dimensional array often used for linear algebra.

(I) Matrix Manipulations

1) **Concatenation:** Using MATLAB command cat() as such $\boxed{C = cat(dim, A, B)}$ to concatenate B to the end of A along dimension dim when A and B have compatible sizes (the lengths of the dimensions match except for the operating dimension dim).

$\boxed{C = cat(dim, A1, A2, \dots, An)}$ concatenates A1, A2, … , An along dimension dim.

Using square bracket operator [] to concatenate. For example, [A,B] or [A B] concatenates arrays A and B horizontally, and [A; B] concatenates them vertically.

2) **Indexing:** The most common way is to explicitly specify the indices of the elements. As such, to access a single element of a matrix, specify the row number followed by the column number of the element. For example, $\boxed{e = A(3,2)}$, e is the element in the 3,2 position (third row, second column) of A.

You can also reference multiple elements at a time by specifying their indices in a vector. For example, to access the first and third elements of the second row of A, the command would be $\boxed{r = A(2, [1\ 3])}$.

To access elements in a range of rows or columns, use the colon. For example, to access the elements in the first through third row and the second through fourth column of A, the command is $\boxed{r = A(1{:}3, 2{:}4)}$.

An alternative way to compute r is to use the keyword “end” to specify the second column through the last column. This approach lets you specify the last column without knowing exactly how many columns are in A.

$$\boxed{r = A(1{:}3, 2{:}end)}$$

If you want to access all the rows or columns, use the colon operator by itself. For example, to return the entire third column of A, the command would be $r = A(:,3)$.

3) **Sorting:** Using MATLAB command sort() as such $B = sort(A)$, sorts the elements of A in ascending order.
   - If A is a vector, then $sort(A)$ sorts the vector elements.
   - If A is a matrix, then $sort(A)$ treats the columns of A as vectors and sorts each column.
   - If A is a multidimensional array, then $sort(A)$ operates along the first array dimension whose size does not equal 1, treating the elements as vectors.

   $B = sort(A, dim)$ returns the sorted elements of A along dimension dim. For example, if A is a matrix, then sort(A,2) sorts the elements of each row.

   $B = sort(\_\_, direction)$ returns sorted elements of A in the order specified by direction using any of the previous syntaxes. 'ascend' indicates ascending order (the default) and 'descend' indicates descending order.

4) **Shifting:** Using MATLAB command circshift() as such $Y = circshift(A, K)$, you can circularly shift the elements in array A by K positions. If K is an integer, then circshift() shifts along the first dimension of A whose size does not equal 1. If K is a vector of integers, then each element of K indicates the shift amount in the corresponding dimension of A.

   $Y = circshift(A, K, dim)$ circularly shifts the values in array A by K positions along dimension dim. Inputs K and dim must be scalars.

5) **Reshaping and Resizing**: Using MATLAB command reshape() as such $B = reshape(A, sz)$ reshapes A using the size vector, sz, to define size(B). For example, reshape(A,[2,3]) reshapes A into a 2-by-3 matrix. sz must contain at least 2 elements, and prod(sz) must be the same as numel(A).

   $B = reshape(A, sz1, \ldots, szN)$ reshapes A into a sz1-by-...-by-szN array where sz1,...,szN indicates the size of each dimension. You can specify a single dimension size of [] to have the dimension size automatically calculated, such that the number of elements in B matches the number of elements in A.

   For example, if A is a 10-by-10 matrix, then $reshape(A, 2, 2, [])$ reshapes the 100 elements of A into a 2-by-2-by-25 array.

6) **Flipping**: Using MATLAB command flip() as such $B = flip(A)$, returns array B the same size as A, but with the order of the elements reversed. The dimension that is reordered in B depends on the shape of A: -
   - If A is vector, then flip(A) reverses the order of the elements along the length of the vector.
   - If A is a matrix, then flip(A) reverses the elements in each column.
   - If A is an N-D array, then flip(A) operates on the first dimension of A in which the size value is not 1.

   $B = flip(A, dim)$ reverses the order of the elements in A along dimension dim.

   For example, if A is a matrix, then $flip(A, 1)$ reverses the elements in each column, and $flip(A, 2)$ reverses the elements in each row.

7) **Rotation**: Using MATLAB command rot90() as such $B = rot90(A)$ rotates array A counterclockwise by 90 degrees. For multidimensional arrays, rot90 rotates in the plane formed by the first and second dimensions.

   $B = rot90(A, k)$ rotates array A counterclockwise by k*90 degrees, where k is an integer.

   Using Octave command rotdim() as such $rotdim\ (x[, n, plane])$, it returns a copy of x with the elements rotated counterclockwise in 90-degree increments.

The second argument n is optional and specifies how many 90-degree rotations are to be applied (the default value is 1). Negative values of n rotate the matrix in a clockwise direction.

The third argument is also optional and defines the plane of the rotation. If present, plane is a two-element vector containing two different valid dimensions of the matrix. When plane is not given the first two non-singleton dimensions are used.

(II) Performing Relational Operations on 2 arrays X & Y of given size (1xN)

Relational operators can also work on both scalar and non-scalar data. Relational operators for arrays perform element-by-element comparisons between two arrays and return a logical array of the same size, with elements set to logical 1 (true) where the relation is true and elements set to logical 0 (false) where it is not.

S.No.	Operator	MATLAB Command/Function	Description
1	<	lt(a,b)	Tests whether a is less than b
2	<=	le(a,b)	Tests whether a is less than or equal to b
3	>	gt(a,b)	Tests whether a is greater than b
4	>=	ge(a,b)	Tests whether a is greater than or equal to b
5	==	eq(a,b)	Tests whether a is equal to b
6	~=	ne(a,b)	Tests whether a is not equal to b
7		isequal(a,b)	Determine array equality, treating NaN values as unequal
8		isequaln(a,b)	Determine array equality, treating NaN values as equal

(III) Performing Logical Operations on 2 arrays X & Y of given size (1xN)

MATLAB represents Boolean data using the logical data type. This data type represents true and false states using the numbers 1 and 0, respectively. Certain MATLAB functions and operators return logical values to indicate fulfilment of a condition.

1. **Logical NOT**: Using tilde operator (~) as such $\boxed{\sim A}$, returns a logical array of the same size as A. The array contains logical 1 (true) values where A is zero and logical 0 (false) values where A is nonzero.

   Alternatively, use MATLAB command $\boxed{not(A)}$ to execute ~A.
2. **Logical AND**: Using ampersand operator (&) as such $\boxed{A \ \& \ B}$ to perform a logical AND of arrays A and B and to return an array containing elements set to either logical 1 (true) or logical 0 (false). An element of the output array is set to logical 1 (true) if both A and B contain a nonzero element at that same array location. Otherwise, the array element is set to 0.

   Using MATLAB command $\boxed{and(A,B)}$ is an alternate way to execute A & B.
3. **Logical OR**: Using operator (|) as such $\boxed{A \mid B}$ to perform a logical OR of arrays A and B and to return an array containing elements set to either logical 1 (true) or logical 0 (false). An element of the output array is set to logical 1 (true) if either A or B contain a nonzero element at that same array location. Otherwise, the array element is set to 0.

   Using MATLAB command $\boxed{or(A,B)}$ is an alternate way to execute A | B.
4. **Logical Exclusive-OR**: Using MATLAB command $\boxed{C = xor(A,B)}$ to perform a logical exclusive-OR of arrays A and B and to return an array containing elements set to either logical 1 (true) or logical 0 (false). An element of the output array is set to logical 1 (true) if A or B, but not both, contains a nonzero element at that same array location. Otherwise, the array element is set to 0.

PROGRAM CODE

```
%CONCATENATE
A = [1 2 3 4;5 6 7 8]
B = [3 5 2 1;7 4 9 8]
C = [A B]
D = [A;B]
CC = cat (2,A,B)
DD = cat (1,A,B)
%INDEXING
E = A([1:2],[2:4])
EE = A(6)

%SORTING BY COLUMNWISE
F = sort(B)
G = sort(B,'descend')
%SORTING BY ROW WISE
H = sort(B,2)
I = sort(B,2,'descend')
%SHIFTING
J = circshift([1 2 3 4 5 6 7],2)
JJ = circshift([1;2;3;4;5;6;7],2)
%RESHAPING
K = reshape ([1, 2, 3, 4], 2, 2)
L = reshape ([1, 2, 3, 4], 2, [])
M = reshape ([1, 2;3, 4], 1,[])
%FLIPPING
N = flip(A)
O = flip(A,2)
%ROTATION
rot90 ([1, 2; 3, 4], -1)
rot90 ([1, 2; 3, 4], 1)
rot90 ([1, 2; 3, 4], 7)
rotdim ([1, 2; 3, 4], -1)
rotdim ([1, 2; 3, 4], -1, [1, 2])
rotdim ([1, 2; 3, 4], 1, [1, 2])
%CREATING X AND Y MATRICES
x = [2 3 5 6 0 1 9 8]
y = [1 4 7 2 0 6 2 0]
less = x < y
more = x > y
lessequal = x <= y
moreequal = x>= y
equal = x == y
notequal = x ~= y
less2 = lt(x,y)
more2 = gt(x,y)
lessequal2 = le(x,y)
moreequal2 = ge(x,y)
equal2 = eq(x,y)
notequal2 = ne(x,y)
p = [1 2 3 4 NaN]
q = [1 2 3 4 NaN]
equality = isequal(p,q)
noteq = isequaln(p,q)
%LOGICAL OPERATORS
or1 = x | y
or2 = or(x,y)
and1 = x & y
and2 = and(x,y)
notA = not(y)
nta = ~y
exor = xor(x,y)
```

RESULTS

```
A =

   1   2   3   4
   5   6   7   8

B =

   3   5   2   1
   7   4   9   8

C =

   1   2   3   4   3   5
2   1
```

```
K =

   1   3
   2   4

L =

   1   3
   2   4

M =

   1   3   2   4

N =
```

```
moreequal =

  1  0  0  1  1  0  1  1

equal =

  0  0  0  0  1  0  0  0

notequal =

  1  1  1  1  0  1  1  1

less2 =

  0  1  1  0  0  1  0  0
```

```
   5   6   7   8   7   4
9   8

D =

   1   2   3   4
   5   6   7   8
   3   5   2   1
   7   4   9   8

CC =

   1   2   3   4   3   5
2   1
   5   6   7   8   7   4
9   8

DD =

   1   2   3   4
   5   6   7   8
   3   5   2   1
   7   4   9   8

E =

   2   3   4
   6   7   8

EE = 7
F =

   3   4   2   1
   7   5   9   8

G =

   7   5   9   8
   3   4   2   1

H =

   1   2   3   5
   4   7   8   9

I =

   5   3   2   1
   9   8   7   4
```

```
   5   6   7   8
   1   2   3   4

O =

   4   3   2   1
   8   7   6   5

ans =

   3   1
   4   2

ans =

   2   4
   1   3

ans =

   3   1
   4   2

ans =

   3   1
   4   2

ans =

   3   1
   4   2

ans =

   2   4
   1   3

x =

   2   3   5   6   0   1
9   8

y =

   1   4   7   2   0   6
2   0
```

```
more2 =

  1  0  0  1  0  0  1  1

lessequal2 =

  0  1  1  0  1  1  0  0

moreequal2 =

  1  0  0  1  1  0  1  1

equal2 =

  0  0  0  0  1  0  0  0

notequal2 =

  1  1  1  1  0  1  1  1

p =

     1     2     3     4
NaN

q =

     1     2     3     4
NaN

equality = 0
noteq = 1
or1 =

  1  1  1  1  0  1  1  1

or2 =

  1  1  1  1  0  1  1  1

and1 =

  1  1  1  1  0  1  1  0

and2 =

  1  1  1  1  0  1  1  0
```

```
J =

   6   7   1   2   3   4
5

JJ =

   6
   7
   1
   2
   3
   4
   5
```

```
less =

  0  1  1  0  0  1  0  0

more =

  1  0  0  1  0  0  1  1

lessequal =

  0  1  1  0  1  1  0  0
```

```
notA =

  0  0  0  0  1  0  0  1

nta =

  0  0  0  0  1  0  0  1

exor =

  0  0  0  0  0  0  0  1
```

DISCUSSION and CONCLUSION

The several MATLAB commands have been explored and successfully used to perform Matrix Manipulations – Concatenating, Indexing, Sorting, Shifting, Reshaping, Resizing and Flipping about a Vertical Axis / Horizontal Axis, and to create Arrays X & Y of given size (1 x N) and performing relational and logical operations on them.

PRECAUTIONS

- Don't forget to save the code after every change you make.
- Use MATLAB properly.
- MATLAB requires a stable network connection.
- Save the file after compiling the code and take the required notes and screenshots, so that you don't have to open octave and do everything again.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		

EXPERIMENT- 3

AIM

Generating a set of Commands on a given Vector (Example: X = [1 8 3 9 0 1]) to
(A). Add up the values of the elements (Check with sum)
(B). Compute the Running Sum (Check with sum), where Running Sum for element j = the sum of the elements from 1 to j, inclusive.
(C) Generating a Random Sequence using $rand()$ / $randn()$ functions and plot them.

SOFTWARE USED

Octave Online - https://octave-online.net/

PROGRAM CODE

% Generating a set of Commands on a given Vector (Example: X = [1 8 3 9 0 1])

```
A = 1:10 #vector from 1 to 10
AA = 1:0.5:10 #vector from 1 to 10 with step size of 0.5
AAA = 1:0.1:10 #vector from 1 to 10 with step size of 0.1
B = [1 2 3;4 5 6;7 8 9]
```

% (A). Add up the values of the elements (Check with sum)

```
#Sum of elements of a VECTOR
saa = sum(AA)
saaa = sum(AAA)
sa = sum(A)

#Sum of elements of MATRIX
sb = sum(B) #sum of elements columnwise
sbc = sum(B,1)          #sum of elements columnwise
sbr = sum(B,2           #sum of elements rowwise
```

% (B). Compute the Running Sum (Check with sum), where Running Sum for element j = the sum of the elements from 1 to j, inclusive.

```
#Cumulative sum of elements of a VECTOR
sca = cumsum(A)

ssA = 0

for i=1 : length(A)
   ssA = ssA + A(i)
end

#Cumulative sum of elements of a MATRIX
scb = cumsum(B) #cumulative sum of elements columnwise
scbc = cumsum(B,1) #cumulative sum of elements columnwise
scbr = cumsum(B,2) #cumulative sum of elements rowwise
```

```
#Cumulative Sum of elements rowwise using loop construct
for i=1 : size(B,1)
   sb = 0
   for j=1 : size(B,2)
      sb = sb + B(i,j)
   end
end
```

%(C) Generating a Random Sequence using rand() / randn() functions and plot them.

```
#Generating random real no.s between 0 and 1
C = rand
D = rand
#Generating matrix with its elements as random real no.s between 0 and 1
E = rand(5,3)
F = rand(5)

#Ploting with the help of plot()
X = 0:0.1:10
Yexp = exp(X)
Ysin = sin(X)
Ycos = cos(X)

pa = plot(10:-1:1)
pexp = plot(X,Yexp)
psin = plot(X,Ysin)
pcos = plot(X,Ycos)
```

RESULTS

Generating a set of Commands on a given Vector (Example: X = [1 8 3 9 0 1])

```
A =

    1    2    3    4    5    6    7    8
9   10

AA =

 Columns 1 through 7:

     1.0000         1.5000         2.0000
2.5000     3.0000     3.5000     4.0000

 Columns 8 through 14:

     4.5000         5.0000         5.5000
6.0000     6.5000     7.0000     7.5000

 Columns 15 through 19:

 Columns 36 through 42:

     4.5000         4.6000         4.7000
4.8000     4.9000     5.0000     5.1000

 Columns 43 through 49:

     5.2000         5.3000         5.4000
5.5000     5.6000     5.7000     5.8000

 Columns 50 through 56:

     5.9000         6.0000         6.1000
6.2000     6.3000     6.4000     6.5000

 Columns 57 through 63:
```

```
     8.0000         8.5000         9.0000
9.5000    10.0000

AAA =

 Columns 1 through 7:

     1.0000         1.1000         1.2000
1.3000     1.4000     1.5000     1.6000

 Columns 8 through 14:

     1.7000         1.8000         1.9000
2.0000     2.1000     2.2000     2.3000

 Columns 15 through 21:

     2.4000         2.5000         2.6000
2.7000     2.8000     2.9000     3.0000

 Columns 22 through 28:

     3.1000         3.2000         3.3000
3.4000     3.5000     3.6000     3.7000

 Columns 29 through 35:

     3.8000         3.9000         4.0000
4.1000     4.2000     4.3000     4.4000
```

```
     6.6000         6.7000         6.8000
6.9000     7.0000     7.1000     7.2000

 Columns 64 through 70:

     7.3000         7.4000         7.5000
7.6000     7.7000     7.8000     7.9000

 Columns 71 through 77:

     8.0000         8.1000         8.2000
8.3000     8.4000     8.5000     8.6000

 Columns 78 through 84:

     8.7000         8.8000         8.9000
9.0000     9.1000     9.2000     9.3000

 Columns 85 through 91:

     9.4000         9.5000         9.6000
9.7000     9.8000     9.9000    10.0000

B =

   1   2   3
   4   5   6
   7   8   9
```

(A). Add up the values of the elements (Check with sum)

```
saa = 104.50
saaa = 500.50
sa = 55
sb =

   12   15   18

sbc =

   12   15   18

sbr =

    6
   15
   24
```

(B). Compute the Running Sum (Check with sum), where Running Sum for element j = the sum of the elements from 1 to j, inclusive.

```
sca =

    1    3    6   10   15   21   28   36
45   55

ssA = 0
ssA = 1
ssA = 3
ssA = 6
ssA = 10
ssA = 15
ssA = 21
ssA = 28
ssA = 36
ssA = 45
ssA = 55
scb =

    1    2    3
    5    7    9
   12   15   18
```

```
scbc =

    1    2    3
    5    7    9
   12   15   18

scbr =

    1    3    6
    4    9   15
    7   15   24

sb = 0
sb = 1
sb = 3
sb = 6
sb = 0
sb = 4
sb = 9
sb = 15
sb = 0
sb = 7
sb = 15
sb = 24
```

(C) Generating a Random Sequence using $rand()$ / $randn()$ functions and plot them.

```
C = 0.3927
D = 0.4648
E =

   0.078051       0.172380
0.668933
   0.217670       0.011819
0.771541
   0.886589       0.315641
0.808936
   0.046360       0.271458
0.493604
   0.645525       0.759192
0.678757

F =

   0.6599   0.8430   0.7434
0.1666   0.4927
```

```
 Columns 13 through 18:

   3.3201e+00   3.6693e+00
4.0552e+00      4.4817e+00
4.9530e+00   5.4739e+00

 Columns 19 through 24:

   6.0496e+00   6.6859e+00
7.3891e+00      8.1662e+00
9.0250e+00   9.9742e+00

 Columns 25 through 30:

   1.1023e+01   1.2182e+01
1.3464e+01      1.4880e+01
1.6445e+01   1.8174e+01

 Columns 31 through 36:
```

```
  -0.6313    -0.5507    -
0.4646  -0.3739  -0.2794  -
0.1822  -0.0831   0.0168

 Columns 65 through 72:

   0.1165   0.2151   0.3115
0.4048    0.4941    0.5784
0.6570   0.7290

 Columns 73 through 80:

   0.7937   0.8504   0.8987
0.9380    0.9679    0.9882
0.9985   0.9989

 Columns 81 through 88:
```

```
   0.1059   0.6563   0.7810
0.8541   0.2505
   0.8910   0.7735   0.5439
0.3215   0.4518
   0.1689   0.4789   0.7256
0.1398   0.1916
   0.6553   0.2968   0.1714
0.7497   0.8807

X =

 Columns 1 through 7:

         0         0.1000
0.2000    0.3000    0.4000
0.5000     0.6000

 Columns 8 through 14:

     0.7000         0.8000
0.9000    1.0000    1.1000
1.2000     1.3000

 Columns 15 through 21:

     1.4000         1.5000
1.6000    1.7000    1.8000
1.9000     2.0000

 Columns 22 through 28:

     2.1000         2.2000
2.3000    2.4000    2.5000
2.6000     2.7000

 Columns 29 through 35:

     2.8000         2.9000
3.0000    3.1000    3.2000
3.3000     3.4000

 Columns 36 through 42:

     3.5000         3.6000
3.7000    3.8000    3.9000
4.0000     4.1000

 Columns 43 through 49:
```

```
   2.0086e+01   2.2198e+01
2.4533e+01      2.7113e+01
2.9964e+01   3.3115e+01

 Columns 37 through 42:

   3.6598e+01   4.0447e+01
4.4701e+01      4.9402e+01
5.4598e+01   6.0340e+01

 Columns 43 through 48:

   6.6686e+01   7.3700e+01
8.1451e+01      9.0017e+01
9.9484e+01   1.0995e+02

 Columns 49 through 54:

   1.2151e+02   1.3429e+02
1.4841e+02      1.6402e+02
1.8127e+02   2.0034e+02

 Columns 55 through 60:

   2.2141e+02   2.4469e+02
2.7043e+02      2.9887e+02
3.3030e+02   3.6504e+02

 Columns 61 through 66:

   4.0343e+02   4.4586e+02
4.9275e+02      5.4457e+02
6.0185e+02   6.6514e+02

 Columns 67 through 72:

   7.3510e+02   8.1241e+02
8.9785e+02      9.9227e+02
1.0966e+03   1.2120e+03

 Columns 73 through 78:

   1.3394e+03   1.4803e+03
1.6360e+03      1.8080e+03
1.9982e+03   2.2083e+03

 Columns 79 through 84:
```

```
   0.9894   0.9699   0.9407
0.9022    0.8546    0.7985
0.7344   0.6630

 Columns 89 through 96:

   0.5849   0.5010   0.4121
0.3191    0.2229    0.1245
0.0248  -0.0752

 Columns 97 through 101:

  -0.1743    -0.2718    -
0.3665  -0.4575  -0.5440

Ycos =

 Columns 1 through 7:

   1.000000       0.995004
0.980067          0.955336
0.921061          0.877583
0.825336

 Columns 8 through 14:

   0.764842       0.696707
0.621610          0.540302
0.453596          0.362358
0.267499

 Columns 15 through 21:

   0.169967    0.070737   -
0.029200    -0.128844    -
0.227202    -0.323290    -
0.416147

 Columns 22 through 28:

  -0.504846   -0.588501   -
0.666276    -0.737394    -
0.801144    -0.856889    -
0.904072

 Columns 29 through 35:

  -0.942222   -0.970958   -
0.989992    -0.999135    -
```

```
    4.2000         4.3000
4.4000    4.5000    4.6000
4.7000     4.8000

 Columns 50 through 56:

    4.9000         5.0000
5.1000    5.2000    5.3000
5.4000     5.5000

 Columns 57 through 63:

    5.6000         5.7000
5.8000    5.9000    6.0000
6.1000     6.2000

 Columns 64 through 70:

    6.3000         6.4000
6.5000    6.6000    6.7000
6.8000     6.9000

 Columns 71 through 77:

    7.0000         7.1000
7.2000    7.3000    7.4000
7.5000     7.6000

 Columns 78 through 84:

    7.7000         7.8000
7.9000    8.0000    8.1000
8.2000     8.3000

 Columns 85 through 91:

    8.4000         8.5000
8.6000    8.7000    8.8000
8.9000     9.0000

 Columns 92 through 98:

    9.1000         9.2000
9.3000    9.4000    9.5000
9.6000     9.7000

 Columns 99 through 101:
```

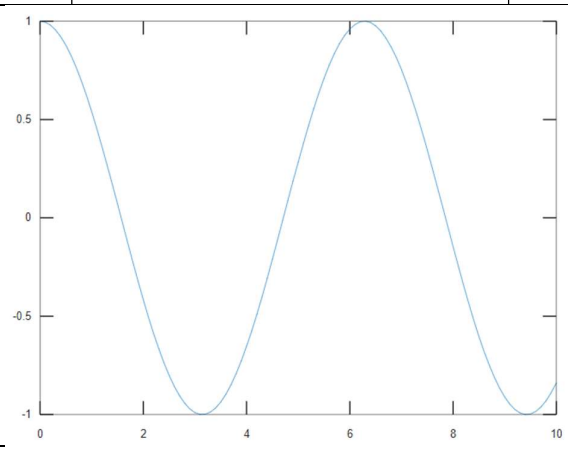
```
   2.4406e+03   2.6973e+03
2.9810e+03      3.2945e+03
3.6410e+03   4.0239e+03

 Columns 85 through 90:

   4.4471e+03   4.9148e+03
5.4317e+03      6.0029e+03
6.6342e+03   7.3320e+03

 Columns 91 through 96:

   8.1031e+03   8.9553e+03
9.8971e+03      1.0938e+04
1.2088e+04   1.3360e+04

 Columns 97 through 101:

   1.4765e+04   1.6318e+04
1.8034e+04      1.9930e+04
2.2026e+04

Ysin =

 Columns 1 through 8:

         0   0.0998   0.1987
0.2955    0.3894    0.4794
0.5646   0.6442

 Columns 9 through 16:

   0.7174   0.7833   0.8415
0.8912    0.9320    0.9636
0.9854   0.9975

 Columns 17 through 24:

   0.9996   0.9917   0.9738
0.9463    0.9093    0.8632
0.8085   0.7457

 Columns 25 through 32:

   0.6755   0.5985   0.5155
0.4274    0.3350    0.2392
0.1411   0.0416

 Columns 33 through 40:
```

```
0.998295    -0.987480    -
0.966798

 Columns 36 through 42:

  -0.936457   -0.896758   -
0.848100    -0.790968    -
0.725932    -0.653644    -
0.574824

 Columns 43 through 49:

  -0.490261   -0.400799   -
0.307333    -0.210796    -
0.112153         -0.012389
0.087499

 Columns 50 through 56:

   0.186512       0.283662
0.377978          0.468517
0.554374          0.634693
0.708670

 Columns 57 through 63:

   0.775566       0.834713
0.885520          0.927478
0.960170          0.983268
0.996542

 Columns 64 through 70:

   0.999859       0.993185
0.976588          0.950233
0.914383          0.869397
0.815725

 Columns 71 through 77:

   0.753902       0.684547
0.608351          0.526078
0.438547          0.346635
0.251260

 Columns 78 through 84:

   0.153374    0.053955   -
0.046002    -0.145500    -
```

```
     9.8000          9.9000
10.0000

Yexp =

 Columns 1 through 6:

   1.0000e+00   1.1052e+00
1.2214e+00      1.3499e+00
1.4918e+00   1.6487e+00

 Columns 7 through 12:

   1.8221e+00   2.0138e+00
2.2255e+00      2.4596e+00
2.7183e+00   3.0042e+00
```

```
  -0.0584    -0.1577    -
0.2555  -0.3508  -0.4425  -
0.5298  -0.6119  -0.6878

 Columns 41 through 48:

  -0.7568    -0.8183    -
0.8716  -0.9162  -0.9516  -
0.9775  -0.9937  -0.9999

 Columns 49 through 56:

  -0.9962    -0.9825    -
0.9589  -0.9258  -0.8835  -
0.8323  -0.7728  -0.7055

 Columns 57 through 64:
```

```
0.243544    -0.339155    -
0.431377

 Columns 85 through 91:

  -0.519289   -0.602012   -
0.678720    -0.748647    -
0.811093    -0.865435    -
0.911130

 Columns 92 through 98:

  -0.947722   -0.974844   -
0.992225    -0.999693    -
0.997172    -0.984688    -
0.962365

 Columns 99 through 101:

  -0.930426   -0.889191   -
0.839072

pa = -6.7602
pexp = -3.4376
psin = -6.7385
pcos = -3.4401
```



DISCUSSION and CONCLUSION

The several MATLAB commands have been explored and successfully used to create vectors, and their row-wise and column-wise sum and cumulative sum are calculated with functions sum and cumsum respectively. Also, the running sum is computed with looping construct. Vectors and matrices are also created using rand function. Finally, sine, exponential and cosine plots of a vector X are generated using sin, exp and cosine functions respectively.

PRECAUTIONS

- Don’t forget to save the code after every change you make.
- Use MATLAB properly.
- MATLAB requires a stable network connection.
- Save the file after compiling the code and take the required notes and screenshots, so that you don’t have to open octave and do everything again.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		

EXPERIMENT- 4

AIM

Evaluating a given expression and rounding it to the nearest integer value using Round, Floor, Ceil and Fix functions.

Also, generating and Plots of

(A) Trigonometric Functions - sin(t), cos(t), tan(t), sec(t), cosec(t) and cot(t) for a given duration, 't'.

(B) Logarithmic and other Functions – log(A), log10(A), Square root of A, Real nth root of A.

SOFTWARE USED

Octave Online - https://octave-online.net/

PROGRAM CODE

% Evaluating a given expression and rounding it to the nearest integer value using Round, Floor, Ceil and Fix functions.

```
round(99.9987)

ceil(99.9)

ceil(-99.9)

floor(99.9)

floor(-99.9)

fix(50.55)

fix(-50.55)
```

% (A) Trigonometric Functions - sin(t), cos(t), tan(t), sec(t), cosec(t) and cot(t) for a given duration, 't'.

```
#Trigonomeetric Functions

t = -pi:0.1:pi

subplot(3,2,1)
plot(t,sin(t))
xlabel('t')
ylabel('sin(t)')
title('Plot of sin(t)')

subplot(3,2,2)
plot(t,cos(t))
xlabel('t')
ylabel('cos(t)')
title('Plot of cos(t)')

t2 = 0.01:0.01:pi-0.01
subplot(3,2,4)
plot(t,csc(t))
xlabel('t')
ylabel('cosec(t)')
title('Plot of cosec(t)')

t1 = -pi/2+0.01:0.01:pi/2-0.01;
t2 = pi/2+0.01:0.01:(3*pi/2)-0.01;
subplot(3,2,5)
plot(t,sec(t))
xlabel('t')
ylabel('sec(t)')
title('Plot of sec(t)')

t1 = -pi+0.01:0.01:-0.01;
```

```
subplot(3,2,3)
plot(t,tangent)
xlabel('t')
ylabel('tan(t)')
title('Plot of tan(t)')

t1 = -pi+0.01:0.01:-0.01
```

```
t2 = 0.01:0.01:pi-0.01;
subplot(3,2,6)
plot(t,cot(t))
xlabel('t')
ylabel('cot(t)')
title('Plot of cot(t)')
```

% (B) Logarithmic and other Functions – log(A), log10(A), Square root of A, Real nth root of A.

```
x = 1:20

subplot(4,1,1)
plot(x,log(x))
xlabel('Values of x')
ylabel('log(x)')
title('Plot of log(x)')

subplot(4,1,2)
plot(x,log10(x))
xlabel('Values of x')
ylabel('log10(x)')
title('Plot of log10(x)')
```

```
subplot(4,1,3)
plot(x,sqrt(x))
xlabel('Values of x')
ylabel('sqrt(x)')
title('Plot of sqrt(x)')

subplot(4,1,4)
plot(x,nthroot(x,5))
xlabel('Values of x')
ylabel('5th root(x)')
title('Plot of 5th root(x)')
```

RESULTS

Evaluating a given expression and rounding it to the nearest integer value using Round, Floor, Ceil and Fix functions.

```
ans = 100
ans = 100
ans = -99
ans = 99
ans = -100
ans = 50
ans = -50
```

(A) Trigonometric Functions - sin(t), cos(t), tan(t), sec(t), cosec(t) and cot(t) for a given duration, ‘t’.

```
t =

 Columns 1 through 8:

   -3.1416   -3.0416   -2.9416   -2.8416   -2.7416   -2.6416   -2.5416   -2.4416

 Columns 9 through 16:
```

```
   -1.391593   -1.381593   -1.371593   -1.361593   -1.351593   -1.341593

 Columns 181 through 186:

   -1.331593   -1.321593   -1.311593   -1.301593   -1.291593   -1.281593

 Columns 187 through 192:
```

```
    0.850000    0.860000    0.870000    0.880000    0.890000    0.900000

 Columns 91 through 96:

    0.910000    0.920000    0.930000    0.940000    0.950000    0.960000

 Columns 97 through 102:
```

```
   -2.3416   -2.2416   -
2.1416   -2.0416   -
1.9416   -1.8416   -
1.7416   -1.6416

 Columns 17 through 24:

   -1.5416   -1.4416   -
1.3416   -1.2416   -
1.1416   -1.0416   -
0.9416   -0.8416

 Columns 25 through 32:

   -0.7416   -0.6416   -
0.5416   -0.4416   -
0.3416   -0.2416   -
0.1416   -0.0416

 Columns 33 through 40:

    0.0584    0.1584
0.2584    0.3584
0.4584    0.5584
0.6584    0.7584

 Columns 41 through 48:

    0.8584    0.9584
1.0584    1.1584
1.2584    1.3584
1.4584    1.5584

 Columns 49 through 56:

    1.6584    1.7584
1.8584    1.9584
2.0584    2.1584
2.2584    2.3584

 Columns 57 through 63:

    2.4584    2.5584
2.6584    2.7584
2.8584    2.9584
3.0584

t1 =
```

```
   -1.271593   -1.261593
-1.251593   -1.241593   -
1.231593   -1.221593

 Columns 193 through 198:

   -1.211593   -1.201593
-1.191593   -1.181593   -
1.171593   -1.161593

 Columns 199 through 204:

   -1.151593   -1.141593
-1.131593   -1.121593   -
1.111593   -1.101593

 Columns 205 through 210:

   -1.091593   -1.081593
-1.071593   -1.061593   -
1.051593   -1.041593

 Columns 211 through 216:

   -1.031593   -1.021593
-1.011593   -1.001593   -
0.991593   -0.981593

 Columns 217 through 222:

   -0.971593   -0.961593
-0.951593   -0.941593   -
0.931593   -0.921593

 Columns 223 through 228:

   -0.911593   -0.901593
-0.891593   -0.881593   -
0.871593   -0.861593

 Columns 229 through 234:

   -0.851593   -0.841593
-0.831593   -0.821593   -
0.811593   -0.801593

 Columns 235 through 240:
```

```
    0.970000    0.980000
0.990000    1.000000
1.010000    1.020000

 Columns 103 through 108:

    1.030000    1.040000
1.050000    1.060000
1.070000    1.080000

 Columns 109 through 114:

    1.090000    1.100000
1.110000    1.120000
1.130000    1.140000

 Columns 115 through 120:

    1.150000    1.160000
1.170000    1.180000
1.190000    1.200000

 Columns 121 through 126:

    1.210000    1.220000
1.230000    1.240000
1.250000    1.260000

 Columns 127 through 132:

    1.270000    1.280000
1.290000    1.300000
1.310000    1.320000

 Columns 133 through 138:

    1.330000    1.340000
1.350000    1.360000
1.370000    1.380000

 Columns 139 through 144:

    1.390000    1.400000
1.410000    1.420000
1.430000    1.440000

 Columns 145 through 150:
```

```
 Columns 1 through 6:

   -3.131593   -3.121593   -3.111593   -3.101593   -3.091593   -3.081593

 Columns 7 through 12:

   -3.071593   -3.061593   -3.051593   -3.041593   -3.031593   -3.021593

 Columns 13 through 18:

   -3.011593   -3.001593   -2.991593   -2.981593   -2.971593   -2.961593

 Columns 19 through 24:

   -2.951593   -2.941593   -2.931593   -2.921593   -2.911593   -2.901593

 Columns 25 through 30:

   -2.891593   -2.881593   -2.871593   -2.861593   -2.851593   -2.841593

 Columns 31 through 36:

   -2.831593   -2.821593   -2.811593   -2.801593   -2.791593   -2.781593

 Columns 37 through 42:

   -2.771593   -2.761593   -2.751593   -2.741593   -2.731593   -2.721593

 Columns 43 through 48:

   -2.711593   -2.701593   -2.691593   -2.681593   -2.671593   -2.661593

 Columns 49 through 54:

   -0.791593   -0.781593   -0.771593   -0.761593   -0.751593   -0.741593

 Columns 241 through 246:

   -0.731593   -0.721593   -0.711593   -0.701593   -0.691593   -0.681593

 Columns 247 through 252:

   -0.671593   -0.661593   -0.651593   -0.641593   -0.631593   -0.621593

 Columns 253 through 258:

   -0.611593   -0.601593   -0.591593   -0.581593   -0.571593   -0.561593

 Columns 259 through 264:

   -0.551593   -0.541593   -0.531593   -0.521593   -0.511593   -0.501593

 Columns 265 through 270:

   -0.491593   -0.481593   -0.471593   -0.461593   -0.451593   -0.441593

 Columns 271 through 276:

   -0.431593   -0.421593   -0.411593   -0.401593   -0.391593   -0.381593

 Columns 277 through 282:

   -0.371593   -0.361593   -0.351593   -0.341593   -0.331593   -0.321593

 Columns 283 through 288:

    1.450000    1.460000    1.470000    1.480000    1.490000    1.500000

 Columns 151 through 156:

    1.510000    1.520000    1.530000    1.540000    1.550000    1.560000

 Columns 157 through 162:

    1.570000    1.580000    1.590000    1.600000    1.610000    1.620000

 Columns 163 through 168:

    1.630000    1.640000    1.650000    1.660000    1.670000    1.680000

 Columns 169 through 174:

    1.690000    1.700000    1.710000    1.720000    1.730000    1.740000

 Columns 175 through 180:

    1.750000    1.760000    1.770000    1.780000    1.790000    1.800000

 Columns 181 through 186:

    1.810000    1.820000    1.830000    1.840000    1.850000    1.860000

 Columns 187 through 192:

    1.870000    1.880000    1.890000    1.900000    1.910000    1.920000

 Columns 193 through 198:
```

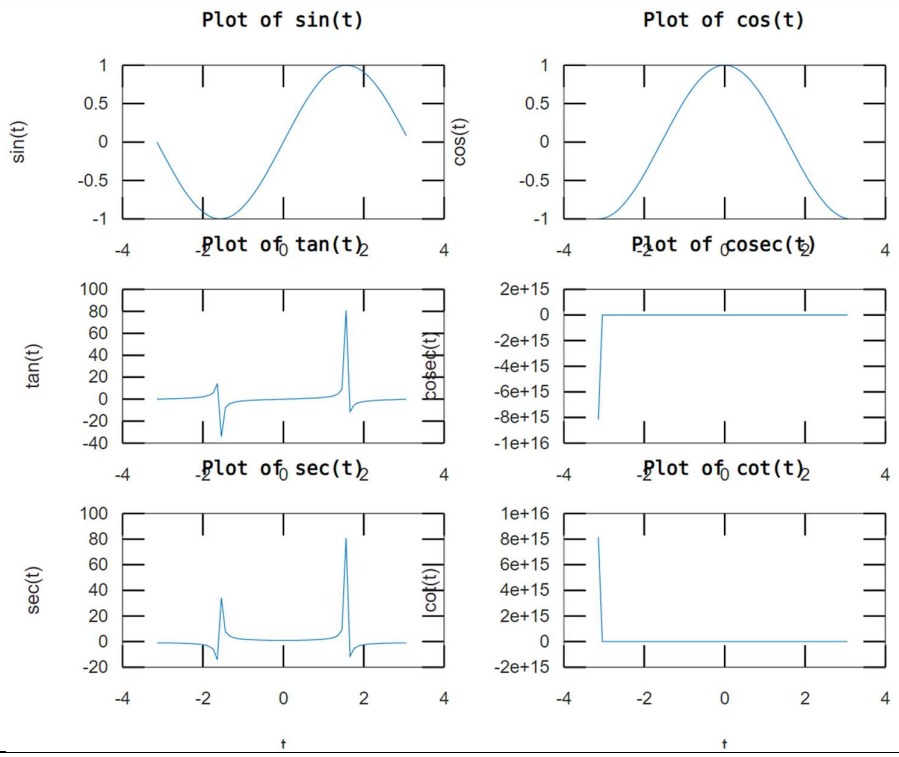
```
   -2.651593   -2.641593   -2.631593   -2.621593   -2.611593   -2.601593

 Columns 55 through 60:

   -2.591593   -2.581593   -2.571593   -2.561593   -2.551593   -2.541593

 Columns 61 through 66:

   -2.531593   -2.521593   -2.511593   -2.501593   -2.491593   -2.481593

 Columns 67 through 72:

   -2.471593   -2.461593   -2.451593   -2.441593   -2.431593   -2.421593

 Columns 73 through 78:

   -2.411593   -2.401593   -2.391593   -2.381593   -2.371593   -2.361593

 Columns 79 through 84:

   -2.351593   -2.341593   -2.331593   -2.321593   -2.311593   -2.301593

 Columns 85 through 90:

   -2.291593   -2.281593   -2.271593   -2.261593   -2.251593   -2.241593

 Columns 91 through 96:

   -2.231593   -2.221593   -2.211593   -2.201593   -2.191593   -2.181593

 Columns 97 through 102:

   -0.311593   -0.301593   -0.291593   -0.281593   -0.271593   -0.261593

 Columns 289 through 294:

   -0.251593   -0.241593   -0.231593   -0.221593   -0.211593   -0.201593

 Columns 295 through 300:

   -0.191593   -0.181593   -0.171593   -0.161593   -0.151593   -0.141593

 Columns 301 through 306:

   -0.131593   -0.121593   -0.111593   -0.101593   -0.091593   -0.081593

 Columns 307 through 312:

   -0.071593   -0.061593   -0.051593   -0.041593   -0.031593   -0.021593

 Column 313:

   -0.011593

t2 =

 Columns 1 through 6:

    0.010000    0.020000    0.030000    0.040000    0.050000    0.060000

 Columns 7 through 12:

    0.070000    0.080000    0.090000    0.100000    0.110000    0.120000

 Columns 13 through 18:

    1.930000    1.940000    1.950000    1.960000    1.970000    1.980000

 Columns 199 through 204:

    1.990000    2.000000    2.010000    2.020000    2.030000    2.040000

 Columns 205 through 210:

    2.050000    2.060000    2.070000    2.080000    2.090000    2.100000

 Columns 211 through 216:

    2.110000    2.120000    2.130000    2.140000    2.150000    2.160000

 Columns 217 through 222:

    2.170000    2.180000    2.190000    2.200000    2.210000    2.220000

 Columns 223 through 228:

    2.230000    2.240000    2.250000    2.260000    2.270000    2.280000

 Columns 229 through 234:

    2.290000    2.300000    2.310000    2.320000    2.330000    2.340000

 Columns 235 through 240:

    2.350000    2.360000    2.370000    2.380000    2.390000    2.400000

 Columns 241 through 246:
```

-2.171593 -2.161593 -2.151593 -2.141593 -2.131593 -2.121593	0.130000 0.140000 0.150000 0.160000 0.170000 0.180000	2.410000 2.420000 2.430000 2.440000 2.450000 2.460000
Columns 103 through 108:	Columns 19 through 24:	Columns 247 through 252:
-2.111593 -2.101593 -2.091593 -2.081593 -2.071593 -2.061593	0.190000 0.200000 0.210000 0.220000 0.230000 0.240000	2.470000 2.480000 2.490000 2.500000 2.510000 2.520000
Columns 109 through 114:	Columns 25 through 30:	Columns 253 through 258:
-2.051593 -2.041593 -2.031593 -2.021593 -2.011593 -2.001593	0.250000 0.260000 0.270000 0.280000 0.290000 0.300000	2.530000 2.540000 2.550000 2.560000 2.570000 2.580000
Columns 115 through 120:	Columns 31 through 36:	Columns 259 through 264:
-1.991593 -1.981593 -1.971593 -1.961593 -1.951593 -1.941593	0.310000 0.320000 0.330000 0.340000 0.350000 0.360000	2.590000 2.600000 2.610000 2.620000 2.630000 2.640000
Columns 121 through 126:	Columns 37 through 42:	Columns 265 through 270:
-1.931593 -1.921593 -1.911593 -1.901593 -1.891593 -1.881593	0.370000 0.380000 0.390000 0.400000 0.410000 0.420000	2.650000 2.660000 2.670000 2.680000 2.690000 2.700000
Columns 127 through 132:	Columns 43 through 48:	Columns 271 through 276:
-1.871593 -1.861593 -1.851593 -1.841593 -1.831593 -1.821593	0.430000 0.440000 0.450000 0.460000 0.470000 0.480000	2.710000 2.720000 2.730000 2.740000 2.750000 2.760000
Columns 133 through 138:	Columns 49 through 54:	Columns 277 through 282:
-1.811593 -1.801593 -1.791593 -1.781593 -1.771593 -1.761593	0.490000 0.500000 0.510000 0.520000 0.530000 0.540000	2.770000 2.780000 2.790000 2.800000 2.810000 2.820000
Columns 139 through 144:	Columns 55 through 60:	Columns 283 through 288:
-1.751593 -1.741593 -1.731593 -1.721593 -1.711593 -1.701593	0.550000 0.560000 0.570000 0.580000 0.590000 0.600000	2.830000 2.840000 2.850000 2.860000 2.870000 2.880000
Columns 145 through 150:	Columns 61 through 66:	Columns 289 through 294:

```
   -1.691593   -1.681593
-1.671593   -1.661593   -
1.651593   -1.641593

 Columns 151 through 156:

   -1.631593   -1.621593
-1.611593   -1.601593   -
1.591593   -1.581593

 Columns 157 through 162:

   -1.571593   -1.561593
-1.551593   -1.541593   -
1.531593   -1.521593

 Columns 163 through 168:

   -1.511593   -1.501593
-1.491593   -1.481593   -
1.471593   -1.461593

 Columns 169 through 174:

   -1.451593   -1.441593
-1.431593   -1.421593   -
1.411593   -1.401593

 Columns 175 through 180:
```

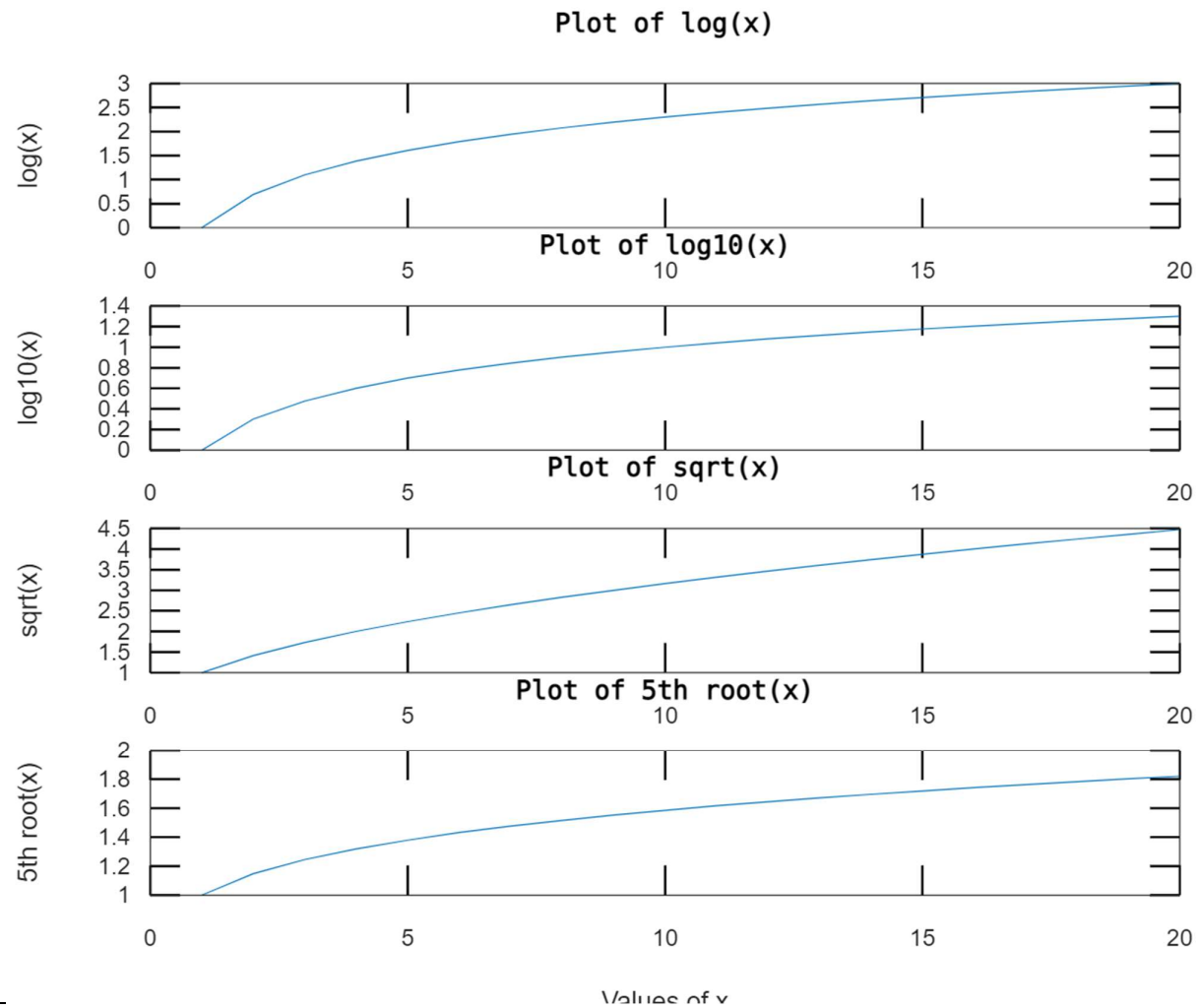
```
    0.610000    0.620000
0.630000    0.640000
0.650000    0.660000

 Columns 67 through 72:

    0.670000    0.680000
0.690000    0.700000
0.710000    0.720000

 Columns 73 through 78:

    0.730000    0.740000
0.750000    0.760000
0.770000    0.780000

 Columns 79 through 84:

    0.790000    0.800000
0.810000    0.820000
0.830000    0.840000

 Columns 85 through 90:
```

```
    2.890000    2.900000
2.910000    2.920000
2.930000    2.940000

 Columns 295 through 300:

    2.950000    2.960000
2.970000    2.980000
2.990000    3.000000

 Columns 301 through 306:

    3.010000    3.020000
3.030000    3.040000
3.050000    3.060000

 Columns 307 through 312:

    3.070000    3.080000
3.090000    3.100000
3.110000    3.120000

 Column 313:

    3.130000
```



(B) Logarithmic and other Functions – log(A), log10(A), Square root of A, Real nth root of A.

```
x =

 Columns 1 through 16:

    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16

 Columns 17 through 20:

   17   18   19   20
```



DISCUSSION and CONCLUSION

The several MATLAB commands have been explored and successfully used in this experiment where natural logarithm, logarithm to the base 10, square root and nth root of a vector x are calculated using log, log10, sqrt, and nth root functions provided by Octave. Further plots of these functions are plotted using the plot function.

PRECAUTIONS

- Don't forget to save the code after every change you make.

- Use MATLAB properly.
- MATLAB requires a stable network connection.
- Save the file after compiling the code and take the required notes and screenshots, so that you don't have to open octave and do everything again.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		

EXPERIMENT- 5

AIM

Creating a vector X with elements, $X_n = \frac{(-1)^{n+1}}{(2n-1)}$ and adding up 100 elements of the vector, X; And, plotting the functions, x, x^3, e^x, $exp(x^2)$ over the interval 0 < x < 4 (by choosing appropriate mesh values for x to obtain smooth curves), on a Rectangular Plot.

SOFTWARE USED

Octave Online - https://octave-online.net/

PROGRAM CODE

% Creating a vector X with elements, $X_n = \frac{(-1)^{n+1}}{(2n-1)}$ and adding up 100 elements of the vector X

```
for n = 1:100
   X(n) = ((-1)^(n+1))/(2*n-1)
end

sumX = sum(X)
```

% Plotting the functions, x, x^3, e^x, $exp(x^2)$ over the interval 0 < x < 4, on a Rectangular Plot

```
t = 0.04:0.04:4

subplot(4,2,1)
plot(t,X)
xlabel('Values of t')
ylabel('X')
title('Plot of X')

subplot(4,2,2)
plot(t,X.^3)
xlabel('Values of t')
ylabel('X^3')
title('Plot of X^3')

subplot(4,2,3)
plot(t,exp(X))
xlabel('Values of t')
ylabel('e^X')
title('Plot of e^X')

subplot(4,2,4)
plot(t,exp(X.^2))
xlabel('Values of t')
ylabel('exp(X^2)')
title('Plot of exp(X^2)')
```

RESULTS

Creating a vector X with elements, $X_n = \frac{(-1)^{n+1}}{(2n-1)}$ and adding up 100 elements of the vector X

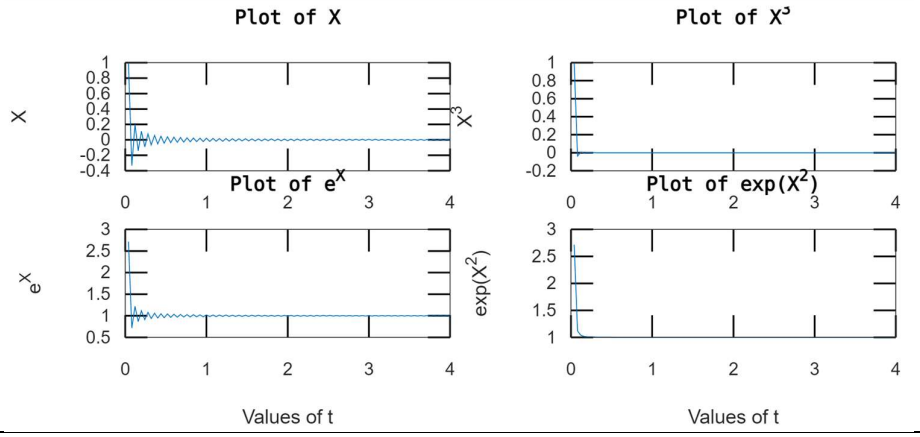
```
X =

 Columns 1 through 6:

   1.0000e+00  -3.3333e-01   2.0000e-01  -1.4286e-01   1.1111e-01  -9.0909e-02

   1.6393e-02  -1.5873e-02   1.5385e-02  -1.4925e-02   1.4493e-02  -1.4085e-02

 Columns 37 through 42:

   7.5188e-03  -7.4074e-03   7.2993e-03  -7.1942e-03   7.0922e-03  -6.9930e-03

 Columns 73 through 78:
```

```
 Columns 7 through 12:

   7.6923e-02  -6.6667e-02   5.8824e-02  -5.2632e-02   4.7619e-02  -4.3478e-02

 Columns 13 through 18:

   4.0000e-02  -3.7037e-02   3.4483e-02  -3.2258e-02   3.0303e-02  -2.8571e-02

 Columns 19 through 24:

   2.7027e-02  -2.5641e-02   2.4390e-02  -2.3256e-02   2.2222e-02  -2.1277e-02

 Columns 25 through 30:

   2.0408e-02  -1.9608e-02   1.8868e-02  -1.8182e-02   1.7544e-02  -1.6949e-02

 Columns 31 through 36:

   1.3699e-02  -1.3333e-02   1.2987e-02  -1.2658e-02   1.2346e-02  -1.2048e-02

 Columns 43 through 48:

   1.1765e-02  -1.1494e-02   1.1236e-02  -1.0989e-02   1.0753e-02  -1.0526e-02

 Columns 49 through 54:

   1.0309e-02  -1.0101e-02   9.9010e-03  -9.7087e-03   9.5238e-03  -9.3458e-03

 Columns 55 through 60:

   9.1743e-03  -9.0090e-03   8.8496e-03  -8.6957e-03   8.5470e-03  -8.4034e-03

 Columns 61 through 66:

   8.2645e-03  -8.1301e-03   8.0000e-03  -7.8740e-03   7.7519e-03  -7.6336e-03

 Columns 67 through 72:

   6.8966e-03  -6.8027e-03   6.7114e-03  -6.6225e-03   6.5359e-03  -6.4516e-03

 Columns 79 through 84:

   6.3694e-03  -6.2893e-03   6.2112e-03  -6.1350e-03   6.0606e-03  -5.9880e-03

 Columns 85 through 90:

   5.9172e-03  -5.8480e-03   5.7803e-03  -5.7143e-03   5.6497e-03  -5.5866e-03

 Columns 91 through 96:

   5.5249e-03  -5.4645e-03   5.4054e-03  -5.3476e-03   5.2910e-03  -5.2356e-03

 Columns 97 through 100:

   5.1813e-03  -5.1282e-03   5.0761e-03  -5.0251e-03

sumX = 0.7829
```

Plotting the functions, x, x^3, e^x, $exp(x^2)$ over the interval 0 < x < 4, on a Rectangular Plot

```
t =

 Columns 1 through 6:

    0.040000    0.080000    0.120000    0.160000    0.200000    0.240000

 Columns 7 through 12:

    0.280000    0.320000    0.360000    0.400000    0.440000    0.480000

    1.960000    2.000000    2.040000    2.080000    2.120000    2.160000

 Columns 55 through 60:

    2.200000    2.240000    2.280000    2.320000    2.360000    2.400000

 Columns 61 through 66:
```

```
 Columns 13 through 18:

    0.520000    0.560000    0.600000
0.640000    0.680000    0.720000

 Columns 19 through 24:

    0.760000    0.800000    0.840000
0.880000    0.920000    0.960000

 Columns 25 through 30:

    1.000000    1.040000    1.080000
1.120000    1.160000    1.200000

 Columns 31 through 36:

    1.240000    1.280000    1.320000
1.360000    1.400000    1.440000

 Columns 37 through 42:

    1.480000    1.520000    1.560000
1.600000    1.640000    1.680000

 Columns 43 through 48:

    1.720000    1.760000    1.800000
1.840000    1.880000    1.920000

 Columns 49 through 54:

    2.440000    2.480000    2.520000
2.560000    2.600000    2.640000

 Columns 67 through 72:

    2.680000    2.720000    2.760000
2.800000    2.840000    2.880000

 Columns 73 through 78:

    2.920000    2.960000    3.000000
3.040000    3.080000    3.120000

 Columns 79 through 84:

    3.160000    3.200000    3.240000
3.280000    3.320000    3.360000

 Columns 85 through 90:

    3.400000    3.440000    3.480000
3.520000    3.560000    3.600000

 Columns 91 through 96:

    3.640000    3.680000    3.720000
3.760000    3.800000    3.840000

 Columns 97 through 100:

    3.880000    3.920000    3.960000
4.000000
```



DISCUSSION and CONCLUSION

The several MATLAB commands have been explored and successfully used to create a vector with its individual elements are found by computing its function and as such, exponential curves and cubic curves of

a vector X are plotted using element wise method of exponentiation X.^3, X.^2. The curves were possible with the use of function exp, which gives exponential values of the argument.

PRECAUTIONS

- Don't forget to save the code after every change you make.
- Use MATLAB properly.
- MATLAB requires a stable network connection.
- Save the file after compiling the code and take the required notes and screenshots, so that you don't have to open octave and do everything again.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		

EXPERIMENT- 6

AIM

Generating a sinusoidal signal of a given frequency (say 100Hz) and plotting with graphical enhancements: titling, labelling, adding text, adding legends, adding new plots to existing plots, printings text in Greek letters, plotting as multiple subplots.

SOFTWARE USED

Octave Online - https://octave-online.net/

PROGRAM CODE

% Generating a sinusoidal signal of a given frequency (say 100Hz) and plotting with graphical enhancements: titling, labelling, adding text, adding legends, adding new plots to existing plots, printings text in Greek letters, plotting as multiple subplots.

```
t = 0:0.05*pi:2*pi

x = sin(t)
plot(t,x,'r-')
xlabel('t')
ylabel('sine(t)')
title('Plot of sin(t)')
legend('sine(t)')
text(pi,0,'\Leftarrow sin(\pi)','FontSize',18)

hold on

x1 = sin(3*t)
plot(t,x1,'b+-')
xlabel('radians')
ylabel('amplitude')
title('Plot of sin(3{\alpha}) over existing wave sin({\alpha})')
legend('sine(t)','sin(3t)')
text(pi,0,'\Leftarrow sin(3({\alpha}))','FontSize',18)

x2 = sin(4*t)
plot(t,x2,'g*-')
xlabel('t')
ylabel('sine(t)')
title('Plot of sin(t)')
legend('sine(t)','sin(3t)','sin(4t)')
text(pi,0,'\Leftarrow sin(\pi)','FontSize',18)

hold off
```

RESULTS

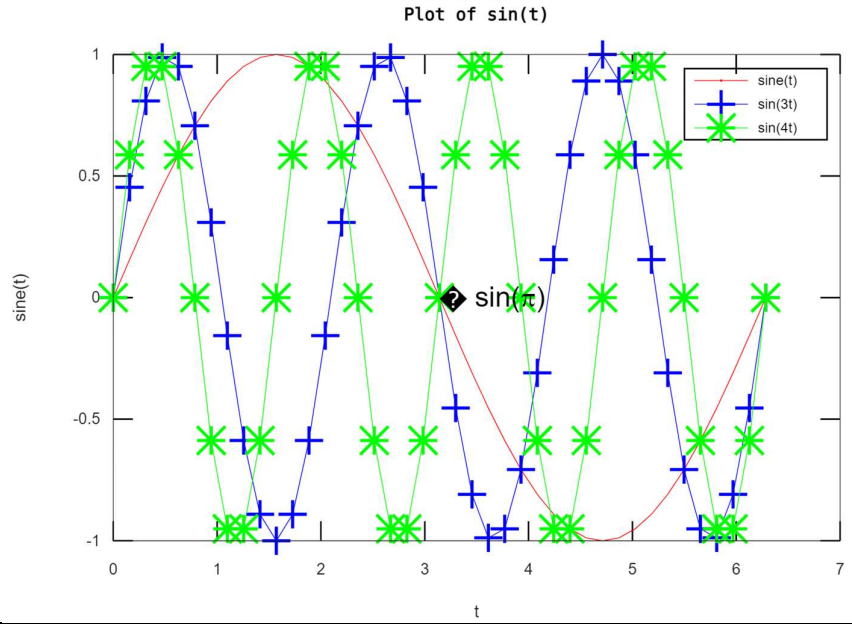
Generating a sinusoidal signal of a given frequency (say 100Hz) and plotting with graphical enhancements: titling, labelling, adding text, adding legends, adding new plots to existing plots, printings text in Greek letters, plotting as multiple subplots.

```
t =

 Columns 1 through 8:

         0    0.1571    0.3142    0.4712    0.6283    0.7854    0.9425
1.0996

 Columns 9 through 16:

 Columns 1 through 8:

         0    0.4540    0.8090    0.9877    0.9511    0.7071    0.3090   -0.1564

 Columns 9 through 16:

  -0.5878   -0.8910   -1.0000   -0.8910   -0.5878   -0.1564    0.3090    0.7071

 Columns 17 through 24:
```

```
    1.2566    1.4137    1.5708
1.7279    1.8850    2.0420    2.1991
2.3562

 Columns 17 through 24:

    2.5133    2.6704    2.8274
2.9845    3.1416    3.2987    3.4558
3.6128

 Columns 25 through 32:

    3.7699    3.9270    4.0841
4.2412    4.3982    4.5553    4.7124
4.8695

 Columns 33 through 40:

    5.0265    5.1836    5.3407
5.4978    5.6549    5.8119    5.9690
6.1261

 Column 41:

    6.2832

x =

 Columns 1 through 8:

        0   0.1564   0.3090   0.4540
0.5878   0.7071   0.8090   0.8910

 Columns 9 through 16:

   0.9511   0.9877   1.0000   0.9877
0.9511   0.8910   0.8090   0.7071
 Columns 17 through 24:

   0.5878   0.4540   0.3090   0.1564
0.0000  -0.1564  -0.3090  -0.4540

 Columns 25 through 32:

  -0.5878  -0.7071  -0.8090  -0.8910  -
0.9511  -0.9877  -1.0000  -0.9877

 Columns 33 through 40:

   0.9511   0.9877   0.8090   0.4540
0.0000  -0.4540  -0.8090  -0.9877

 Columns 25 through 32:

  -0.9511  -0.7071  -0.3090   0.1564
0.5878   0.8910   1.0000   0.8910

 Columns 33 through 40:

   0.5878   0.1564  -0.3090  -0.7071  -
0.9511  -0.9877  -0.8090  -0.4540

 Column 41:

  -0.0000

ans = -20.950
x2 =

 Columns 1 through 8:

        0   0.5878   0.9511   0.9511
0.5878   0.0000  -0.5878  -0.9511

 Columns 9 through 16:

  -0.9511  -0.5878  -0.0000   0.5878
0.9511   0.9511   0.5878   0.0000

 Columns 17 through 24:

  -0.5878  -0.9511  -0.9511  -0.5878  -
0.0000   0.5878   0.9511   0.9511

 Columns 25 through 32:

   0.5878   0.0000  -0.5878  -0.9511  -
0.9511  -0.5878  -0.0000   0.5878

 Columns 33 through 40:

   0.9511   0.9511   0.5878   0.0000  -
0.5878  -0.9511  -0.9511  -0.5878

 Column 41:

  -0.0000
```

```
  -0.9511  -0.8910  -0.8090  -0.7071  -
0.5878  -0.4540  -0.3090  -0.1564

 Column 41:

  -0.0000

ans = -20.950
x1 =
```

```
ans = -20.950
```



DISCUSSION and CONCLUSION

In this experiment, the specifications of a plot are added where to add the requirements specified in the question xlabel, ylabel, and text functions are used. Also sin() function is used with different arguments is used to generate the sine curve and some Greek letters are printed in the text of the plot.

PRECAUTIONS

- Don't forget to save the code after every change you make.
- Use MATLAB properly.
- MATLAB requires a stable network connection.
- Save the file after compiling the code and take the required notes and screenshots, so that you don't have to open octave and do everything again.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		

EXPERIMENT- 7

AIM

Writing brief script starting each script with a request for input (using input() function) to evaluate the function h(T) using if-else statement, where,

h(T) = (T-10) for 0<T<100

h(T) = (0.45T + 900) for T>100

SOFTWARE USED

Octave Online - https://octave-online.net/

PROGRAM CODE

% Writing brief script starting each script with a request for input to evaluate the function h(T) using if-else statement

```
H = 0
T = input('Enter the value of T: ')

if (T<0)
   disp('Enter a value greater then 0')
else if (0<T) && (T<100)
   fprintf('For T = %d,\n\t',T)
   H = T-10
else if (T>100)
   fprintf('For T = %d,\n\t',T)
   H = (0.45*T)+900
end
end
end
```

RESULTS

Writing brief script starting each script with a request for input to evaluate the function h(T) using if-else statement

```
octave:27> source("exp7.m")
H = 0
Enter the value of T: > -25
T = -25
Enter a value greater then 0
```

```
octave:29> source("exp7.m")
H = 0
Enter the value of T: > 25
T = 25
For T = 25,
        H = 15
```

```
octave:28> source("exp7.m")
H = 0
Enter the value of T: > 150
T = 150
For T = 150,
        H = 967.50
```

DISCUSSION and CONCLUSION

The MATLAB/ Octave functionality have been explored and successfully implemented to take input from user and to solve the problem statement if-else statements were used to process different kinds of inputs based on the range defined in the question.

PRECAUTIONS

- Don't forget to save the code after every change you make.
- Use MATLAB properly.
- MATLAB requires a stable network connection.
- Save the file after compiling the code and take the required notes and screenshots, so that you don't have to open octave and do everything again.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		

EXPERIMENT- 8

AIM

Solving first order differential equation using the built-in functions. Consider the following differential equation

$$x\left(\frac{dy}{dx}\right) + 2y = x^3, \quad \text{where } \frac{dy}{dx} = \frac{(x^3 - 2y)}{x}, \quad 1<x<3 \text{ and } y = 4.2$$

SOFTWARE USED

Octave Online - https://octave-online.net/

PROGRAM CODE

% Solving first order differential equation using the built-in functions

```
ode1 = @(x,y)(x^3-2*y)/x

[x,y]  = ode45(ode1,[1.01:0.01:3],4.2)

plot(x,y,'linewidth',2)
xlabel('x')
ylabel('y')
grid on
title('Solution to ODE, dy/dx = (x^3-2*y)/x')
```

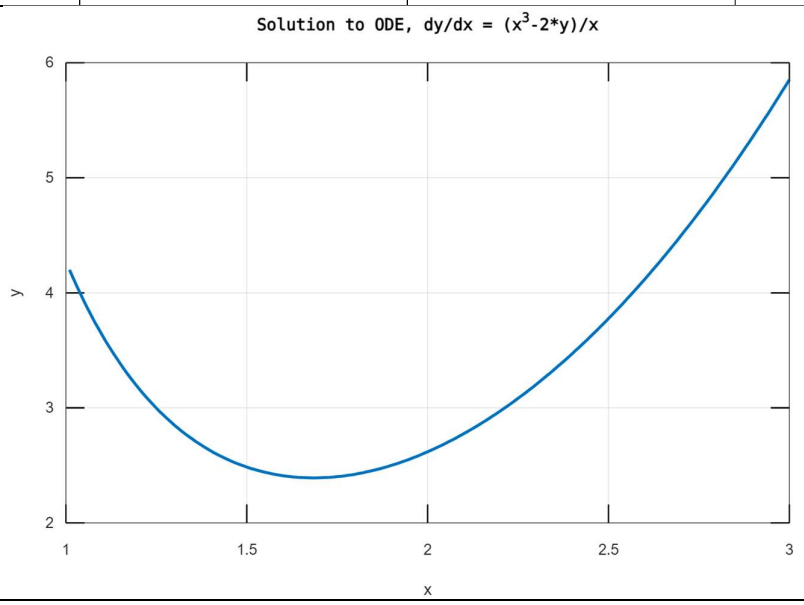
RESULTS

Solving first order differential equation using the built-in functions

```
ode1 =

@(x, y) (x ^ 3 - 2 * y) / x

x =

   1.0100
   1.0200
   1.0300
   1.0400
   1.0500
   1.0600
   1.0700
   1.0800
   1.0900
   1.1000
   1.1100
   1.1200
   1.1300
   1.1400
   1.1500
   1.9800
   1.9900
   2.0000
   2.0100
   2.0200
   2.0300
   2.0400
   2.0500
   2.0600
   2.0700
   2.0800
   2.0900
   2.1000
   2.1100
   2.1200
   2.1300
   2.1400
   2.1500
   2.1600
   2.1700
   2.1800
   2.1900

y =

   4.2000
   4.1283
   4.0589
   3.9918
   3.9270
   3.8642
   3.8036
   3.7449
   3.6882
   3.6333
   3.5803
   3.5289
   3.4793
   3.4313
   3.3849
   3.3400
   3.2966
   3.2546
   3.2141
   2.6186
   2.6326
   2.6470
   2.6618
   2.6769
   2.6925
   2.7084
   2.7248
   2.7415
   2.7586
   2.7761
   2.7939
   2.8121
   2.8307
   2.8497
   2.8691
   2.8888
   2.9089
   2.9293
   2.9502
   2.9714
   2.9930
```

1.1600	2.2000	3.1749	3.0149
1.1700	2.2100	3.1371	3.0372
1.1800	2.2200	3.1005	3.0599
1.1900	2.2300	3.0652	3.0829
1.2000	2.2400	3.0310	3.1063
1.2100	2.2500	2.9981	3.1301
1.2200	2.2600	2.9663	3.1542
1.2300	2.2700	2.9357	3.1787
1.2400	2.2800	2.9061	3.2036
1.2500	2.2900	2.8776	3.2288
1.2600	2.3000	2.8502	3.2544
1.2700	2.3100	2.8237	3.2803
1.2800	2.3200	2.7983	3.3066
1.2900	2.3300	2.7738	3.3333
1.3000	2.3400	2.7502	3.3604
1.3100	2.3500	2.7276	3.3878
1.3200	2.3600	2.7058	3.4155
1.3300	2.3700	2.6850	3.4436
1.3400	2.3800	2.6650	3.4721
1.3500	2.3900	2.6458	3.5010
1.3600	2.4000	2.6275	3.5302
1.3700	2.4100	2.6099	3.5598
1.3800	2.4200	2.5932	3.5897
1.3900	2.4300	2.5772	3.6200
1.4000	2.4400	2.5620	3.6506
1.4100	2.4500	2.5475	3.6817
1.4200	2.4600	2.5338	3.7130
1.4300	2.4700	2.5207	3.7448
1.4400	2.4800	2.5084	3.7769
1.4500	2.4900	2.4967	3.8093
1.4600	2.5000	2.4858	3.8422
1.4700	2.5100	2.4755	3.8754
1.4800	2.5200	2.4658	3.9089
1.4900	2.5300	2.4568	3.9428
1.5000	2.5400	2.4484	3.9771
1.5100	2.5500	2.4406	4.0118
1.5200	2.5600	2.4334	4.0468
1.5300	2.5700	2.4269	4.0822
1.5400	2.5800	2.4209	4.1179
1.5500	2.5900	2.4155	4.1540
1.5600	2.6000	2.4107	4.1905
1.5700	2.6100	2.4064	4.2273
1.5800	2.6200	2.4027	4.2645
1.5900	2.6300	2.3996	4.3021
1.6000	2.6400	2.3970	4.3400
1.6100	2.6500	2.3949	4.3783
1.6200	2.6600	2.3934	4.4170
1.6300	2.6700	2.3924	4.4561
1.6400	2.6800	2.3919	4.4955

1.6500	2.6900	2.3919	4.5353
1.6600	2.7000	2.3924	4.5754
1.6700	2.7100	2.3934	4.6159
1.6800	2.7200	2.3949	4.6568
1.6900	2.7300	2.3968	4.6981
1.7000	2.7400	2.3993	4.7398
1.7100	2.7500	2.4022	4.7818
1.7200	2.7600	2.4056	4.8242
1.7300	2.7700	2.4095	4.8669
1.7400	2.7800	2.4138	4.9101
1.7500	2.7900	2.4186	4.9536
1.7600	2.8000	2.4239	4.9975
1.7700	2.8100	2.4296	5.0417
1.7800	2.8200	2.4357	5.0864
1.7900	2.8300	2.4423	5.1314
1.8000	2.8400	2.4493	5.1768
1.8100	2.8500	2.4567	5.2226
1.8200	2.8600	2.4646	5.2688
1.8300	2.8700	2.4729	5.3153
1.8400	2.8800	2.4817	5.3622
1.8500	2.8900	2.4908	5.4096
1.8600	2.9000	2.5004	5.4573
1.8700	2.9100	2.5104	5.5053
1.8800	2.9200	2.5208	5.5538
1.8900	2.9300	2.5316	5.6026
1.9000	2.9400	2.5428	5.6519
1.9100	2.9500	2.5544	5.7015
1.9200	2.9600	2.5665	5.7515
1.9300	2.9700	2.5789	5.8019
1.9400	2.9800	2.5917	5.8527
1.9500	2.9900	2.6049	
1.9600	3.0000		
1.9700			



DISCUSSION and CONCLUSION

To achieve the solution for first order differential equations, the MATLAB/Octave's built-in functions are used. The ode45() function is used to solve the ode given in the problem statement, it takes definition of the ode as the first argument, range as second parameter and initial condition as third parameter.

As such, the solution for the required differential equation is successfully obtained.

PRECAUTIONS

- Don't forget to save the code after every change you make.
- Use MATLAB properly.
- MATLAB requires a stable network connection.
- Save the file after compiling the code and take the required notes and screenshots, so that you don't have to open octave and do everything again.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		

EXPERIMENT- 9

AIM

Generating a square wave from sum of sine waves of certain amplitude and frequency

$$x(t) = \frac{4A}{\pi}\left(sin\omega t + \frac{sin3\omega t}{3} + \frac{sin5\omega t}{5} + \frac{sin7\omega t}{7}\cdots\right)$$

SOFTWARE USED

Octave Online - https://octave-online.net/

PROGRAM CODE

% Generating a square wave from sum of sine waves of certain amplitude and frequency

```
disp(pi)

t = 0:0.05:2
length(t)



f = 1
A = 4
amp = 2*pi*f
sum = 0
sine = 0

for n = 1:2:100
   y = sin(n*amp*t)/n
   sum = sum + y

end
```

```
sum = sum * (4*A/pi)

for n = 1:100
   z = sin(amp*t)/n
   sine = sine + z
end




hold on

plot(t,sum)
plot(t,sine,"g-+")

hold off
```

RESULTS

Generating a square wave from sum of sine waves of certain amplitude and frequency

```
3.1416
t =

 Columns 1 through 8:

         0    0.0500    0.1000
0.1500    0.2000    0.2500    0.3000
0.3500

 Columns 9 through 16:

    0.4000    0.4500    0.5000
0.5500    0.6000    0.6500    0.7000
0.7500
```

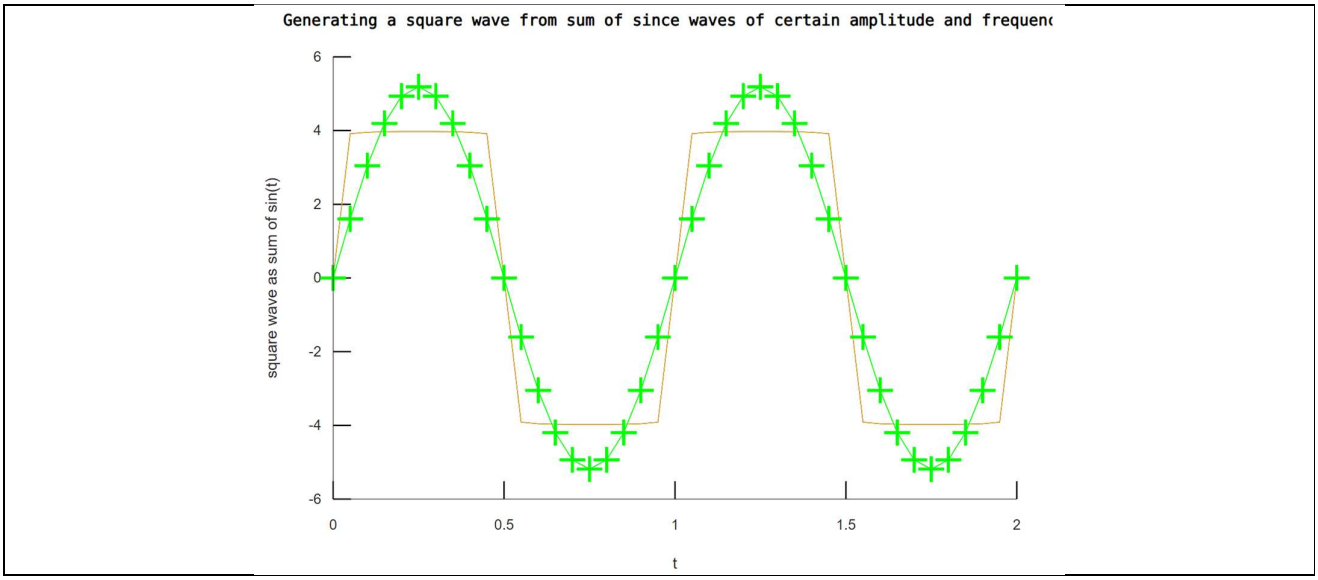
```
 Column 41:

  -0.0000

sum =

 Columns 1 through 8:

        0   3.9178   3.9567   3.9685
3.9732   3.9745   3.9732   3.9685

 Columns 9 through 16:
```

```
 Columns 17 through 24:

    0.8000    0.8500    0.9000
0.9500    1.0000    1.0500    1.1000
1.1500

 Columns 25 through 32:

    1.2000    1.2500    1.3000
1.3500    1.4000    1.4500    1.5000
1.5500

 Columns 33 through 40:

    1.6000    1.6500    1.7000
1.7500    1.8000    1.8500    1.9000
1.9500

 Column 41:

    2.0000

ans = 41
f = 1
A = 4
amp = 6.2832
sum = 0
sine = 0

y =

 Columns 1 through 7:

          0  -0.003121  -0.005937  -
0.008172  -0.009607  -0.010101  -
0.009607

 Columns 8 through 14:

  -0.008172  -0.005937  -0.003121  -
0.000000   0.003121   0.005937
0.008172

 Columns 15 through 21:

   0.009607   0.010101   0.009607
0.008172   0.005937   0.003121
0.000000
```

```
   3.9567   3.9178  -0.0000  -3.9178  -
3.9567  -3.9685  -3.9732  -3.9745

 Columns 17 through 24:

  -3.9732  -3.9685  -3.9567  -3.9178
0.0000   3.9178   3.9567   3.9685

 Columns 25 through 32:

   3.9732   3.9745   3.9732   3.9685
3.9567   3.9178  -0.0000  -3.9178

 Columns 33 through 40:

  -3.9567  -3.9685  -3.9732  -3.9745  -
3.9732  -3.9685  -3.9567  -3.9178

 Column 41:

  -0.0000

z =

 Columns 1 through 7:

          0   0.003090   0.005878
0.008090   0.009511   0.010000
0.009511

 Columns 8 through 14:

   0.008090   0.005878   0.003090
0.000000  -0.003090  -0.005878  -
0.008090

 Columns 15 through 21:

  -0.009511  -0.010000  -0.009511  -
0.008090  -0.005878  -0.003090  -
0.000000

 Columns 22 through 28:

   0.003090   0.005878   0.008090
0.009511   0.010000   0.009511
0.008090

 Columns 29 through 35:
```

```
 Columns 22 through 28:

  -0.003121  -0.005937  -0.008172  -
0.009607  -0.010101  -0.009607  -
0.008172

 Columns 29 through 35:

  -0.005937  -0.003121  -0.000000
0.003121   0.005937   0.008172
0.009607

 Columns 36 through 41:

   0.010101   0.009607   0.008172
0.005937   0.003121   0.000000

sum =

 Columns 1 through 8:

        0   0.7692   0.7769   0.7792
0.7801   0.7804   0.7801   0.7792

 Columns 9 through 16:

   0.7769   0.7692  -0.0000  -0.7692  -
0.7769  -0.7792  -0.7801  -0.7804

 Columns 17 through 24:

  -0.7801  -0.7792  -0.7769  -0.7692
0.0000   0.7692   0.7769   0.7792

 Columns 25 through 32:

   0.7801   0.7804   0.7801   0.7792
0.7769   0.7692  -0.0000  -0.7692

 Columns 33 through 40:

  -0.7769  -0.7792  -0.7801  -0.7804  -
0.7801  -0.7792  -0.7769  -0.7692
```

```
   0.005878   0.003090   0.000000  -
0.003090  -0.005878  -0.008090  -
0.009511

 Columns 36 through 41:

  -0.010000  -0.009511  -0.008090  -
0.005878  -0.003090  -0.000000

sine =

 Columns 1 through 8:

        0   1.6030   3.0491   4.1967
4.9335   5.1874   4.9335   4.1967

 Columns 9 through 16:

   3.0491   1.6030   0.0000  -1.6030  -
3.0491  -4.1967  -4.9335  -5.1874

 Columns 17 through 24:

  -4.9335  -4.1967  -3.0491  -1.6030  -
0.0000   1.6030   3.0491   4.1967

 Columns 25 through 32:

   4.9335   5.1874   4.9335   4.1967
3.0491   1.6030   0.0000  -1.6030

 Columns 33 through 40:

  -3.0491  -4.1967  -4.9335  -5.1874  -
4.9335  -4.1967  -3.0491  -1.6030

 Column 41:

  -0.0000
```



DISCUSSION and CONCLUSION

In this experiment, the concept of loops and trigonometric functions are used for applying mathematical operations such that the terms for square wave using the sum of sine waves is obtained.

Using the computed terms and previously defined vector are used to plot the square wave.

PRECAUTIONS

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- MATLAB requires a stable network connection.
- Save the file after compiling the code and take the required notes and screenshots, so that you don't have to open octave and do everything again.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		

EXPERIMENT- 10

AIM

Basic 2D and 3D plots: parametric space curve, polygons with vertices, 3D contour lines and pie and bar charts.

SOFTWARE USED

Octave Online - https://octave-online.net/
MATLAB ONLINE - https://matlab.mathworks.com/

PROGRAM CODE

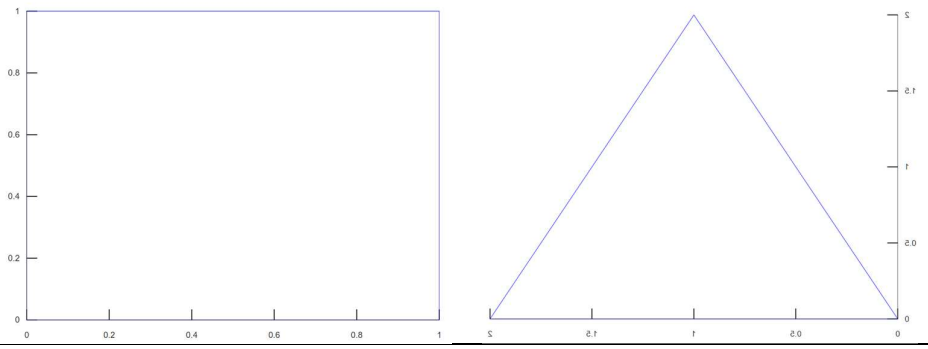
% Basic 2D and 3D plots

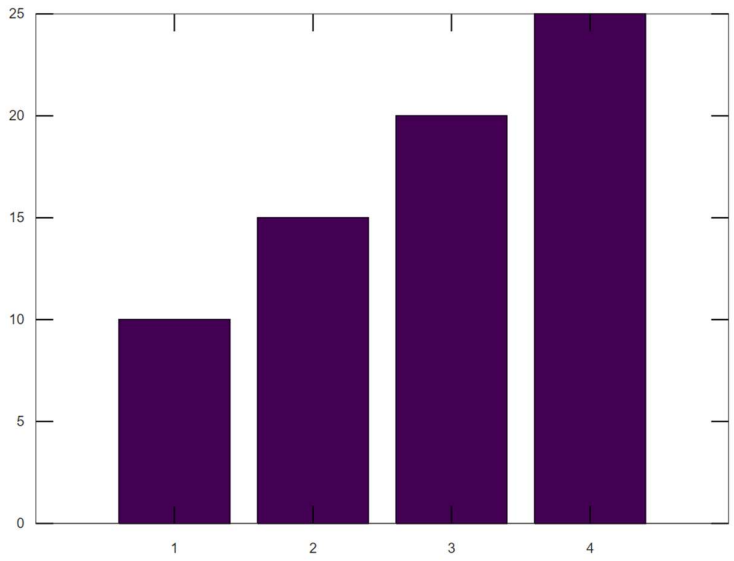
```
x = [10 15 20 25]

#Polygons with vertices
drawPolygon([0,0; 1,0; 1,1; 0,1])
drawPolygon([0,0; 2,0; 1,2])

#Bar Graphs
bar(x)

figure
bar3(x)

#Pie Charts
pie(x)

figure
pie3(x)

#3D Contour lines
[X,Y,Z] = peaks;
contour(X,Y,Z)
```

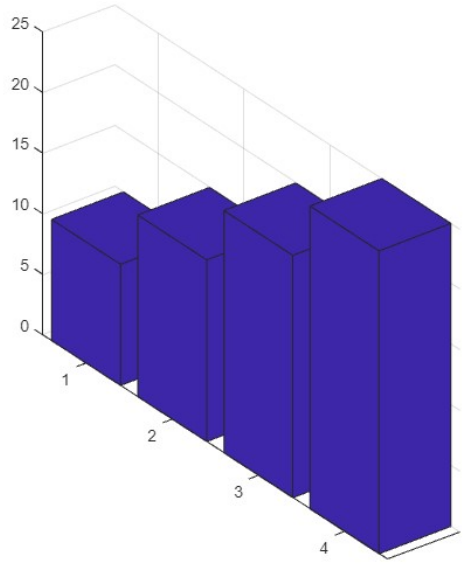
RESULTS

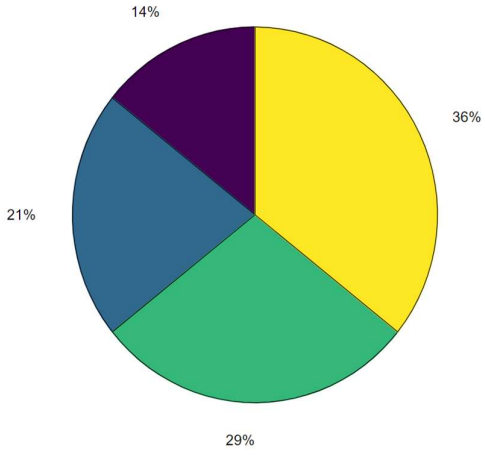
% Basic 2D and 3D plots

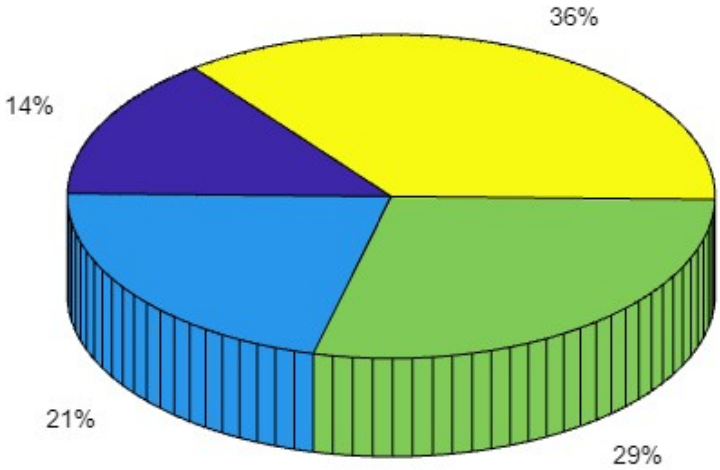
```
x =

   10   15   20   25
```

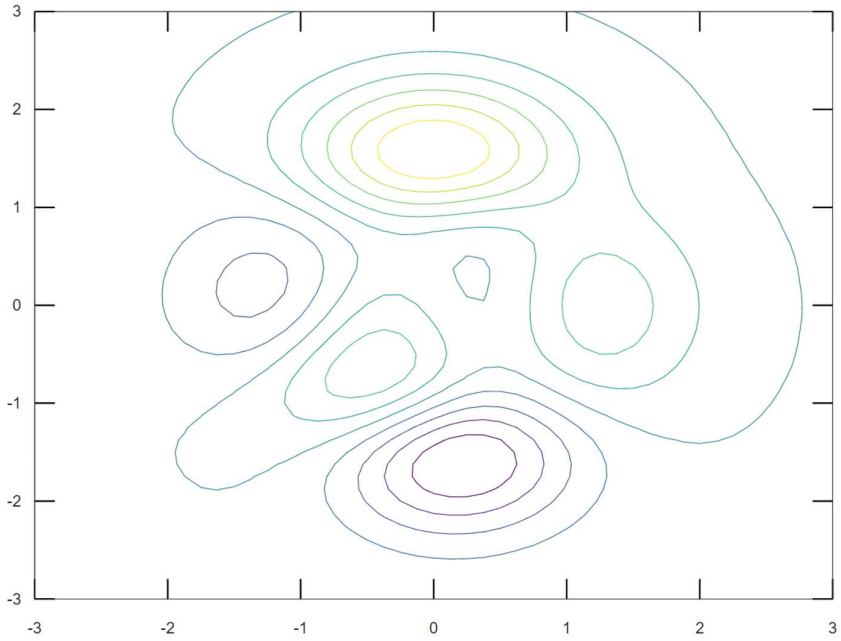



25
20
15
10
5
0
1
2
3
4


25
20
15
10
5
0
1
2
3
4


14%
36%
21%
29%


36%
14%
21%
29%


3
2
1
0
-1
-2
-3
-3
-2
-1
0
1
2
3

DISCUSSION and CONCLUSION

The various MATLAB commands have been explored and successfully used to plot the required 2D and 3D plots. Using some predefined functions in MATLAB, namely – drawPolygon, bar, bar3, pie, pie3 and contour, polygons with vertices, bar graphs & pie charts in both 2-D and 3-D, contour plots have been illustrated marking the completion of the experiment.

PRECAUTIONS

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- Use MATLAB properly.
- MATLAB requires a stable network connection.
- Save the file after compiling the code and take the required notes and screenshots, so that you don't have to open octave and do everything again.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		