Experiment No: 01

Name of the experiment: Familiarization with MATLAB and Functions in MATLAB

Objective: To familiarize the students with MATLAB

Software Requirement: MATLAB 2014

Theory:

Introduction to MATLAB

MATLAB is a high-level technical computing language equipped with a user-friendly interface. Its name stems from the words ***Matrix*** and ***Laboratory*** as it is based on the use of matrices. MATLAB is an extremely powerful tool useful for scientists and engineers from various disciplines. For example, MATLAB can be used in a wide range of applications, such as telecommunications, signal and image processing, control, mathematics, financial modelling, bioengineering, aeronautics, and many more.

M-Files

In order to write many commands that are executed all together, the program must be written in a text editor. In this editor, one can type all the needed commands to form a program, save the program, and execute it any time he or she wants. The text files are called *M-files* due to their suffice * .m.

There are two categories of M-files: the Scripts and the Functions.

Scripts

Scripts are the M-files with MATLAB commands. Their name must have a .m suffix. Scripts are suitable for solving the problems that require many commands. The advantage of the scripts is that they are implemented very easily.

Functions

Function are also M-files, That is, are files with extension .m and must be saved in the current Directory of MATLAB. The difference between functions and scripts is that a function accepts one or more input arguments and returns one or more output arguments. To declare that an M-file is a function the first line of the m file must contain the syntax definition. More specifically, the first line of the M-file must be of the form function[y1,y2,y3,…yn]=name{x1,x2,x3… xm}. The variable y1,y2,…yn are the outputs of the function while x1,x2,…xm are the input arguments. In case there is only one output, the square brackets are not necessary. The "name" specifies the name of the function. In order to execute a function, first the M-File is saved in Current Directory.

Useful Commands

Here we will learn and practice useful (when working with vectors and matrices) commands. As already discussed, the command sumreturns the sum of the elements of a vector. The command cumsumreturns a vector whose elements are the cumulative sum of the previous elements, the command prodis the product of the vector elements, while the command diffreturns a vector in which each element is given by its subtraction with the previous element. The command max and min return the largest and smallest elements of the vector, respectively, as well as their index. The command sortsorts the

vector elements in ascending (by default) or descending order. The command mean computes the mean value, while the command medianreturns the median value. All these commands are suitable also for matrices by slightly changing their syntax.

Lab Tasks:

1. Write a script file and execute.
2. Write a function file and execute

Discussion:

In this laboratory session, I delved into the fundamentals of signals and gained hands-on experience with the powerful MATLAB software. The focus of the lab was on establishing a foundational understanding of signal processing concepts and leveraging MATLAB's capabilities for analysis and visualization

Experiment no: 02

Experiment name: Observation of Matrix operations in MATLAB

Objective: To perform matrix additions, subtractions and multiplications in MATLAB

Software Requirement: MATLAB 2014

Theory:

Matrices

The MATLAB environment uses the term matrix to indicate a variable containing real or complex numbers arranged in a two-dimensional grid. An array is, more generally, a vector, matrix, or higher dimensional grid of numbers. All arrays in MATLAB are rectangular, in the sense that the component vectors along any dimension are all the same length.

Adding and Subtracting Matrices

Addition and subtraction of matrices is defined just as it is for arrays, element by element. Adding A to B, and then subtracting A from the result recovers B:

```
A = pascal(3);

B = magic(3);

X = A + B

X =

     9     2     7

     4     7    10

     5    12     8

Y = X - A

Y =

     8     1     6

     3     5     7

     4     9     2
```

Vector Products and Transpose

A row vector and a column vector of the same length can be multiplied in either order. The result is either a scalar, the inner product, or a matrix, the outer product :

```
u = [3; 1; 4];
```

```
v = [2 0 -1];
x = v*u

x =
     2

X = u*v

X =
     6     0    -3
     2     0    -1
     8     0    -4
```

Transposition turns a row vector into a column vector:

```
x = v'

x =
     2
     0
    -1
```

If x and y are both real column vectors, the product x*y is not defined, but the two products

```
x'*y
```

and

```
y'*x
```

are the same scalar. This quantity is used so frequently, it has three different names: inner product, scalar product, or dot product.

Multiplying Matrices

Multiplication of matrices is defined in a way that reflects composition of the underlying linear transformations and allows compact representation of systems of simultaneous linear equations. The matrix product C = AB is defined when the column dimension of A is equal to the row dimension of B, or when one of them is a scalar.

MATLAB uses a single asterisk to denote matrix multiplication. The next two examples illustrate the fact that matrix multiplication is not commutative; AB is usually not equal to BA:

```
X = A*B
```

```
X =

    15    15    15
    26    38    26
    41    70    39
```

```
Y = B*A
```

```
Y =

    15    28    47
    15    34    60
    15    28    43
```

A matrix can be multiplied on the right by a column vector and on the left by a row vector:

```
u = [3; 1; 4];
x = A*u
```

```
x =

     8

    17

    30
```

```
v = [2 0 -1];

y = v*B
```

```
y =

    12    -7    10
```

Identity Matrix

Generally accepted mathematical notation uses the capital letter I to denote identity matrices, matrices of various sizes with ones on the main diagonal and zeros elsewhere. These matrices have the property that AI = A and IA = A whenever the dimensions are compatible. The original version of MATLAB could not use I for this purpose because it did not distinguish between uppercase and lowercase letters and i already served as a subscript and as the complex unit. So an English language pun was introduced. The function

```
eye(m,n)
```

returns an m-by-n rectangular identity matrix and eye(n) returns an n-by-n square identity matrix.

Lab Tasks:

1. Execute addition and subtraction of matrics

2. Execute multiplication of matrics

3. Find out INVERSE MATRIX of Your Input A Matrix.

Discussion:

In this lab, we focused on matrix implementation and key operations—addition, subtraction, multiplication, and inversion. The hands-on exercises, executed error-free, demonstrated proficiency in utilizing MATLAB for efficient matrix manipulations. This foundational understanding lays the groundwork for applying matrices in various mathematical and engineering applications.