Computer science

Second Stage

Lec. one

Introduction to MATLAB

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MATLAB :

The Name MATLAB Stands For Matrix Laboratory. MATLAB is a fourth-generation high-level programming language and interactive environment for numerical computation, visualization and programming. MATLAB is developed by MathWorks.

Matlab was first released in 1984 as a commercial product by MathWorks Inc.

Their official website http://www.mathworks.com.

It allows matrix manipulations; plotting of functions and data; implementation of algorithms; creation of user interfaces; interfacing with programs written in other languages, including C, C++, Java, and FORTRAN; analyze data; develop algorithms ;and create models and applications.

It has numerous built-in commands and math functions that help you in mathematical calculations, generating plots, and performing numerical methods.

MATLAB's Power of Computational Mathematics:

MATLAB is used in every facet of computational mathematics. Following are some commonly used mathematical calculations where it is used most commonly:

1. Dealing with Matrices and Arrays
2. 2-D and 3-D Plotting and graphics
3. Linear Algebra
4. Algebraic Equations
5. Non-linear Functions
6. Statistics
7. Data Analysis

8. Calculus and Differential Equations
9. Numerical Calculations
10. Integration
11. Transforms
12. Curve Fitting
13. Various other special functions

Features of MATLAB:

Following are the basic features of MATLAB:

1. It is a high-level language for numerical computation, visualization and application development.
2. It also provides an interactive environment for iterative exploration, design and problem solving.
3. It provides vast library of mathematical functions for linear algebra, statistics ,Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations.
4. It provides built-in graphics for visualizing data and tools for creating custom plots.
5. MATLAB's programming interface gives development tools for improving code quality, maintainability, and maximizing performance.
6. It provides tools for building applications with custom graphical interfaces.
7. It provides functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET and Microsoft Excel.

Applications of MATLAB:

MATLAB is widely used in various fields, including:

•Electrical and Electronic Engineering: for circuit analysis, signal processing, and control system design.

•Mechanical Engineering: for studying vibrations, simulating dynamic systems, and stress analysis.

•Artificial Intelligence and Machine Learning: for building predictive models, data classification, and improving smart systems.

•Physics and Applied Mathematics: for solving differential equations, plotting functions, and analyzing mathematical systems.

•Biomedical Fields: for medical image processing and analyzing biological signals like ECG and EEG

Using MATLAB in Medical Physics:

Medical Image Processing: Enhances images like MRI and CT scans, - .removes noise, and identifies Important regions using advanced techniques

Biological Data Analysis: Analyzes signals such as ECG and EEG to - .understand physiological changes accurately

Simulation and Modeling: Simulates the behavior of medical devices and - .models radiation spread in the human body using tools like Simulink

Artificial Intelligence: Trains models to detect tumors or diseases from -
.medical images using deep learning.

- Quality Assurance: Helps check the performance of medical devices and analyze test results automatically and precisely.

Starting MATLAB

Matlab window

After logging into your account, you can enter MATLAB by double-clicking on the MATLAB shortcut icon (MATLAB) on your Windows desktop. When you start MATLAB, a special window called the MATLAB desktop appears. The desktop is a window that contains other windows. The major tools within or accessible from the desktop are:

1. Current Directory: To view, open, search for, and make changes to MATLAB related directories and files.
2. Command Window: This is the main area where commands can be entered at the command line. It is indicated by the command prompt (>>).
3. Workspace: Shows the name of each variable, its value, and the Min and Max entry if the variable is a matrix.
4. Command History: This panel shows or rerun commands that are entered at the command line.
5. Editor : Used for writing and editing scripts and longer programs.

-Allows saving code files with the .m extension and running them later.

6. Toolstrip :Contains buttons and tools that provide quick access to common functions such as saving, running, plotting, etc.

7- Search Documents Window in MATLAB: This window is used to search inside project files, such as .m code files or text files. Instead of opening each file manually, you can type a word or function name, and MATLAB will search for it across all files in the current folder.

How does it help?

•Saves time: It searches all files at once.

•Shows results clearly: Displays the file name, line number, and the content where the word appears.

• Easy navigation: You can click on any result to jump directly to its location in the code.

How to use it?

1. Open the Search Documents window from the toolbar or press

Ctrl + Shift + F.

2.Type the word or function you want to find.

3. Press Enter, and the results will appear in a separate window.

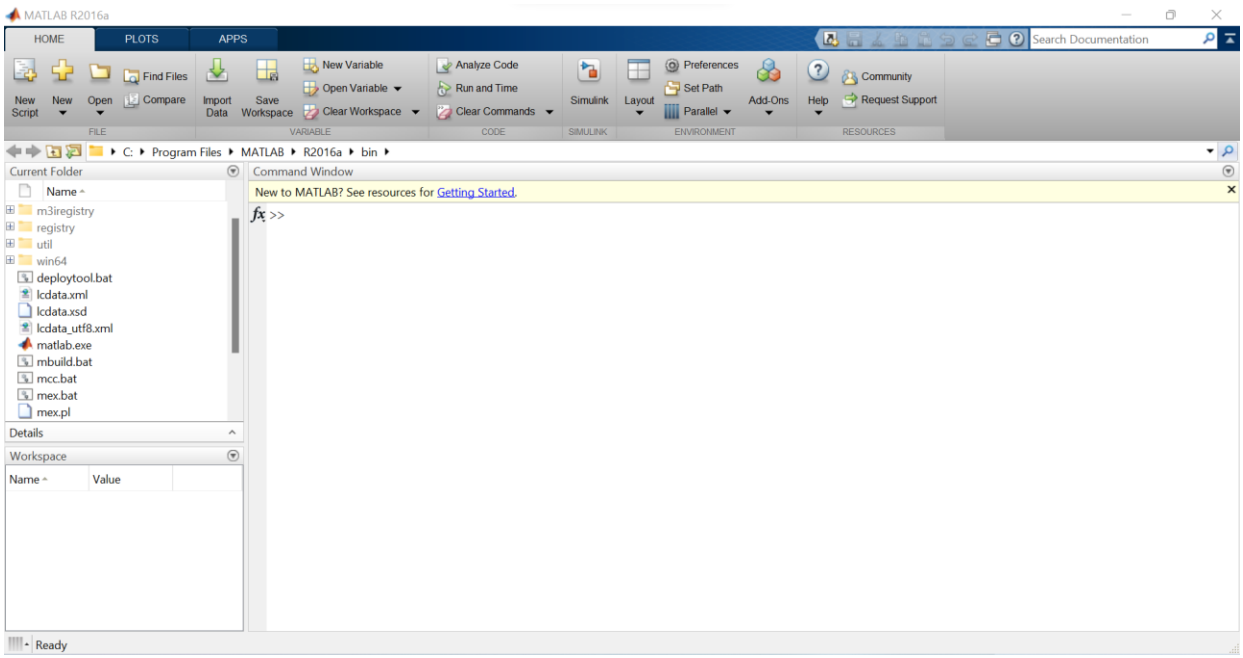

Figure 1: MATLAB interface

Using MATLAB as a calculator:

MATLAB is not only a powerful programming environment—it can also be used as a scientific calculator. In the Command Window, users can perform a wide range of mathematical operations instantly. Below are examples that demonstrate how MATLAB handles basic arithmetic, functions, matrices, and more.

For example, let's suppose you want to calculate

the expression, 5 + 7 × 2. You type it at the prompt command (>>) as follows,

>>5+7*2

Ans=

19

You will have noticed that if you do not specify an output variable, MATLAB uses a default variable ans, short for answer, to store the results of the current calculation. Note that the variable ans is created (or overwritten, if it is already existed). To avoid this, you may assign a value to a variable or output argument name. For example,

```
>> L = 5+7*2

L=

19
```

will result in L being given the value 5 + 7 × 2 = 19. This variable name can always be used to refer to the results of the previous computations. Therefore, computing 4L will result in

```
>>L*4

ans=

76
```

Ex: What is the result of adding 25 and 17 in MATLAB?

```
>> 25 + 17

ans  =

   42
```

EX: What is the result of subtracting 45 from 100?

```
>> 100 - 45

ans  =

   55
```

EX:If x=12 and Y=8 Calculate the product of x and y using MATLAB.

```
>> x=12,y=8,x*y
x=
12
y=
8
ans =
   96
```

Ex:What is the result of 144 divided by 12 in MATLAB?

```
>> 144 / 12
= ans
   12
```

EX:Use MATLAB to calculate 5 raised to the power of 3 and the square root of 49.

```
>> 5^3
= ans
125
```

```
>>sqrt(49)
ans  =
   7
```

MATLAB provides a wide range of built-in mathematical functions that allow users to perform advanced calculations easily. Functions are called by writing their name followed by parentheses (), with the input placed inside.

General Syntax:

$$\gg function\_name(input);$$

sqrt(x)	Square root
log(x)	Natural logarithm
log10(x)	Logarithm base 10
exp(x)	Exponential (e^x)
sin(x)	Sine of angle
cos(x)	Cosine of angle
tan(x)	Tangent of angle
abs(x)	Absolute value
round(x)	Round to nearest integer
floor(x)	Round down
ceil(x)	Round up

Table1 :common Matlab mathematical function

Review questions

1.What is the full meaning of the term MATLAB?

2. What is the main function of the Command Window in MATLAB?

3. In MATLAB, define two variables:

a = 10

b = 20

Write an expression to calculate the result of adding a and b, then dividing the sum by 2.?

4.What does the Workspace window display in MATLAB?

5. what does the tool strip in Matlab contain?