جامعة المستقبل
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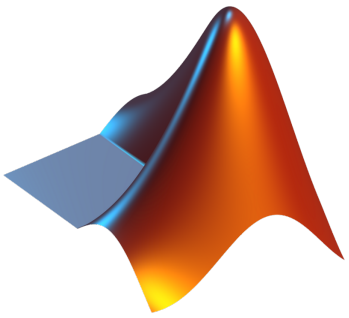

**1st class**

**2024- 2025**

# Mathematics

Practical

# MATLAB

## Lecture 1

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الرياضيات الاساسية: المرحلة الاولى

**مادة الرياضيات**

**ماتلاب**

المحاضرة الاولى

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# 1 Introduction to MATLAB for Numerical Computations

MATLAB (short for MATrix LABoratory) is a high-level programming environment widely used for numerical computations, data analysis, algorithm development, and visualization. It is especially powerful for working with matrices and arrays, making it ideal for scientific and engineering applications.

## 1.1 Matlab Programming

A computer program is a sequence of instructions in a given language that achieves a specific task.

MATLAB programming is centered around matrix and array manipulations, offering an extensive collection of built-in functions and toolboxes for numerical computation, algorithm development, data analysis, and visualization.

## 1.2 Understanding the MATLAB Environment

MATLAB development IDE can be launched from the icon created on the desktop. Understanding the MATLAB environment is essential for efficiently using its features. Below are the key components of the MATLAB environment.

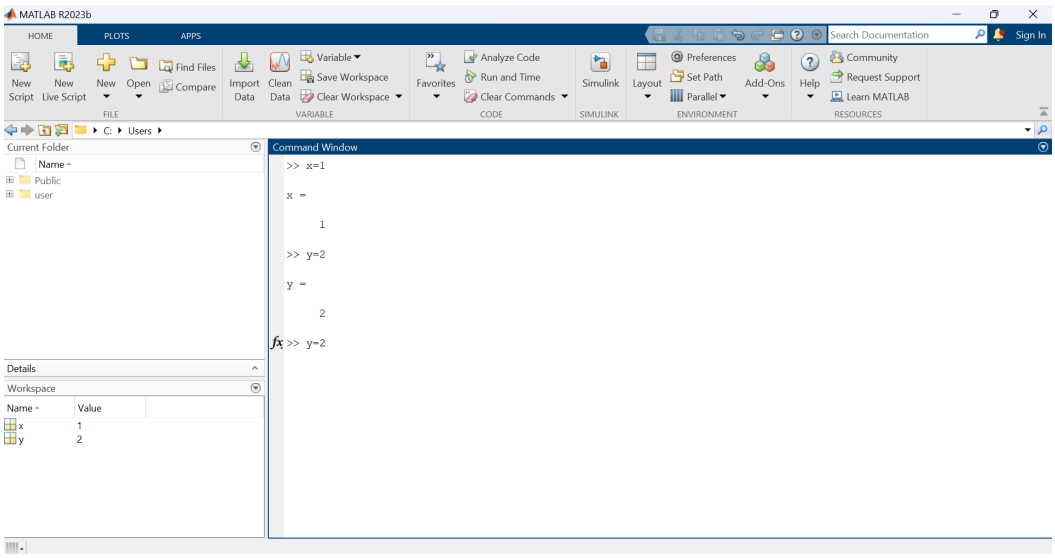


Figure 1: The Main Working Window in Matlab

### 1.2.1 MATLAB Desktop Components

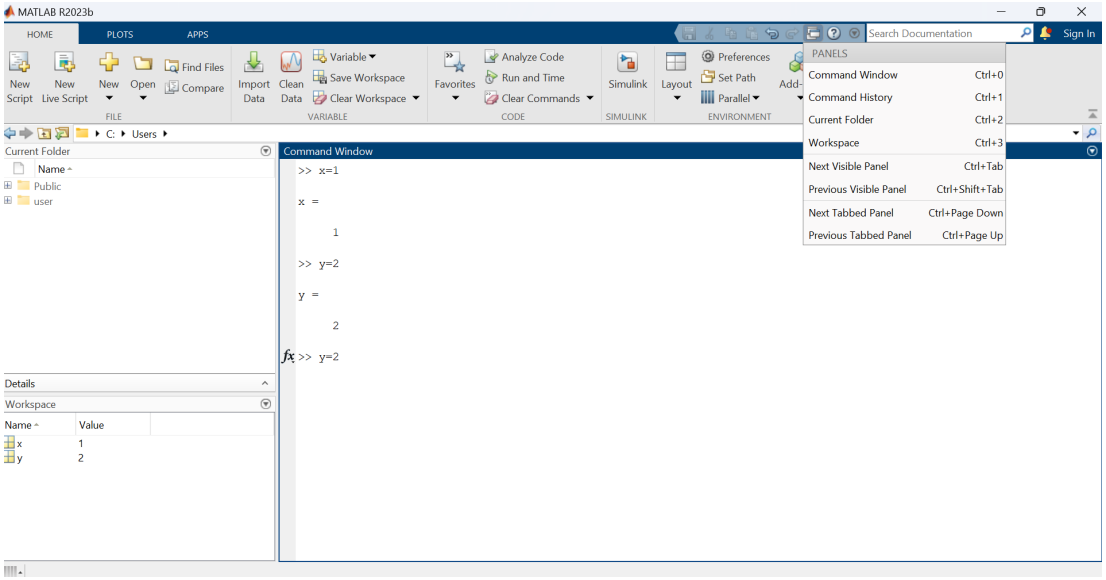


Figure 2: MATLAB Desktop Components: Switch Window

1. **Command Window:**

   - The Command Window is where you can type and execute MATLAB commands interactively. For example, entering a calculation like $3+4$ will immediately show the result.
   - You can also run scripts and functions from the Command Window by typing their names.


Figure 3: Command Window

2. **Workspace:**

   - The Workspace shows all the variables currently in memory. You can view their values and details like size and type.
   - You can double-click a variable in the Workspace to open the Variable Editor and inspect or modify its contents.

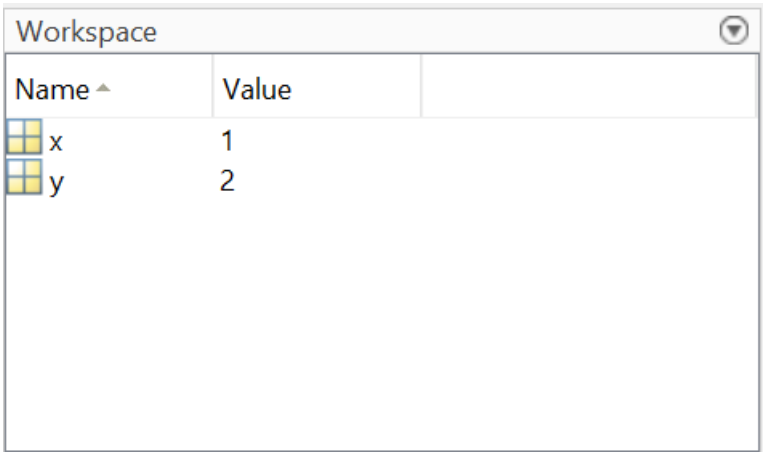


Figure 4: Workspace

3. **Command History:** This window stores all the commands you have previously entered in the Command Window. You can easily re-execute commands from here by double-clicking them.

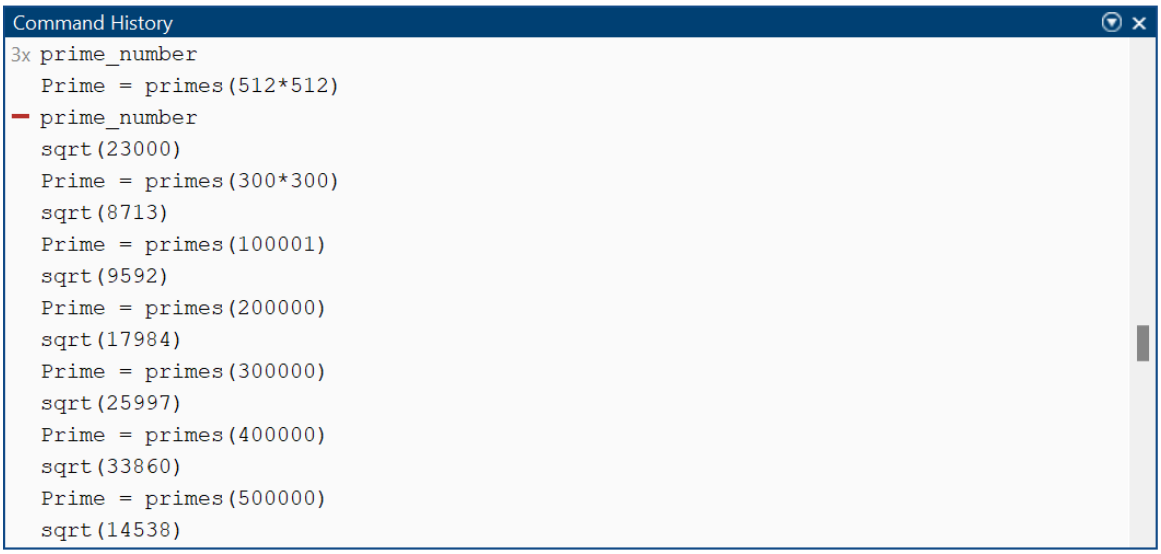


Figure 5: Command History

4. **Current Folder:** The Current Folder window displays the files and folders in your working directory. This is the default location where MATLAB will save or look for scripts, functions, and data files.

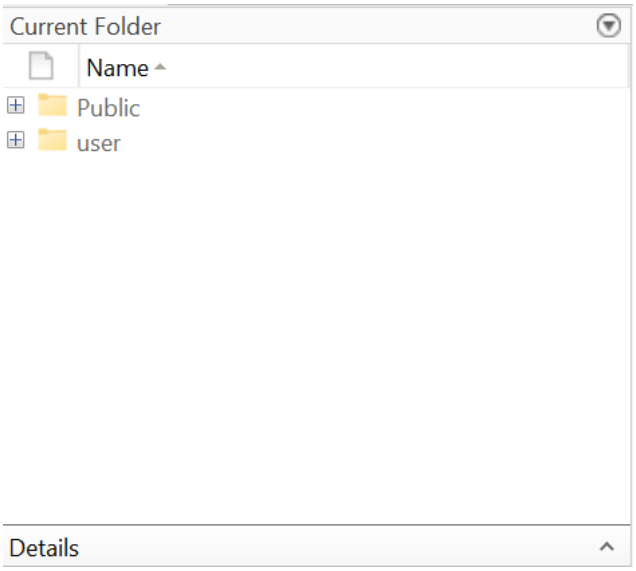


Figure 6: Current Folder

# 2 Basic Syntax

MATLAB has a simple and intuitive syntax designed for numerical computing and matrix manipulations. Here's an overview of the basic syntax rules and commands to get started with MATLAB.

## 2.1 Hands on Practice

Type a valid expression, for example,

```
5+5
%And press ENTER. When you click the Execute button, or type Ctrl+E, MATLAB ...
executes it immediately and the result returned is:
ans =
    10
```

**Let us take up few more examples:**

```
3^2 %3 raised to the power of 2
%Press ENTER.
ans =
     9
```

**Another example,**

```
sin(pi/2) %sine of angle 90 (π/2)
%Press ENTER.
ans =
     1
```

**Another example,**

```
7/0 %Divide by zero
%Press ENTER.
ans =
     Inf %Warning: division by zero
```

**Another example,**

```
732*20.3
%Press ENTER.
ans =
     1.4860e+04
```

MATLAB provides some special expressions for some mathematical symbols, like $\pi$, $\infty$, $\sqrt{a}$ etc. Nan stands for 'not a number'.

| Function | Description | Syntax |
|---|---|---|
| sin(x) | Sine of x | $\sin(x)$ |
| cos(x) | Cosine of x | $\cos(x)$ |
| tan(x) | Tangent of x | $\tan(x)$ |
| asin(x) | Inverse sine (arcsin) of x | $\sin^{-1}(x)$ |
| acos(x) | Inverse cosine (arccos) of x | $\cos^{-1}(x)$ |
| atan(x) | Inverse tangent (arctan) of x | $\tan^{-1}(x)$ |
| exp(x) | Exponential function of x | $e^x$ |
| log(x) | Natural logarithm of x | $\log(x)$ |
| log10(x) | Base-10 logarithm of x | $\log_{10}(x)$ |
| sqrt(x) | Square root of x | $\sqrt{x}$ |
| abs(x) | Absolute value of x | $\|x\|$ |
| floor(x) | Round towards negative infinity | $floor(x)$ |
| ceil(x) | Round towards positive infinity | $ceil(x)$ |
| round(x) | Round to nearest integer | $round(x)$ |
| sinh(x) | Hyperbolic sine of x | $\sinh(x)$ |
| cosh(x) | Hyperbolic cosine of x | $\cosh(x)$ |
| tanh(x) | Hyperbolic tangent of x | $\tanh(x)$ |
| asinh(x) | Inverse hyperbolic sine of x | $sinh^{-1}(x)$ |
| acosh(x) | Inverse hyperbolic cosine of x | $\cosh^{-1}(x)$ |
| atanh(x) | Inverse hyperbolic tangent of x | $\tanh^{-1}(x)$ |

Table 1: Table of Special Functions in MATLAB

| Operator | Description | Example |
|---|---|---|
| + | Addition | $a + b$ |
| - | Subtraction | $a - b$ |
| * | Multiplication | $a * b$ |
| / | Right Division | $\frac{a}{b}$ |
| .+ | Element-wise Addition | $A. + B$ |
| .- | Element-wise Subtraction | $A. - B$ |
| .* | Element-wise Multiplication | $A. * B$ |
| ./ | Element-wise Right Division | $A./B$ |

Table 2: Table of Arithmetic Operators in MATLAB

## 2.2 Variables

In MATLAB environment, every variable is an array or matrix. You can assign variables in a simple way.

Variables are used to store data for manipulation and analysis. Here's a brief overview of how to create and use variables in MATLAB:

### 2.2.1 Creating Variables

You can create variables by simply assigning a value to a name. Variable names must start with a letter, followed by letters, digits, or underscores.

```
    x = 5 %Numeric variable
%Press ENTER
 x =

        5
 y = sin(67) %Numeric variable

%Press ENTER
 y =

        -0.8555
 name = 'MATLAB' %String variable

%Press ENTER
 name =

        'MATLAB'
 A = [1, 2, 3; 4, 5, 6] %Matrix variable

%Press ENTER
 A =
        1   2   3
        4   5   6
%Accessing Variables: You can access the value of a variable by simply typing its ...
name.
y
%Press ENTER
y =
        -0.8555
```

### 2.2.2 Variable Types

MATLAB supports various data types, including:

- **Numeric:** Scalars, vectors, and matrices.
- **Strings:** Character arrays and string arrays.
- **Logical:** Boolean values (true/false).
- **Cells:** Cell arrays for heterogeneous data.
- **Structures:** Data structures for complex data types.

### 2.2.3 Clearing Variables

You can remove variables from the workspace using the clear command.

```
    clear  x
%Press ENTER
 %Removes variable x

 clear  all

%Press ENTER
 %Clears  all  variables
```

**Remark.** The (clc) command in MATLAB is used to clear the Command Window. It does not delete variables from memory, but it removes all the text and results from the Command Window, giving you a fresh, clean workspace for the next set of outputs.

### 2.2.4 Checking Variable Information

Use the (whos) command to see the variables in the workspace along with their sizes and types.

```
whos %See all  variables
```

**Remark.** In MATLAB, the semicolon (;) has two main purposes:

1. **Suppress Output:** When you use a semicolon at the end of a statement or command, MATLAB will execute the command but suppress the output in the Command Window. For example:

```
x = 5; %The value is assigned, but no output is displayed.
%Without the semicolon:

x =

     5
```

2. **Separate Commands on the Same Line:** You can use a semicolon to separate multiple statements or commands on the same line. For example:

```
a = 3; b = 7; c = a + b;
%This executes all three commands in sequence, a, b, and c.
```