

Mathematics 3

Lecture 9

MAT 132

Introduction to MATLAB

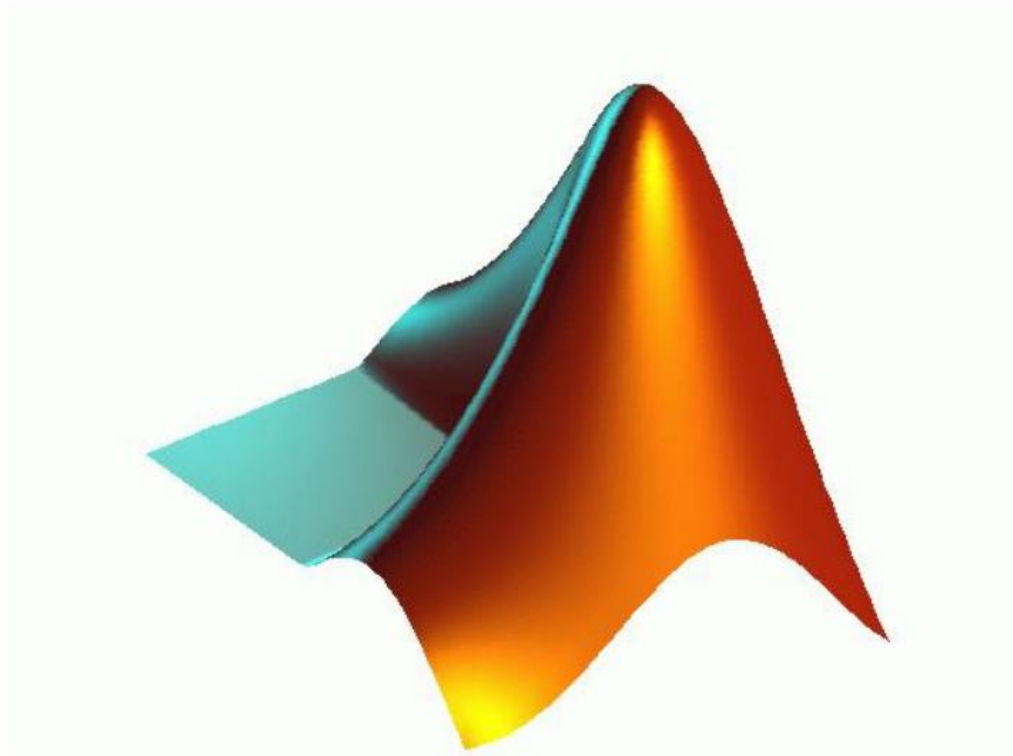
Prepared by
Dr. Israa Lewaa

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1- Introduction to MATLAB

The language of Technical Computing



- **MAT**rix **LAB**oratory- Everything is represented by matrices!
- It is a program for doing Numerical Computation.

- Also used widely as a programming language to develop tools for Machine Learning.

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- Large **toolbox** of numeric/image library functions.
- Very useful for **displaying, visualizing** data.
- It is an Interpreter, not as fast as compiled code.

- **High-level:** focus on algorithm structure, not on low-level details.
- Allows quick prototype development of algorithms.

<https://getintopc.com/software/math/mathworks-matlab-r2021a-free-download-8853012/>

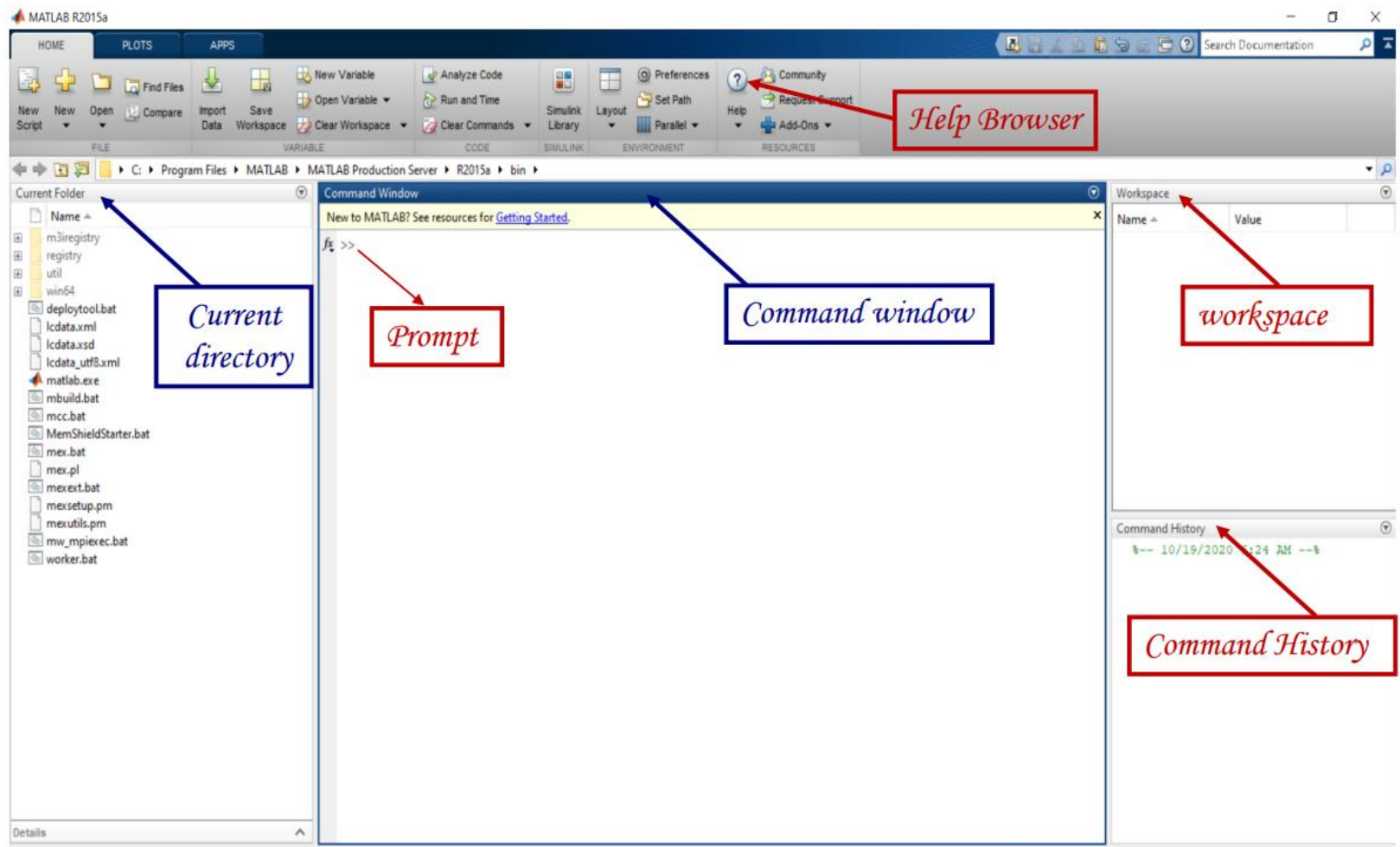
- As we mentioned earlier, the following presentations are designed to get you started quickly in MATLAB.
- The presentations are intended to make you familiar with the basics of MATLAB.

- We urge you to complete the exercises given at the end of each presentation.

The goal of this minimum session (also called starting and exiting sessions) is to learn the first steps:

- How to log on
- Recall MATLAB
- Do a few simple calculations
- How to quit MATLAB

MATLAB Interface



- ❑ After logging into your account, you can enter MATLAB by double-clicking on the MATLAB shortcut icon (MATLAB R2015a) 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:**

- ☐ The Command Window
- ☐ The Command History
- ☐ The Workspace
- ☐ The Current Directory
- ☐ The Help Browser
- ☐ The Start button

Extra Practice – Example 1

let's suppose you want to calculate the expression,

$$1 + 2 \times 3$$

Hint: Use MATLAB

```
>> 1 + 2 * 3
```

MATLAB Output:

```
ans =
```

```
7
```

SYMBOL	OPERATION	EXAMPLE
+	Addition	$2 + 3$
-	Subtraction	$2 - 3$
*	Multiplication	$2 * 3$
/	Division	$2/3$

- Assignment = $a = b$ (assign b to a)
- Addition + $a + b$
- Subtraction - $a - b$
- Multiplication * or .* $a*b$ or $a.*b$
- Division / or ./ a/b or $a./b$
- Power ^ or .^ a^b or $a.^b$
- A “.” means element wise operation

To end your MATLAB session, type **quit** in the Command Window, or select

File → Exit MATLAB

In the desktop main menu.

❖ Creating MATLAB variables

MATLAB variables are created with an assignment statement. The syntax of variable assignment is

variable name = a value (or an expression)

❖ For example:

>> x = expression

where expression is a combination of numerical values, mathematical operators, variables, and function calls. On other words, expression can involve:

- Manual entry
- Built-in functions
- User-defined functions

❖ Overwriting variable

Once a variable has been created, it can be reassigned. In addition, if you do not wish to see the intermediate results, you can suppress the numerical output by putting a semicolon (;) at the end of the line.

Overwriting Example

```
>> t = 5;  
>> t = t + 1
```

MATLAB Output:

```
t =  
6
```

❖ Error messages

If we enter an expression incorrectly, MATLAB will return an error message. For example, in the following, we left out the multiplication sign, *****, in the following expression

Error Messages Example

```
>> x = 10;  
>> 5x
```

MATLAB Output:

```
??? 5x
```

❖ Making Correction

To make corrections, we can, of course retype the expressions. But if the expression is lengthy, we make more mistakes by typing a second time. A previously typed command can be recalled with the up-arrow key ↑.

When the command is displayed at the command prompt, it can be modified if needed and executed.

Extra Practice – Example 2

```
>> 5x
```

```
5x
```

```
|
```

Error: Unexpected MATLAB expression.

Did you mean:

```
>> 5*x
```

❖ Controlling the hierarchy of operations or precedence

Let's consider the previous arithmetic operation, but now we will include parentheses.
For example, $1 + 2 \times 3$ will become $(1 + 2) \times 3$

```
>> (1 + 2) * 3
```

MATLAB Output:

```
ans =
```

```
9
```

```
>> x = 1 + 2 * 3
```

MATLAB Output:

```
x =
```

```
7
```

PRECEDENCE	MATHEMATICAL OPERATIONS
First	The contents of all parentheses are evaluated first, starting from the innermost parentheses and working outward.
Second	All exponentials are evaluated, working from left to right
Third	All multiplications and divisions are evaluated, working from left to right
Fourth	All additions and subtractions are evaluated, starting from left to right

most computer programs. For operators of *equal* precedence, evaluation is from *left to right*.

Solve the following expression on MATLAB:

$$\frac{1}{2 + 3^2} + \frac{4}{5} \times \frac{6}{7}$$

Extra Practice – Example 3 Solution

```
>> 1/(2 + 3^2) + 4/5 * 6/7
```

MATLAB Output:

```
ans =
```

```
0.7766
```

❖ Controlling appearance of floating point number

MATLAB by default displays only 4 decimals in the result of the calculations, for example -163.6667, as shown in above examples. However, MATLAB does numerical calculations in double precision, which is 15 digits. The command `format` controls how the results of computations are displayed. Here are some examples of the different formats together with the resulting outputs.

>> format short

>> x = -163.6667

If we want to see all 15 digits, we use the command format long

>> format long

>> x = -1.6366666666666667e+002

❖ Entering multiple statements per line

- It is possible to enter multiple statements per line. Use commas (,) or semicolons (;) to enter more than one statement at once. Commas (,) allow multiple statements per line without suppressing output.

```
>> a=7; b=cos(a), c=cosh(a)
```

```
b =
```

```
0.6570
```

```
c =
```

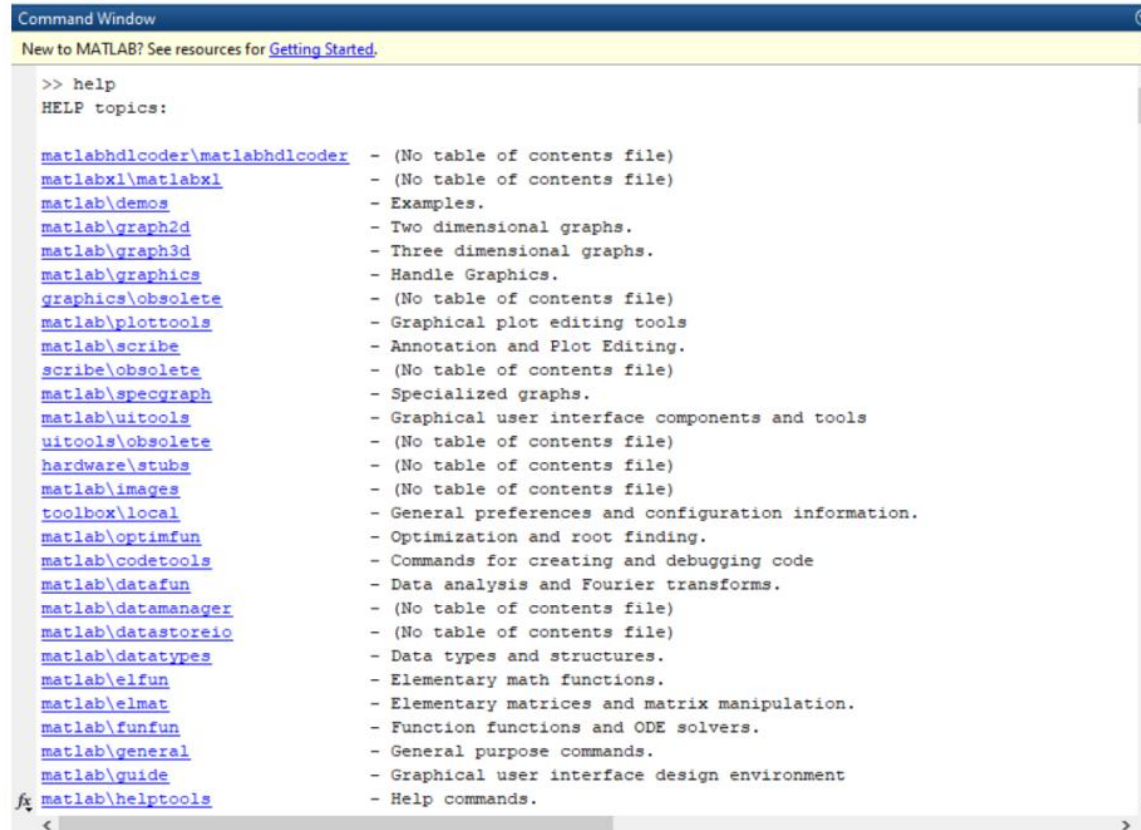
```
548.3170
```

Here are few additional useful commands:

- ✓ To clear the Command Window, type `clc`
- ✓ To abort a MATLAB computation, type `ctrl-c`
- ✓ To continue a line, type `. . .`

- To view the online documentation, select **MATLAB Help** from Help menu or **MATLAB Help** directly in the Command Window.

>> help



```
Command Window
New to MATLAB? See resources for Getting Started.

>> help
HELP topics:

matlabhdldcoder\matlabhdldcoder - (No table of contents file)
matlabxl\matlabxl - (No table of contents file)
matlab\demos - Examples.
matlab\graph2d - Two dimensional graphs.
matlab\graph3d - Three dimensional graphs.
matlab\graphics - Handle Graphics.
graphics\obsolete - (No table of contents file)
matlab\plottools - Graphical plot editing tools
matlab\scribe - Annotation and Plot Editing.
scribe\obsolete - (No table of contents file)
matlab\specgraph - Specialized graphs.
matlab\uitools - Graphical user interface components and tools
uitools\obsolete - (No table of contents file)
hardware\stubs - (No table of contents file)
matlab\images - (No table of contents file)
toolbox\local - General preferences and configuration information.
matlab\optimfun - Optimization and root finding.
matlab\codetools - Commands for creating and debugging code
matlab\datafun - Data analysis and Fourier transforms.
matlab\datamanager - (No table of contents file)
matlab\datastoreio - (No table of contents file)
matlab\datatypes - Data types and structures.
matlab\elfun - Elementary math functions.
matlab\elmat - Elementary matrices and matrix manipulation.
matlab\funfun - Function functions and ODE solvers.
matlab\general - General purpose commands.
matlab\guide - Graphical user interface design environment
fx matlab\helptools - Help commands.
```

- To view the online documentation, select **MATLAB Help** from Help menu or **MATLAB Help** directly in the Command Window.

>> lookfor inverse



```
Command Window
New to MATLAB? See resources for Getting Started.

>> lookfor inverse
ifft          - Inverse discrete Fourier transform.
ifft2         - Two-dimensional inverse discrete Fourier transform.
ifftn         - N-dimensional inverse discrete Fourier transform.
ifftshift     - Inverse FFT shift.
acos          - Inverse cosine, result in radians.
acosd         - Inverse cosine, result in degrees.
acosh         - Inverse hyperbolic cosine.
acot          - Inverse cotangent, result in radian.
acotd         - Inverse cotangent, result in degrees.
acoth         - Inverse hyperbolic cotangent.
acsc          - Inverse cosecant, result in radian.
acscd         - Inverse cosecant, result in degrees.
acsch         - Inverse hyperbolic cosecant.
asec          - Inverse secant, result in radians.
asecd         - Inverse secant, result in degrees.
asech         - Inverse hyperbolic secant.
asin          - Inverse sine, result in radians.
asind         - Inverse sine, result in degrees.
asinh         - Inverse hyperbolic sine.
atan          - Inverse tangent, result in radians.
atan2         - Four quadrant inverse tangent.
atan2d        - Four quadrant inverse tangent, result in degrees.
atand         - Inverse tangent, result in degrees.
atanh         - Inverse hyperbolic tangent.
invhilb       - Inverse Hilbert matrix.
ipermute      - Inverse permute array dimensions.
inv           - Matrix inverse.
pinv          - Pseudoinverse.
betaincinv    - Inverse incomplete beta function.
erfcinv       - Inverse complementary error function.
erfinv        - Inverse error function.
```

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Thank You