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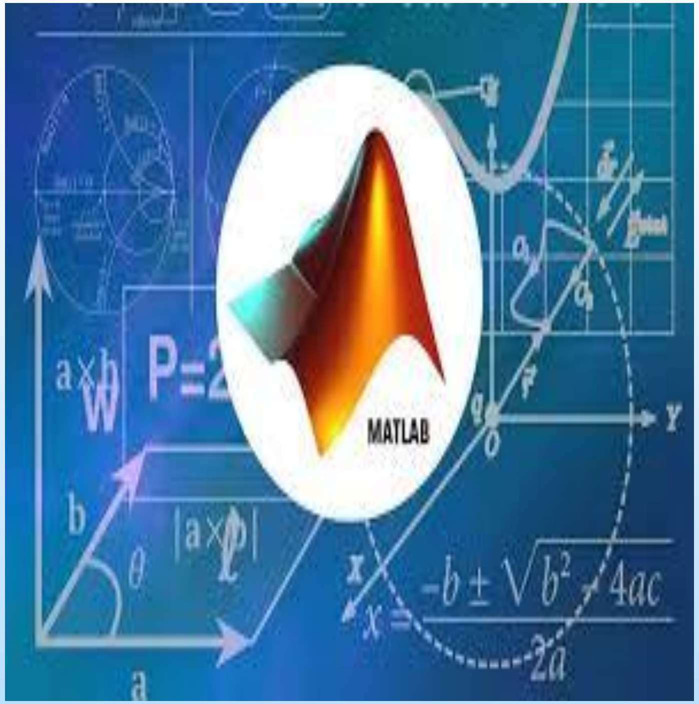
MATLAB®



Course of:

Computer science 03
MATLAB

Lecturer: Dr. O. Zeghba

Directed to second year engineering students

2024/2025

1. OVERVIEW

MATLAB (matrix laboratory) is a fourth-generation high-level programming language and interactive environment for numerical computation, visualization and programming.

MATLAB is developed by MathWorks.

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:

- Dealing with Matrices and Arrays
- 2-D and 3-D Plotting and graphics
- Linear Algebra
- Algebraic Equations
- Non-linear Functions
- Statistics
- Data Analysis
- Calculus and Differential Equations
- Numerical Calculations
- Integration
- Transforms
- Curve Fitting
- Various other special functions

Features of MATLAB

Following are the basic features of MATLAB:

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

Uses of MATLAB

MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math and all engineering streams. It is used in a range of applications including:

- signal processing and Communications
- image and video Processing
- control systems
- test and measurement
- computational finance
- computational biology

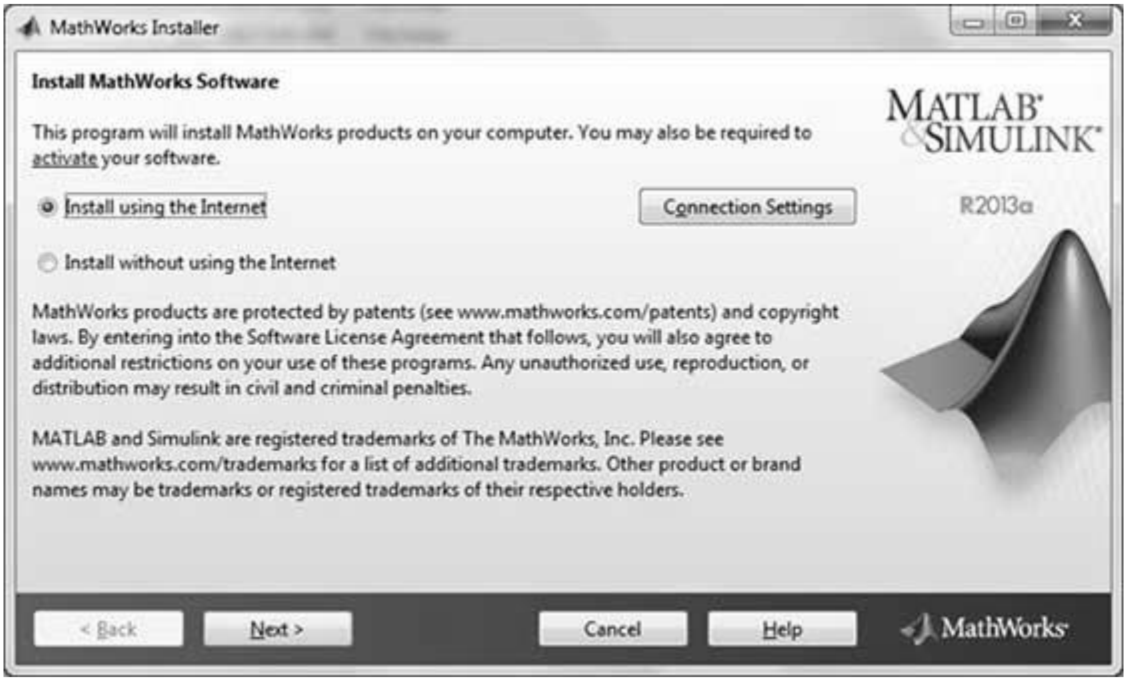
2. ENVIRONMENT

Local Environment Setup

Setting up MATLAB environment is a matter of few clicks. The installer can be downloaded from http://in.mathworks.com/downloads/web_downloads:

MathWorks provides the licensed product, a trial version and a student version as well. You need to log into the site and wait a little for their approval.

After downloading the installer the software can be installed through few clicks.



MathWorks Installer

Install MathWorks Software

This program will install MathWorks products on your computer. You may also be required to activate your software.

● Install using the Internet

○ Install without using the Internet

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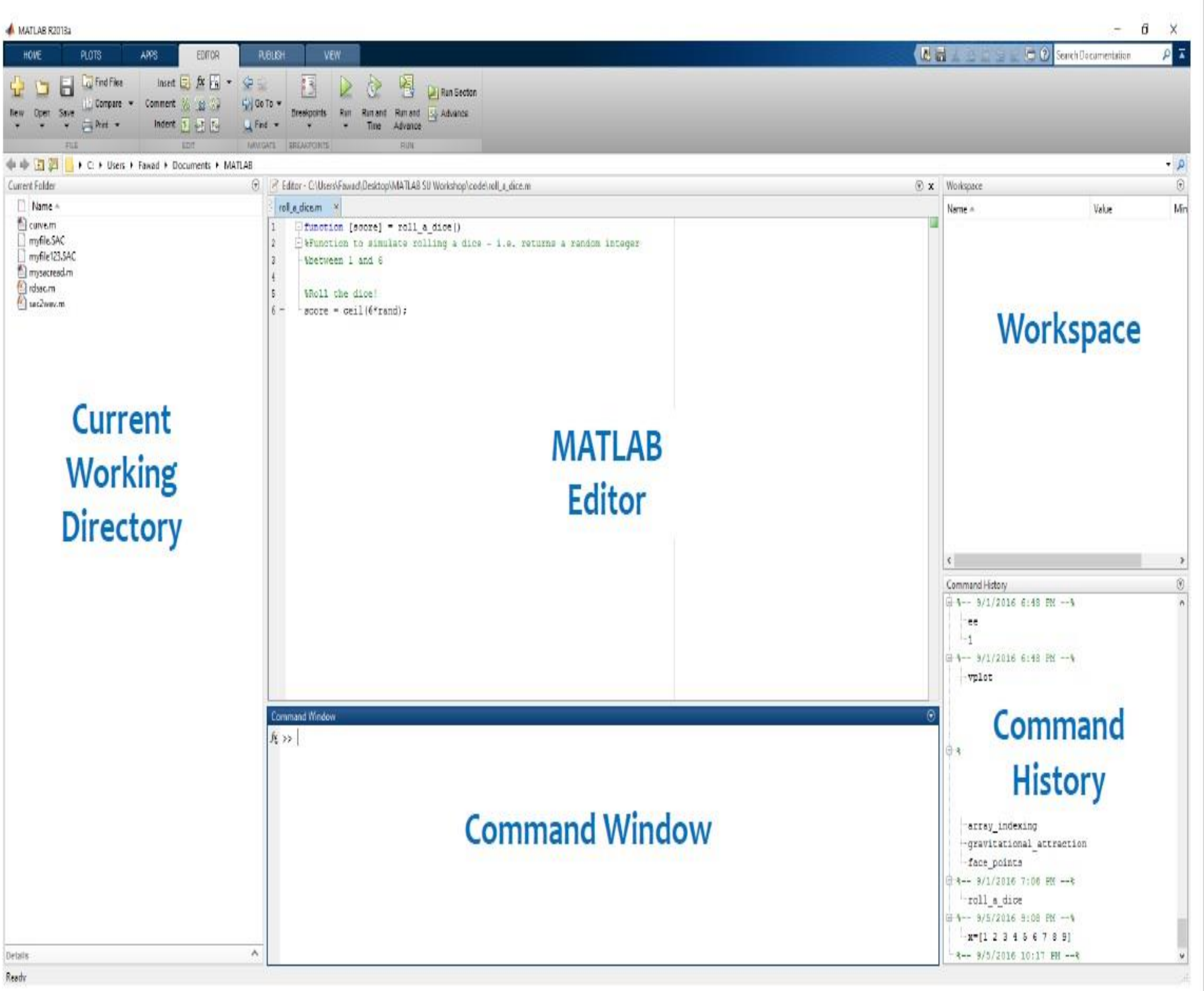
Understanding the MATLAB Environment

MATLAB development IDE can be launched from the icon created on the desktop. The main working window in MATLAB is called the desktop. When MATLAB is started, the desktop appears in its default layout:



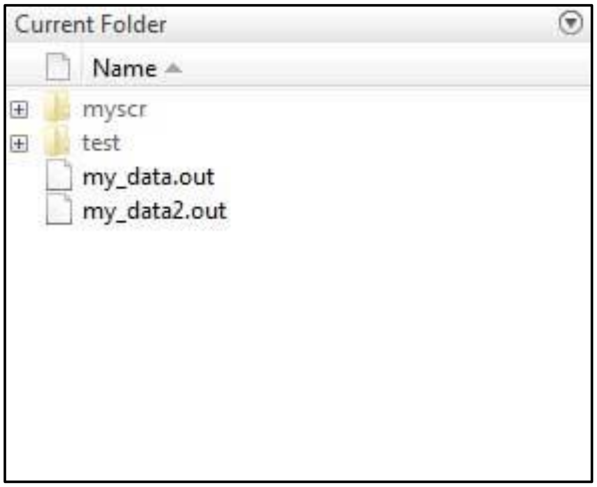
```
function [score] = roll_a_dice()
%Function to simulate rolling a dice - i.e. returns a random integer
%between 1 and 6

%Roll the dice!
score = ceil(6*rand);
```

```
>>
```

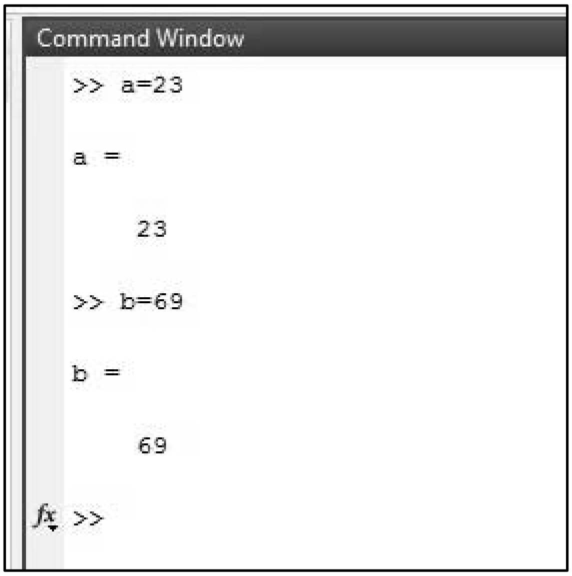
```
%-- 9/1/2016 6:48 PM --%
ee
1
%-- 9/1/2016 6:48 PM --%
vplot
%
array_indexing
gravitational_attraction
face_points
%-- 9/1/2016 7:06 PM --%
roll_a_dice
%-- 9/5/2016 9:08 PM --%
x=[1 2 3 4 5 6 7 8 9]
%-- 9/5/2016 10:17 PM --%
```

The desktop has the following panels:

Current Folder - This panel allows you to access the project folders and files.

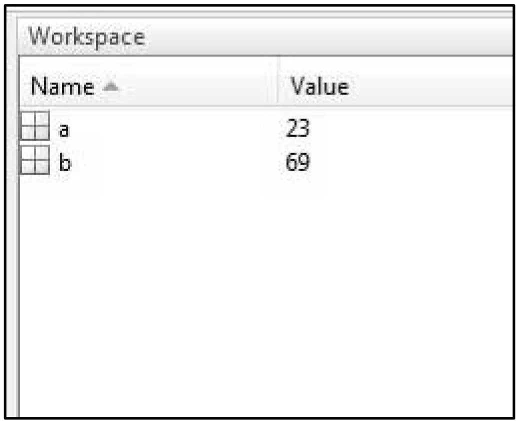


Command Window - This is the main area where commands can be entered at the command line. It is indicated by the command prompt (>>).



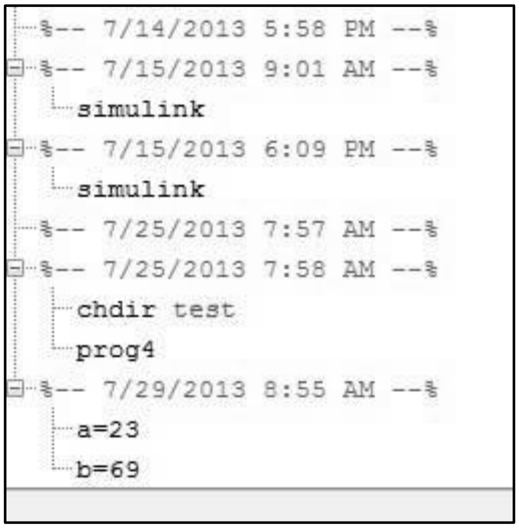
```
>> a=23

a =

    23

>> b=69

b =

    69

>>
```

Workspace - The workspace shows all the variables created and/or imported from files.



Name	Value
a	23
b	69

Command History - This panel shows or rerun commands that are entered at the command line.



```
%-- 7/14/2013 5:58 PM --%
%-- 7/15/2013 9:01 AM --%
   simulink
%-- 7/15/2013 6:09 PM --%
   simulink
%-- 7/25/2013 7:57 AM --%
%-- 7/25/2013 7:58 AM --%
   chdir test
   prog4
%-- 7/29/2013 8:55 AM --%
   a=23
   b=69
```

Set up GNU Octave

If you are willing to use Octave on your machine (Linux, BSD, OS X or Windows), then kindly download latest version from http://www.gnu.org/software/octave/download.html. You can check the given installation instructions for your machine

3. BASIC SYNTAX

MATLAB environment behaves like a super-complex calculator. You can enter commands at the >> command prompt.

MATLAB is an interpreted environment. In other words, you give a command and MATLAB executes it right away.

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
```

When you click the Execute button, or type Ctrl+E, MATLAB executes it immediately and the result returned is:

```
ans = 9
```

Another example,

```
sin(pi /2)    % sine of angle 90o
```

When you click the Execute button, or type Ctrl+E, MATLAB executes it immediately and the result returned is:

```
ans = 1
```

Another example,

```
7/0              % Divide by zero
```

When you click the Execute button, or type Ctrl+E, MATLAB executes it immediately and the result returned is:

```
ans = Inf

warning: division by zero
```

Another example,

```
732 * 20.3
```

When you click the Execute button, or type Ctrl+E, MATLAB executes it immediately and the result returned is:

```
ans =  1.4860e+04
```

MATLAB provides some special expressions for some mathematical symbols, like pi for п, Inf for ∞, i (and j) for √-1 etc. **Nan** stands for 'not a number'.

Use of Semicolon (;) in MATLAB

Semicolon (;) indicates end of statement. However, if you want to suppress and hide the MATLAB output for an expression, add a semicolon after the expression.

For example,

```
x = 3;

y = x + 5
```

When you click the Execute button, or type Ctrl+E, MATLAB executes it immediately and the result returned is:

```
y =  8
```

Adding Comments

The percent symbol (%) is used for indicating a comment line. For example,

```
x = 9     % assign the value 9 to x
```

You can also write a block of comments using the block comment operators % { and % }.

The MATLAB editor includes tools and context menu items to help you add, remove, or change the format of comments.

Commonly used Operators and Special Characters

MATLAB supports the following commonly used operators and special characters:

Operator	Purpose
+	Plus; addition operator.
-	Minus; subtraction operator.
*****	Scalar and matrix multiplication operator.
.*	Array multiplication operator.
^	Scalar and matrix exponentiation operator.
.^	Array exponentiation operator.
\	Left-division operator.
/	Right-division operator.

.	Array left-division operator.
./	Array right-division operator.
:	Colon; generates regularly spaced elements and represents an entire row or column.
( )	Parentheses; encloses function arguments and array indices; overrides precedence.
[ ]	Brackets; enclosures array elements.
.	Decimal point.
…	Ellipsis; line-continuation operator
,	Comma; separates statements and elements in a row
;	Semicolon; separates columns and suppresses display.
%	Percent sign; designates a comment and specifies formatting.
_	Quote sign and transpose operator.
._	Non-conjugated transpose operator.
=	Assignment operator.

Special Variables and Constants

MATLAB supports the following special variables and constants:

Name	Meaning
ans	Most recent answer.
eps	Accuracy of floating-point precision.
i,j	The imaginary unit √-1.
Inf	Infinity.
NaN	Undefined numerical result (not a number).
pi	The number π

Naming Variables

Variable names consist of a letter followed by any number of letters, digits or underscore.

MATLAB is **case-sensitive**.

Variable names can be of any length, however, MATLAB uses only first N characters, where N is given by the function **namelengthmax**.

Saving Your Work

The **save** command is used for saving all the variables in the workspace, as a file with .mat extension, in the current directory.

For example,

```
save myfile
```

You can reload the file anytime later using the **load** command.

```
load myfile
```