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Computer Programming and Programming Languages

Laboratory guide

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Content

1. Introduction to MATLAB

1.1. What is MATLAB and why do we use it?

MATLAB is an easy-to-use platform through which one can both learn programming and use it for solving simple or complex problems.

During this class we will cover the basic elements of MATLAB, those that are related to operating, programming techniques and combining these two to solve problems from mathematics, physics, thermodynamics, electricity, etc.

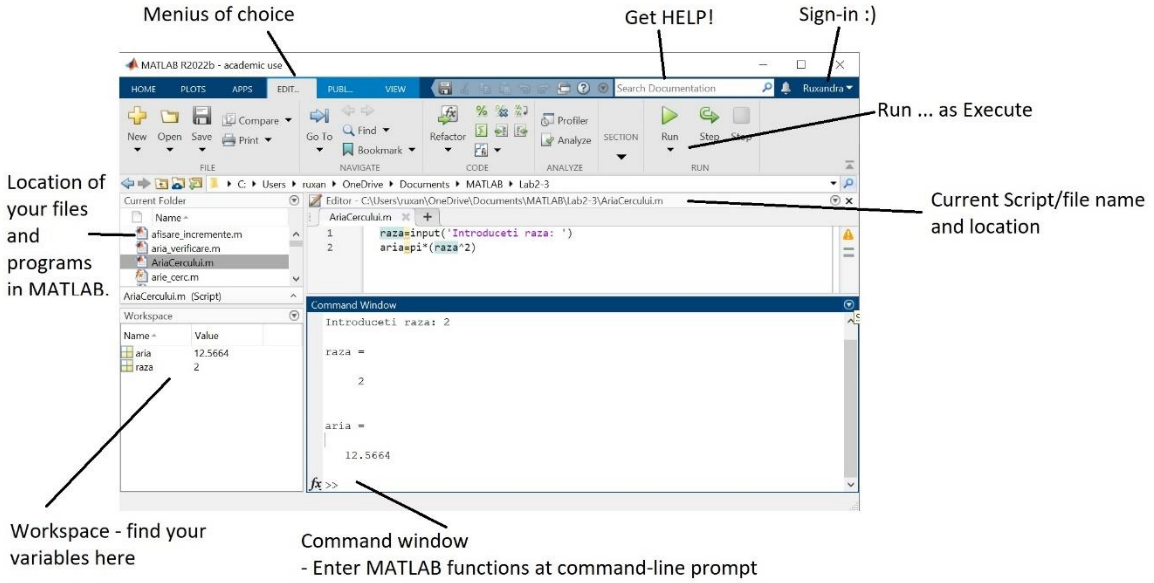
The main purpose of the application sessions is to get students familiar with the software in order to solve problems. The accent falls on learn-by-doing experiences where the student learns while working on a computer and solving problems in MATLAB.

The name MATLAB comes from MATrix LABoratory – an advanced programing language which allows technical calculus. It is more than a programing language, it is a modern programming environment which incorporates complex data structures, instruments that allow editing and debugging programs, support object-oriented programming etc. It is a package that include calculus, visualization and programming.

The main unit or element in MATLAB, as the name says, is the matrix. Hence it integrates matrix or array calculus, signal processing, system identification, statistics, experimental data processing. It works with toolboxes from different domains and areas. It has predefined routines and functions that allow various computations, thus making it a valuable instrument for the academic and industrial environment.

1.1.1. MATLAB’s desktop

When MATLAB software is running, in the program’s window the main area is represented by the Command Window.



```
raza=input('Introduceti raza: ')
aria=pi*(raza^2)
```

Name	Value
aria	12.5664
raza	2

```
Introduceti raza: 2

raza =

     2

aria =

   12.5664

fx >>
```

The main elements of MATLAB window are:

- **Command Window** – The main window – one can enter variables, evaluate expressions, run commands or programs.
- **Help Window** – It shows MATLAB’s help.
- **Workspace Window** – Shows information and data about the variables used.
- **Current Directory Window** – Shows the files in the current folder.
- **Editor Window** – Used to edit and debug/correct MATLAB programs - scrips and/or functions.
- **Command History Window** – Shows the history of commands introduced in the Command Window.
- **Figure Window -** It opens automatically when a graphical command is executed and it shows their result in a visual display.

Command Window is the main window in MATLAB through which the user interacts dynamically with the program. In this window the symbol named prompt “>>” is always visible. Commands and expressions are introduced after the prompt, and MATLAB will immediately show the result or an error message, if this is the case.

Example:

If we type in:

>> help sin

Matlab will return information about the **sin ()** function.

sin   Sine of argument in radians.

sin(X) is the sine of the elements of X.

To remember!

Frequently used commands:

↑ (up arrow) – repeats the last command;

clc – clears all the commands in the Command Window

whos – shows a list with all declared variables

clear – deletes the declared variables

help – explains any existing function

doc – show a documentation page in the Help Browser

The ***Command History*** window displays the commands which have been typed, not only on the current session (in the present Command Window), but also the commands previously introduced. Use "*Shift*" to select more lines at once.

The ***Current Folder*** window displays the files from the current folder. These can be grouped or sorted in many ways, for example grouped by type and sorted by name. If one file is selected, then all the information available is shown in the lower part.

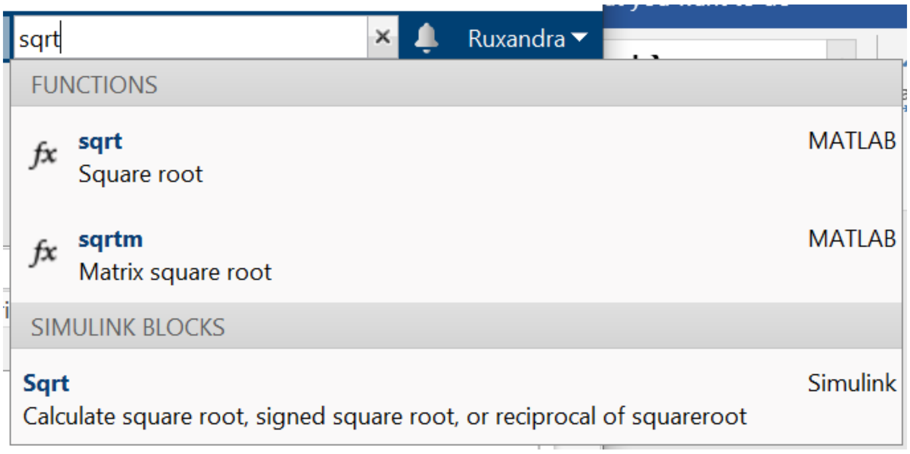
The ***Workspace*** window shows the variables initialized in the current session and their value.

Exercise:

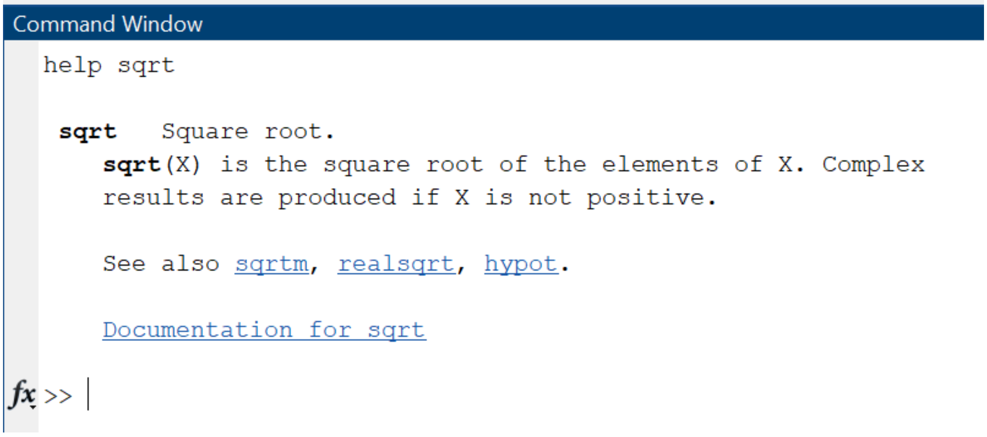
Type the following in the Command Window:
1+1 then press Enter
Sqrt(pi) then press Enter
Sin(10) then press Enter

1.1.2. Help – how we search for information?

Remember that MATLAB uses common names for common functions. In the Help Window is enough to type the first few letters of the command and MATLAB will display of possible functions related to those letters.



Another way, for example, is to type >> *help sqrt* in the Command Window. Here it is what MATLAB will show:



```
help sqrt

 sqrt   Square root.
    sqrt(X) is the square root of the elements of X. Complex
    results are produced if X is not positive.

    See also sqrtm, realsqrt, hypot.

    Documentation for sqrt

fx >> |
```

Both approaches produce the same result – information about the desired function.

1.1.3. Ending a MATLAB session

The easiest way to exit MATLAB is to type at the prompt >>*exit* or *quit*.

ATTENTION!!! Before exiting MATLAB, make sure you have saved your variables, printed/saved your plots and diagrams, saved the files you need or you cleaned up the app before closing.

1.1.4. INPUT and OUTPUT data

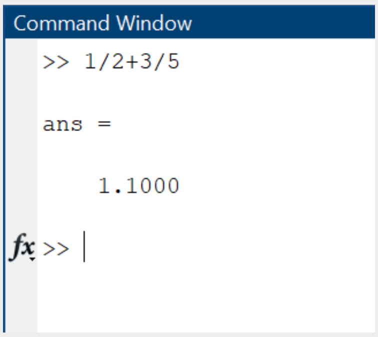
MATLAB gets the input data and commands through the Command Window and returns the results in two ways: text or numerical results displayed also in the Command Window and diagrams/graphics in a separate window.

Input data – define and initialize a variable with a value.

Commands – operations applied to variables in order to obtain the desired result.

Output data – Results display – numerical or graphical.

Example:



Command Window

```
>> 1/2+3/5

ans =

    1.1000

fx >> |
```

Exercise:

a=1 Enter

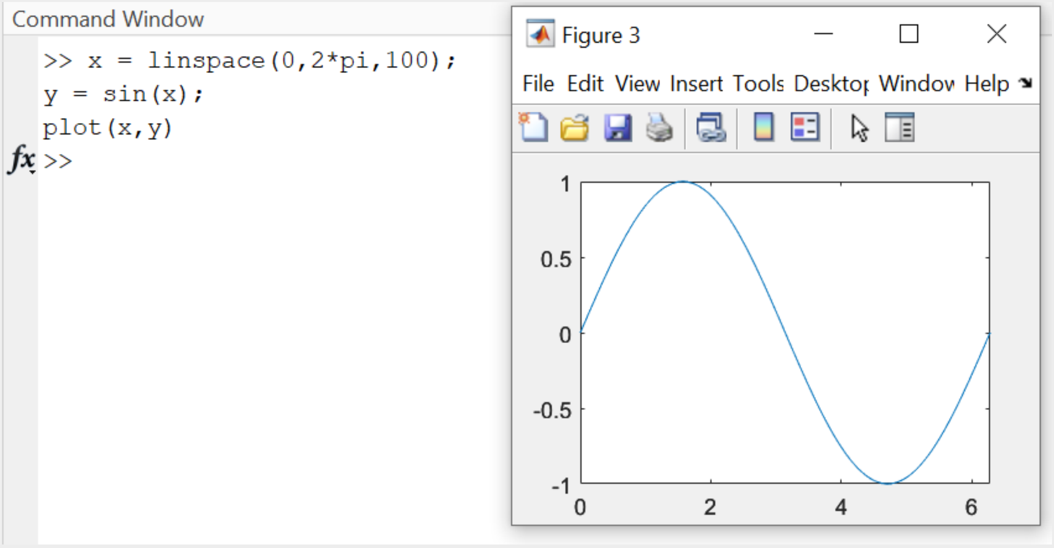
b=2 Enter

a+b Enter

c=(a-4)+b^5 Enter

Example:

Create a 2D diagram using the *plot* function to display the sine function from 0 to 2π.



Command Window

```
>> x = linspace(0,2*pi,100);
y = sin(x);
plot(x,y)
fx >>
```

1.1.5. Arithmetical operations in MATLAB

Number representation in MATLAB:

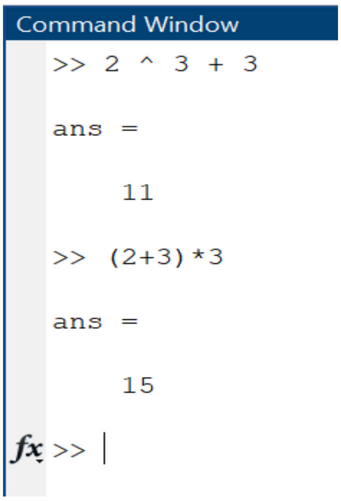
5	-88	0.0003
7.9875934	1.50310E-20	5.03445e23

The numbers used in MATLAB are in the range of 10^{-308} to 10^{308}.

For the arithmetical expressions, MATLAB uses the following symbols:

+	addition
-	subtraction
*	multiplication
/	right division (a/b = a/b)
\	left division (a\b = b/a)
^	exponential (for example 5^2 gives 25)

Division has two symbols which are especially used for arraw operations. For scalar expressions the result is the same using each symbol. For example 1/4 and 4\1 give the same result 0.25.



```
>> 2 ^ 3 + 3

ans =

    11

>>  (2+3)*3

ans =

    15

>>
```

Precedence of Arithmetic Operator

Some arithmetic operators have a different priority from others. For example, in the following expression *2 ^3 + 3*, the power-up has priority versus the addition. The use of parenthesis can change the operation order in an expression.