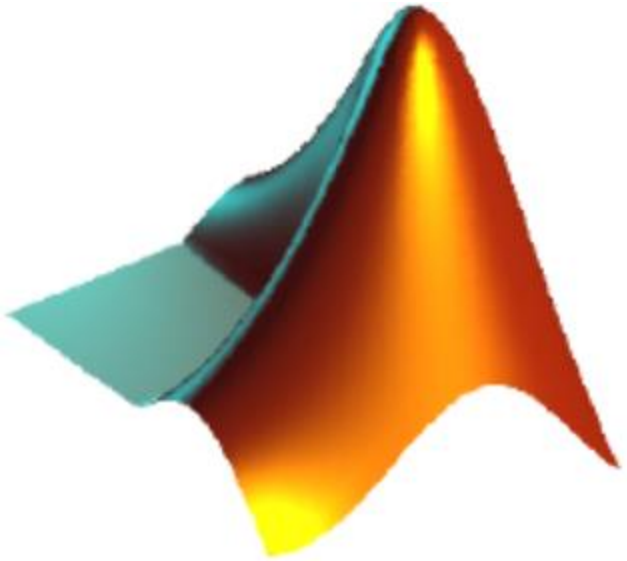
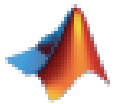
Matlab Programming Introduction



Grading Policy

- 25% for midterm.

- 75% for final exam.

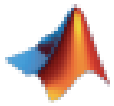


Matlab Material

- Matlab- Programming Fundamentals
- Tobin A. Driscoll, “Crash course in MATLAB”
- Matlab-numerical computing

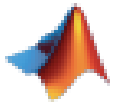
Available at:

http://scholar.cu.edu.eg/?q=zeinab_attia/classes/cs522-matlab



What is Matlab??

- Stands for: **“MATrix LABoratory”**.
- MATLAB is developed by **MathWorks**.
- A **fourth-generation** high-level programming language.
- Support interactive environment for **numerical computation**, **visualization** **and** **programming**.
- MATLAB is used in a range of applications including:
  - image and video Processing
  - signal processing and Communications
  - computational finance

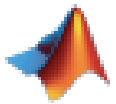


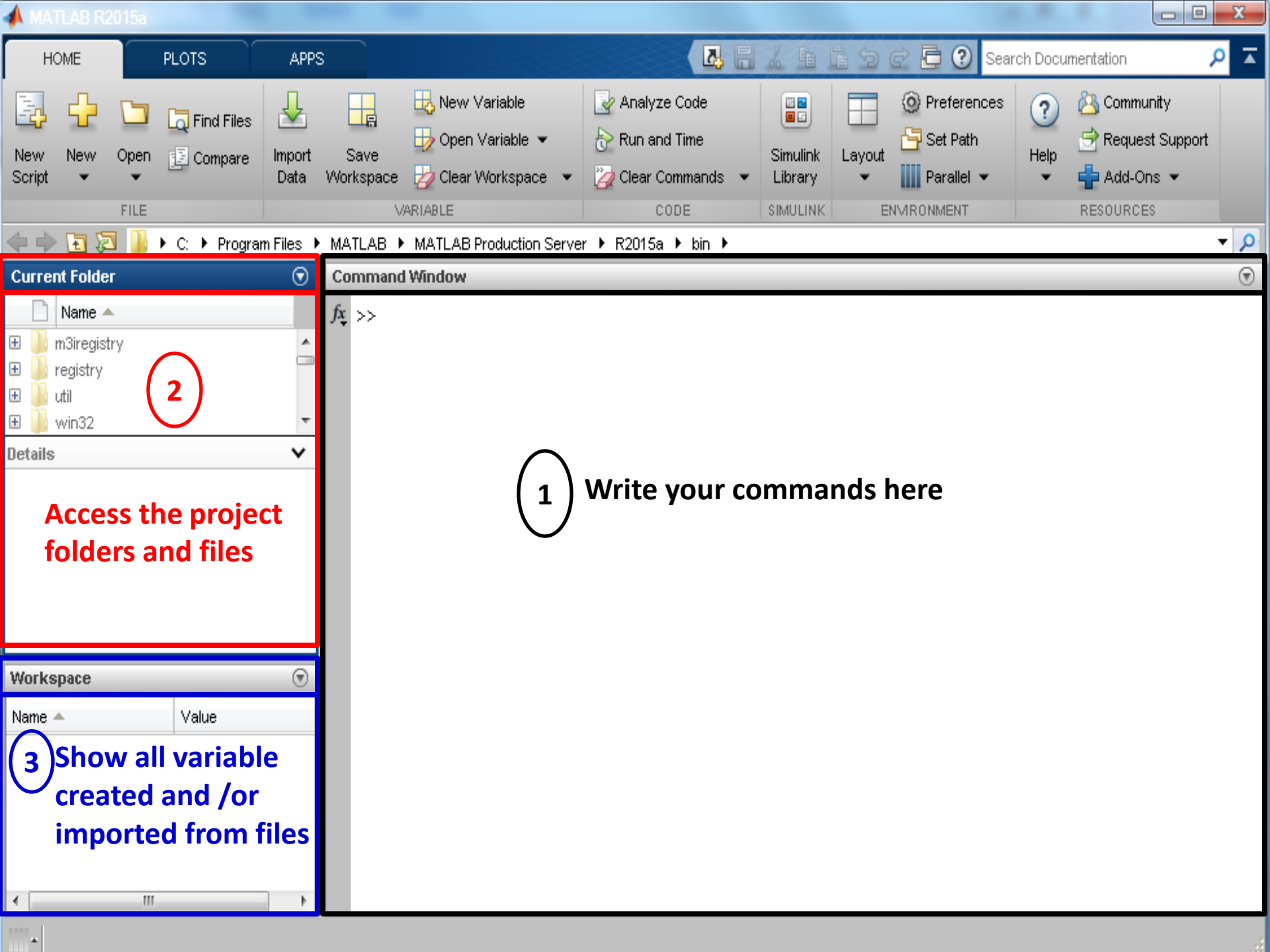
Matlab features

- 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.

- Has many specialized **toolboxes** for scientific programming:

  Signal Processing, Neural Network, Fuzzy Logic, Curve Fitting, Mapping, Statistics, Optimization, … etc.




MATLAB R2015a
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Analyze Code
Run and Time
Clear Commands
Simulink Library
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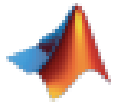
2
Details
Access the project folders and files
Workspace
Name
Value
3
Show all variable created and /or imported from files
Command Window
>>
1
Write your commands here

Arithmetic operations in Matlab

+	Addition
-	Subtraction
/	Right Division
****	Left Division (Reverse Division)
^	Power
*****	Multiplication

```
>> 24 / 4          % Result will be assigned to the default result variable 'ans'
    ans =  6

>> y= 24 \ 4       % This is a comment. 24\4  is the same to  4/24
   y=  0.1667

>> 24*6;           % ; is used to suppress the result
```

Arithmetic operators precedence



Arithmetic operators **precedence (priority)** form **highest to lowest** is shown below, within each precedence level, **operators have equal precedence** are **evaluated from left to right**.

Parenthesis:	**()**
Power:	**^**
Unary operators:	**+, -**
multiplication, left and right division:	*** , / , **
Addition, subtraction:	**+, -**

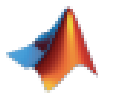
Examples:

```
>> 4 - -4 + 5 ^ 2 * 3 / 2
        ans =  45.5000

>> (4 - -4 )+ 5 ^ 2 * 3 / 2
        ans =  ??
```

Quiz 1

What are the outputs of the following expressions:

```
>> 25 / 5 * 5

>> 4 + 3 ^ 2

>>f= 3 \ 12 + 5

>> -2 ^ 2;

>> 4 - -4 + 5 ^ 2 * 3 / 2

>> 4 – 2 * 3;

>> 11 / 5 + 6
```



Diary

- **Diary** files are activity logs of your Matlab session
- The diary function creates an exact copy of your session in a disk file, excluding graphics
- To turn on the diary function:

```
>> diary
```

- Optionally, giving the name of the log file

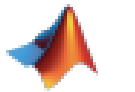
```
>> diary logdata.out
>> 2+4;
>>a=[ 4 6 ; 8 7;9 7;9 8; 8 7];
```

- To turn off the diary function:

```
>> diary off
```

- To show the diary file logdata.out

```
>> type logdata.out
```

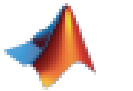


Long Statements on Multiple Lines

- The **ellipsis (…)** is used to continue a statement to the next line

```
>>  s = 1 - 1/2 + 1/3 - 1/4 + 1/5 ...
       - 1/6 + 1/7 - 1/8 + 1/9;
     s =
          0.7456
 >>  mystring = ['Accelerating the pace of ' ...
                        'engineering '];
   mystring =
         Accelerating the pace of engineering
```

Note: The start and end quotation marks for a string must appear on the same line.



Long Statements on Multiple Lines (Cont.)

- For example, this code returns an **error**, because each line contains **only one quotation mark**:

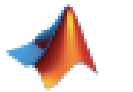
```
>>  mystring = ['Accelerating the pace of ...
                        engineering']
    mystring = ['Accelerating the pace of ...
                |
    Error: String is not terminated properly.
```

- An **ellipsis outside** a quoted **string is** equivalent to a **space**. For example,

```
>>  x = [1.23...
         4.56];
```

- This is the same as:

```
>> x = [1.23 4.56];
```

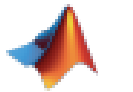
Calling Functions

- To call a function, enclose its input arguments in parentheses ( )

```
>> A = [1  3  5];
>> max(A)
ans =
5
```

- If there are multiple input arguments, separate them with **commas (,)**

```
>> B = [10  6  4];
>> max(A , B)
ans =
   10      6      5
```

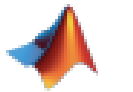
Calling Functions (Cont.)

- Store output from a function by assigning it to a variable:

```
>> maxA = max(A)
    maxA =
         5
```

- If there are multiple output arguments, enclose them in **square brackets [ ]**

```
>> [maxA , location] = max(A)
    maxA =
         5
    location =
         3
```



Calling Functions (Cont.)

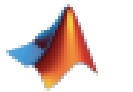
- To call a function that does **not require** any **inputs** and does **not return** any **outputs**, type only the function name.

- For example, **clc function** clears the command window

```
>> clc
>>
```

- **Enclose** text **string inputs** in **single quotation** marks:

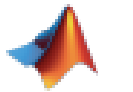
```
>> disp('hello world')
hello world
```

Special Functions

- pi 3.14159265...
- realmin Smallest floating-point number
- realmax Largest floating-point number
- Inf Infinity
- NaN Not-a-number

```
>> 9 / 0
ans =
        Inf
>> 0 / 0        % or  inf / inf
ans =
        NaN
```

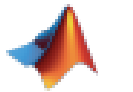


Algebraic Equations in MATLAB

- Solve for x in the equation x-5 = 0

```
>> solve('x-5=0')
     ans = 5
```

'Solve' function is used for solving algebraic equations.

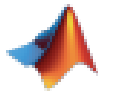


Differentiation in MATLAB

- The differentiation of the equation function
  - $f(t) = 3t^2 + 2t^{-2}$

```
>>syms t
>>f = 3*t^2 + 2*t^(-2);
>>diff(f)
    ans = 6*t - 4/t^3
```

'diff' command is used for **computing symbolic derivatives .**

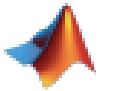


Limits in MATLAB

- Find the limit of the function $f(x) = (x^3 + 5)/(x^4 + 7)$, as x tends to zero.

```
>>syms x
>>limit((x^3 + 5)/(x^4 + 7))
    ans=5/7
```

'limit' command is used for calculating limits.

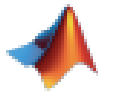


Integration in MATLAB

- integration of 2*x

```
>> syms x
>> int(2*x)
     ans =  x^2
```

'int' command is **used** for **calculating the integration of an expression.**



Workspace commands

Saving your work:

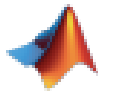
```
>> save myfile % save variables in the workspace in myfile.mat
>> load myfile  %load the saved workspace
```

Deleting variable from workspace:

```
>> clear x   % it will delete x from the workspace. Thus, it cannot
                be accessed until defining it again
>> clear     % it will delete all variables in the workspace
```

Displaying variables stored in the workspace:

```
>> who % display all variables in workspace
>> whos % display information about variables in the workspace
```



Help & Documentation

- Open the function documentation in a separate window using the **doc** command

```
>> doc max
```

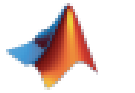
- View an abbreviated text version of the function documentation in the command window using the **help** command

```
>> help max
```

- Display functions with the word “max” in the first help line using the **lookfor** command

```
>> lookfor max
```

- Access the complete product documentation by clicking the help icon  in the menu and tools bars



Quiz 2

Write the instructions that do the following:

- Delete all the variables created in the current matlab session.
- Remove all the current contents of the command window.