

MATLAB: class 1

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Basic MATLAB

The image shows the MATLAB R2016a software interface. The top menu bar includes 'HOME', 'PLOTS', and 'APPS'. Below the menu bar is a ribbon with various toolboxes and functions. The main workspace is divided into three panes: 'Current Folder', 'Command Window', and 'Workspace'.

Current Folder: Displays a list of files and folders in the current directory (F:\CESS_matlab_training). The files include:

- MATLAB_download_link
- anomaly.m
- Array_management.m
- Basic_statistics.m
- CESS_MATLAB_class_1.ppt
- controlflow_practice.m
- data.xlsx
- Download matlab freely and installation guideline.mkv
- Matlab_introduction.ppt
- Matlab_practical_1.ppt
- Matlab_practical_2.ppt
- Monthly_Mean_1980-2017.xls
- ploting.m
- Programming, data analysis and visualization with MA...
- statistics.m
- third_diss.m
- TRMM.nc
- TRMM_data_analysis.m

Command Window: Shows the MATLAB prompt `>>`.

Workspace: Shows a table with columns for 'Name' and 'Value'.

Name	Value
------	-------

Basic MATLAB

Command Window

```
>> help
```

```
HELP topics:
```

```
matlab\datafun
```

```
matlab\datatypes
```

```
matlab\elfun
```

```
matlab\elmat
```

```
matlab\funfun
```

```
matlab\general
```

```
matlab\iofun
```

```
matlab\lang
```

```
matlab\matfun
```

```
matlab\ops
```

```
matlab\polyfun
```

```
matlab\randfun
```

```
matlab\sparfun
```

```
matlab\specfun
```

```
matlab\strfun
```

```
matlab\timefun
```

```
matlabhdlcoder\matlabhdlcoder
```

```
matlabxl\matlabxl
```

```
matlab\demos
```

```
matlab\graph2d
```

```
matlab\graph3d
```

```
matlab\graphics
```

```
graphics\obsolete
```

```
matlab\plottools
```

```
matlab\scribe
```

```
scribe\obsolete
```

```
matlab\specgraph
```

```
fx
```

```
matlab\uitools
```

- Data analysis and Fourier transforms.
- Data types and structures.
- Elementary math functions.
- Elementary matrices and matrix manipulation.
- Function functions and ODE solvers.
- General purpose commands.
- File input and output.
- Programming language constructs.
- Matrix functions - numerical linear algebra.
- Operators and special characters.
- Interpolation and polynomials.
- Random matrices and random streams.
- Sparse matrices.
- Specialized math functions.
- Character strings.
- Time and dates.
- (No table of contents file)
- (No table of contents file)
- Examples.
- Two dimensional graphs.
- Three dimensional graphs.
- Handle Graphics.
- (No table of contents file)
- Graphical plot editing tools
- Annotation and Plot Editing.
- (No table of contents file)
- Specialized graphs.
- Graphical user interface components and tools

Arithmetic Operators

Symbol	Role
+	Addition
-	Subtraction
.*	Element-wise multiplication
*	Matrix multiplication
./	Element-wise right division
/	Matrix right division
.\	Element-wise left division
\	Matrix left division (also known as <i>backslash</i>)
.^	Element-wise power
^	Matrix power
.'	Transpose

Relational Operators

Symbol	Role	(Equivalent, Fortran, NCL, Python)
<code>==</code>	Equal to	<u>eq</u>
<code>~=</code>	Not equal to	<u>ne</u>
<code>></code>	Greater than	<u>gt</u>
<code>>=</code>	Greater than or equal to	<u>ge</u>
<code><</code>	Less than	<u>lt</u>
<code><=</code>	Less than or equal to	<u>le</u>

Logical Operators

Symbol	Role	(Equivalent, Fortran, NCL, Python)
&	Logical AND	<u>and</u>
	Logical OR	<u>or</u>
~	Logical NOT	<u>not</u>

Special Characters

Symbol	Symbol Name	Role
...	ellipsis	Line continuation
,	Comma	Separator
:	Colon	<ul style="list-style-type: none">▪ Vector creation▪ Indexing▪ For-loop iteration
;	Semicolon	<ul style="list-style-type: none">▪ Signify end of row▪ Suppress output of code line
()	Parentheses	<ul style="list-style-type: none">▪ Operator precedence▪ Function argument enclosure▪ Indexing

Special Characters

Symbol	Symbol Name	Role
[]	Square brackets	<ul style="list-style-type: none">▪ Array construction▪ Array concatenation▪ Empty matrix and array element deletion▪ Multiple output argument assignment
{ }	Curly brackets	Cell array assignment and contents
%	Percent	<ul style="list-style-type: none">▪ Comment▪ Conversion specifier
"	Single quotes	Character array constructor
"""	Double quotes	String constructor
=	Equal sign	Assignment

Special Characters (`sprintf`, `fprintf`)

Symbol	Effect on Text
"	Single quotation mark
%%	Single percent sign
\\	Single backslash
\a	Alarm
\b	Backspace
\f	Form feed
\n	New line
\r	Carriage return
\t	Horizontal tab
\v	Vertical tab

Precedence

- Parentheses (`()`)
- Transpose (`.'`), power (`.^`), matrix power (`^`)
- Power with unary minus (`.^-`)
- Unary plus (`+`), unary minus (`-`), logical negation (`~`)
- Multiplication (`*`), right division (`./`), left division (`.\`), matrix multiplication (`*`),
- matrix right division (`/`), matrix left division (`\`)
- Addition (`+`), subtraction (`-`)
- Colon operator (`:`)
- Less than (`<`), less than or equal to (`<=`), greater than (`>`), greater than or equal to (`>=`), equal to (`==`), not equal to (`~=`)
- Element-wise AND (`&`)
- Element-wise OR (`|`)

Data type

How much memory or space will take by computer

- Integer
- Float
- Double
- String (non-numeric)
- Logical (non-numeric)

Integer

$X = 1$

Float

specify the number of digits after the decimal point

$Y = 1.6$

Double (real number)

Can be fractional or integer

$Z = -5, -3, 0, 3, 5$

String

Ripa, Jalal, Jara

Logical



True, False

Variables

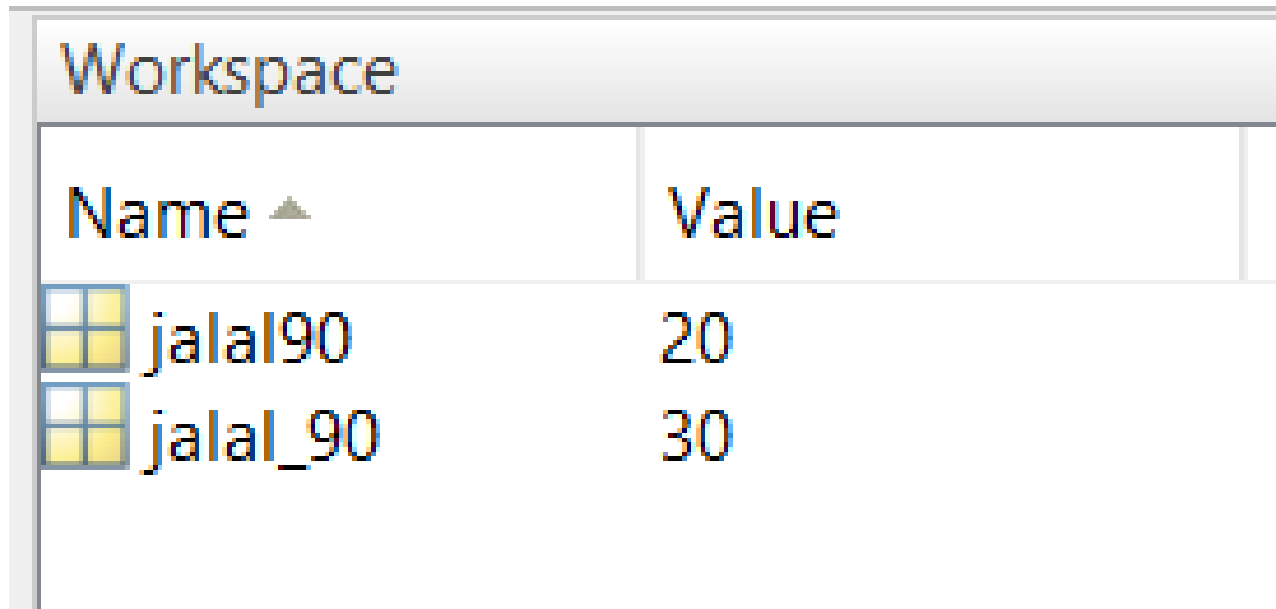
- A name given to a storage area that our programs can manipulate

- Matlab is case sensitive

```
>>A=3; }  
>>a=2; } A≠a
```

Workspace	
Name ▲	Value
 jalal	20
 Jalal	30

- We can use both numbers and underscore in variable names



The image shows a 'Workspace' window with a table of variables. The table has two columns: 'Name' and 'Value'. The first row shows the variable 'jalal90' with a value of 20. The second row shows the variable 'jalal_90' with a value of 30. Each variable name is preceded by a small icon consisting of a blue square with a white cross.

Name ▲	Value
jalal90	20
jalal_90	30

- string (text) variables enclosed in single quotes.

```
>> Jalal = 'Founder and Director of Research Society'
```

```
Jalal =
```

```
Founder and Director of Research Society
```

- to clear a variable from memory

```
>> clear
```

```
>>
```

- Matlab will “echo” commands unless a semi-colon is used

Command Window

```
>> a = 20;
```

```
>> a = 20
```

```
a =
```

```
20
```

Vectors

column vectors

$$\mathbf{a} = \begin{Bmatrix} 1 \\ 2 \\ 3 \end{Bmatrix}$$

```
>>a=[1;2;3]
```

```
>>a
```

```
a =
```

```
1
```

```
2
```

```
3
```

use semi-colon
to separate rows

row vectors

$$\mathbf{a} = \{1 \ 2 \ 3\}$$

```
>>a=[1,2,3]
```

```
>>a
```

```
a =
```

```
1 2 3
```

use comma
to separate columns

Math representation

$$z = y^x$$

$$y = e^x$$

$$y = \ln(x)$$

$$y = \log(x)$$

$$y = \sin(x) \quad y = \sin^{-1}(x)$$

$$y = \cos(x) \quad y = \cos^{-1}(x)$$

$$y = \tan(x) \quad y = \tan^{-1}(x)$$

Matlab interpretation

```
>>z=y^x;
```

```
>>y=exp(x);
```

```
>>y=log(x);
```

```
>>y=log10(x)
```

```
>>y=sin(x);      >>y=asin(x);
```

```
>>y=cos(x);      >>y=acos(x);
```

```
>>y=tan(x);      >>y=atan(x);
```

- Only matrices of the same dimension can be added and subtracted
- For multiplication, the inner dimensions must be the same

$$\mathbf{A} = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$$

$$\mathbf{B} = \begin{bmatrix} 2 & 3 & 4 \\ 5 & 6 & 7 \end{bmatrix}$$

$$\mathbf{C} = \begin{bmatrix} 4 & 5 \\ 6 & 7 \\ 8 & 9 \end{bmatrix}$$

No error

```
>>D=A+B;
```

```
>>D=A-B;
```

Error

```
>>D=A+C;
```

```
>>D=A*B;
```

Left(\) and Right(/) Matrix “division”

Math representation

$$\mathbf{C} = \mathbf{A}^{-1}\mathbf{B}$$

$$\mathbf{C} = \mathbf{B}\mathbf{A}^{-1}$$

Matlab interpretation

```
>>C=A\B;
```

```
>>C=B/A;
```

Matrix Transpose

Math representation

$$\mathbf{C} = \mathbf{A}^T$$

Matlab interpretation

```
>>C=A' ;
```


Thank You