

Experiment 1: Familiarization with MATLAB

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Objective: To learn about MATLAB and familiarize oneself with its usage and applicability to Signals and Systems

Software Required: MATLAB software R2015a

MATLAB (**MA**T**RI**x Laboratory) is matrix based software package for computation engineering. Science and applied mathematics. It offers a powerful programming language, excellent graphics, and wide range of expert Knowledge. A numerical analyst called Cleve Moler wrote the first version of MATLAB in the year 1970.

NOTE:

(1) Open the Matlab: Double click on the Matlab **Icon** available on your computer desktop

(2) Use **HELP** / **SEARCH DOCUMENTATION** options of MATLAB

Run #01:

Q1. Mention **ALL** Matlab windows.

Answer:

Command window, Workspace window, Command History window and Current Directory window, editor window.

Q2. (i) What is the purpose of command window in MATLAB?

Hint: use the option **SEARCH DOCUMENTATION** in your matlab window (Right side top corner)

(ii) Type $a = 7$ $b = 8$ in command window and calculate $c = a + b$ what is c ? Can you save this command and value?

Answer :

- (i) To enter individual lines of code/statements and generate the result immediately or view the result later.
- (ii) 15. Yes, you can save the value as a .mat file. It will contain the value of c as a 1x1 matrix. But you cannot save the command (addition operation)

Q3. What is the purpose of command history in MATLAB?

Answer:

The code/statements used in previous sessions is stored along with the date and time for use. It allows efficient use of popular commands that are used frequently, or can help in retrieving an old set of commands.

Q4. (i) What is the purpose of Workspace in MATLAB?

(ii) Can you save this workspace file?

(iii) What is the extension of this workspace file?

Answer :

- (i) It contains all the variables that were created/imported available for use, it also allows to edit/view the contents of these variables.
- (ii) Yes, the workspace can be saved a .mat file and can be imported into other MATLAB programs
- (iii) .mat is the extension

Q5. (i) What is the current directory that MATLAB is in?

(ii) How can you change the path of the current directory?

Answer :

- (i) Use pwd command or view the current directory in the current directory window
- (ii) The command cd path, can be used to change the current directory to a new directory given in the path. Or you can click on that “browse for folder” icon,

Q6. (i) What is Editor Window?

(ii) What is the extension of the file that is saved in Editor Window?

(iii) What is m-file ?

(iv) Type “edit” command in command window and write your observations?

Answer :

- (i) A text editor to save and run MATLAB programs
- (ii) .m is the extension
- (iii) m-file is the file that contains MATLAB commands and programs which can be executed using MATLAB
- (iv) edit command in the command window opens a new editor window.

Q7. Write comments on the following keywords related to different MATLAB windows (Command window, editor window, workspace window etc)

- i. clc
- ii. clear all
- iii. clf
- iv. help
- v. lookfor
- vi. pwd
- vii. path

Answer:

- (i) clears text in the command window
- (ii) clears all the variables in the workspace
- (iii) resets all the current figure of graphs
- (iv) gives insight on the command/problem using the MATLAB documentation
- (v) It is use to search for keywords
- (vi) returns the path of the current folder
- (vii) Returns all the paths of the contents of Matlab/Simulink toolboxes installed

Run #02: Perform the following Simple Calculations using only **Command Window**

Q8. Arithmetic Operations:

- i. Calculate the value of $\frac{10^5}{25^2-1}$ using power operator (or “power” command) of matlab.
- ii. Calculate the area of a circle of radius 10 cm using multiplication and power operators of matlab. Hint: Keyword **for Π is pi**).

Answer:

(i) Command: $10^5/(25^2-15)$

Ans:

163.9344

(ii) Command: $\pi*(0.1^2)$

Ans:

0.0314

Q9. Trigonometry Operations: Find the values of the following trigonometric functions in both radians and degrees

i. $\sin \frac{\pi}{6}$, $\cos \frac{\pi}{4}$ and $\tan \frac{\pi}{2}$

ii. $\sin^{-1}(-0.3)$ and $\cot^{-1}(3)$

Answer :

(i) Commands: $\sin(\pi/6)$, $\cos(\pi/4)$, $\tan(\pi/2)$

Ans: 0.5000, 0.7071 and 1.6331e+16

(ii) Commands: $\sin^{-1}(-0.3)$ and $\cot^{-1}(3)$, $\sin^{-1}(-0.3)$, $\cot^{-1}(3)$

Ans: -0.3047 and 0.3218, -17.4576 and 18.4349

Q10. Complex Number Operations:

i. $\frac{1+5i}{1-5i}$. Compare the result with matlab code and manual calculations.

ii. Calculate the angle and magnitude of the complex function $\frac{10-3i}{4+3i}$ using **abs** and **angle** functions of matlab

iii. Execute the commands $\exp(\pi/2*i)$ and $\exp(\pi/2i)$ using matlab code. Explain the differences between the two.

Answer :

(i) Command: $c = (1+5i)/(1-5i)$

Ans: $-0.9231 + 0.3846i$

(ii) Command: $\text{abs}(c)$ and $\text{angle}(c)$

Magnitude = 1.0000 and angle = 2.7468

- (iii) They are conjugates of each other. As $\exp(\pi/2*i)$ is different from $\exp(\pi/2i)$ due to the order of precedence of operators. However $\exp(\pi/(2*i))$ and $\exp(\pi/2i)$ will result in the same answers

Run #03: Vectors

Q11. What are the different ways to create a vector? (use help command)

Answer :
Var = [elements], Var = start:step:stop, var(1) = element, etc are the different ways of creating a vector

Q12. Create a row vector of your choice having 10 elements using matlab code

Answer :

y = 1:10

Q13. Create a column vector of your choice having 5 elements/rows using matlab code

Answer :

y = (1:5)'

Q14. Given a vector V = [1 2 3 4 5 6 7 8 9 10 11 12]. Find the **size** of the vector.

Answer :
Command: size(V)
ans =

1 12

Q15. Calculate the values of y for the equation $y = mx + c$ for $m = -5$ and intercept value $c = 10$

for various value of $x = 0, 1.6, 5, 9, 15$ and store the result in the vector y .

Answer:

Command:

```
m = -5;
```

```
c = 10;
```

```
x = [0, 1.6, 5, 9, 15];
```

```
y = m*x + c
```

y =

```
10    2   -15   -35   -65
```

Q16. Create a vector t of 15 elements $1, 2, 3, \dots, 15$. Using this ' t ' vector compute $y = t \sin(t)$

Answer :

Command:

```
t = 1:15;
```

```
y = t.*sin(t)
```

y =

```
0.8415    1.8186    0.4234   -3.0272   -4.7946   -1.6765    4.5989    7.9149    3.7091   -5.4402  
-10.9999   -6.4389    5.4622   13.8685    9.7543
```

Q17. Create two vectors, $V1$ and $V2$ of same size using **linspace** command and perform the following operations.

i. $V_add = V1 + V2$

ii. $V_sub = V1 - V2$

iii. $V_mult = V1 .* V2$

iv. $V_div = V1 ./ V2$

Answer :

```
>> v1 = linspace(10,20,5);
```

```
>> v2 = linspace(5,25,5);
```

```
>> v_add = v1+v2
```

```

v_add =
    15.0000  22.5000  30.0000  37.5000  45.0000

>> v_sub = v1-v2

v_sub =
    5.0000  2.5000     0 -2.5000 -5.0000

>> v_mul = v1.*v2

v_mul =
    50  125  225  350  500

>> v_div = v1./v2

v_div =
    2.0000  1.2500  1.0000  0.8750  0.8000

```

- (19) (i) Now create V1 and V2 of different sizes. Perform the above operations for this new V1 and V2. What happens when V1 and V2 are of different sizes?
- (ii) Compute $V_multi = V1 * V2$. Compare the answers with (iii) and write down your conclusions.

Answer :

(i) “Error matrix dimensions must agree”

(ii) “Incorrect dimensions for matrix multiplication”, if the dimensions for multiplication were satisfied then $*$ would result in matrix multiplication whereas $.*$ would result in element wise multiplication

Link for uploading the completed observation:

<https://forms.gle/f6ZAENbt8KMMTBiQ6>

Due on 31/01/2021 Sunday 5 PM

Run #04: Try yourself

Note: WHEN YOU ARE WRITING A MATLAB PROGRAM AND SAVING IT AS .m file NAME OF THE FILE SHOULD NOT BE THE SAME AS EXISTING MATLAB FUNCTIONS. For e.g. if you are writing a MATLAB program to generate sine wave YOU SHOULD NOT give the file name as sin because MATLAB already has a built in function named 'sin'

Q20. Create a two vectors V1 and V2 such that V1 goes from 1 to 20 in steps/increments of 2, V2 goes from 1 to 50 in steps of 5. Find the size of each vector. Now create a new vector V3 by appending V1 to V2. What is the size of this appended array V3?

Ans:

```
V1 = 1:2:20;
```

```
V2 = 1:5:50;
```

```
size(V1)
```

```
size(V2)
```

```
V3 = [V1 V2];
```

```
size(V3)
```

Q21. Find the values of the following trigonometric functions in both radians and degrees

i. $Y = \sin^2 \frac{2\pi}{6} + \cos^2 \frac{2\pi}{6}$

ii. $Y = \cosh^2 x + \cos^2 x$ at $x = 32\pi$

Ans:

(i) $y = \sin(\pi/6)^2 + \cos(\pi/6)^2$

y =

1

(ii) x = 32*pi;

y = cosh(x)^2 + cos(x)^2

y1 =

5.2243e+86

Q22. Create a vector t of 15 elements 1,2,3,.....15. Using this 't' vector compute the following

i. $Y = \frac{t-1}{t+1}$

ii. $Y = \frac{\sin(t^2)}{t^2}$

Answer:

t = 1:15;

y1 = (t -1)/ (t+1)

y2 = sin(t.^2)/(t.^2)

y1 =

0.8194

y2 =

-0.0012

Q23. If R = 10 Ohms and the current is increased from 0 to 10 A with increments of 2A, write a MATLAB.m file program (use only editor window. Note: You can't use command window, why?) That calculates voltage and power dissipation for the given current values using MATLAB vector multiplication approach. Display voltage and power values in the command window.

Answer:

R = 10;

```
I = 1:2:10;
```

```
V = I*R
```

```
P = V.*I
```

```
V =
```

```
10  30  50  70  90
```

```
P =
```

```
10  90  250  490  810
```
