Digital Signal Processing

Lab1: Introduction to MatLab
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Github Repo: https://github.com/SamarShabanCS/DSP
Slack workspace: https://fayoum-university-fci.slack.com

- Matlab is developed by The Mathworks, Inc. (http://www.mathworks.com)

- It is an interactive, integrated, environment
  - for numerical/symbolic, scientific computations and other apps.
  - slow (compared with FORTRAN or C) because it is interpreted.
  - automatic memory management; no need to declare arrays.
  - intuitive, easy to use.
  - Modeling, simulation Data analysis and visualization
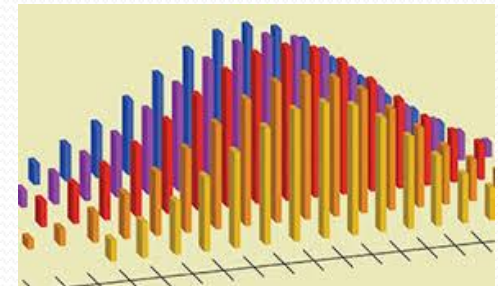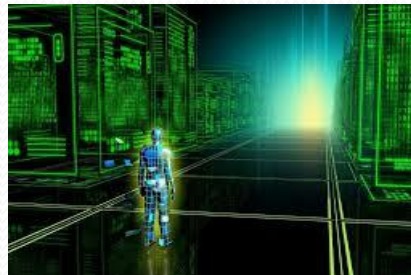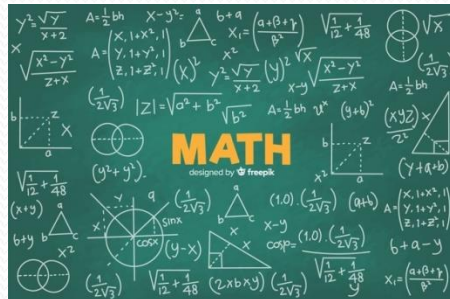
INSTALLATION

- Follow the steps in following video link to download, install and activate MatLab2020 successfully:

  - https://www.youtube.com/watch?v=YJ3MGvBd47U&fbclid=IwAR01gkO_IcfDvu027Q4gqB9ZPJZxMZ1pDDU6AX1gRMYteoWgqcWLWlVHWDA

BASICS OF MATLAB

Rules on Variable and File Names

- ## Variables
  - case sensitive, *e.g.,* NAME and Name are 2 distinct names.
  - variable begins with a *letter*, *e.g.,* A2z or a2z
  - can be a mix of letters, digits, and underscores (*e.g.,* vector_A)
  - reserved characters: % = + – ~ ; : ! ' [ ] ( ) , @ # $ & ^
  - up to 63 characters
- Functions/scripts
  - performs specific tasks; same naming rules as for variables
- ## File names
  - *MATLAB* command files should be named with a suffix of ".m", *e.g., myfile.m*. An m-file typically contains a sequence of MATLAB commands that will be executed in order
  - A file may contain a collection of commands, functions
  - *Note: To run, enter m-file, without .m, e.g.,*
  - >> *myfile*

Variables and Data types

```
>> a = 10
a =
    10

>> class(a)
ans =
double
```

```
>> b = 10.56
b =
    10.5600

>> class(b)
ans =
double
```

```
>> c = 'Bush'
c =
Bush

>> class(c)
ans =
char
```

```
>> d = true
d =
    1

>> class(d)
ans =
logical
```

Variable	Data type
'a'	Char
'ahmed'	Char
"a"	String
"ahmed"	String
0.2	Double
2.0	Double

Class(a)
Return Data type of variable (a)
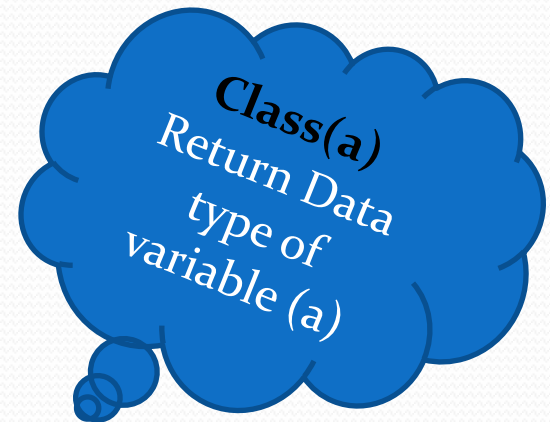
Some basic hints

- help <name> (for example: >> help cos)
- *; blocks automatically output of the variables*
- *% makes a comment*
- *to comment a few rows hold Ctrl+R*
- *to uncomment a few rows Ctrl+T*
- *Always use: clc,clear; close all;*

TASK

Type in Editor:

=================

My MATlab program

=================

• *Use CTRL+R to comment it*

Main MATLAB objects

- *Commands (clc, help, demo)*
- *Constants (10, -17.28, 5+3j, 1e-6, 10^2)*
- *Standard const (pi, 1i or 1j, eps,inf, nan)*
- *Variables – MATlab object, which might change it's value during simulation. <u>All variables are MATRIXES in MATlab</u>*
- *Functions (sin(X), exp(X), log10(X), sqrt(X), abs(X), real(X), imag(X))*
- *Expressions – is a sum of constants, functions, variables, which are summed by operational symbols (x+sin(a)-sqrt(pi);)*

Main operation symbols

Symbol	Operation
+	Summation
-	Difference
*	Multiplication of matrixes
.*	Multiplication of elements
/	Right division
.'	Transposing

Use MATLAB as calculator to find answers

$$\frac{3}{7} - \frac{10}{15}$$

$$\sqrt[4]{5^7}$$

$$(3 + 4i)(5 - 6i)$$

$$\frac{3 + 4i}{5 - 6i}$$

$$(2 + 3i)^2$$

$$\sqrt{5}\,e^{i\pi/4}$$

Activate
Go to Syste

TASK

Type and simulate

➢ z=3+4i

➢ r=abs(z)

➢ fii=angle(z)

➢ r*exp(i*fii)

➢ zk=conj(z)

➢ z*zk-r^2

● *What the command format **does**?*

Vectors

- Type
  - a=[2 4 5 7]
  - b=[-1 4 -2 1]
- Find
  - a+b
  - 2*a-2*b
  - a*b
  - a'*b
  - a*b'
  - a'*b'

- Try: -1:10; 0:2:100; 1:-0.25:-2

- **Form vectors:** a=(7,8,9,...,22); b=(0,2,4,...,100); c=(100,95,90,...,35)

- **What did you get:** a(3)? a([3 5 7])? a(3:7)? a(3:end)?

Matrices

- A=[-7 5 -9; 2 -1 2; 1 -1 2];

$$A = \begin{bmatrix} -7 & 5 & -9 \\ 2 & -1 & 2 \\ 1 & -1 & 2 \end{bmatrix}$$

- Generate Matrix B & D.

$$B = \begin{bmatrix} 16 & 3 & 2 & 13 \\ 5 & 10 & 11 & 8 \\ 9 & 6 & 7 & 12 \\ 4 & 15 & 14 & 1 \end{bmatrix}$$

$$D = \begin{bmatrix} 6 & 3 & 2 \\ 2 & 12 & -7 \\ -1 & 6 & 2 \\ -5 & 15 & 11 \end{bmatrix}$$

$$C = \begin{bmatrix} 4 & 2 & -3 \\ 7 & -7 & 9 \\ 3 & -5 & 6 \end{bmatrix}$$

Activate

TASK

- Calculate: 3A-5C, 7A+2B, CA, CD'
- Find out commands: zeros(n), zeros(m,n), ones(n), ones(m,n), size(D), zeros(size(D)), diag([1 2 3 4]), eye(n)
- What happens [A,B] and [A;B]?
- Try to find an easy way to build a 7*8-matrix whose other entries are zeros, but in its diagonal and its last column are 5s
- Output of: A(i,:) and column with A(:,j)