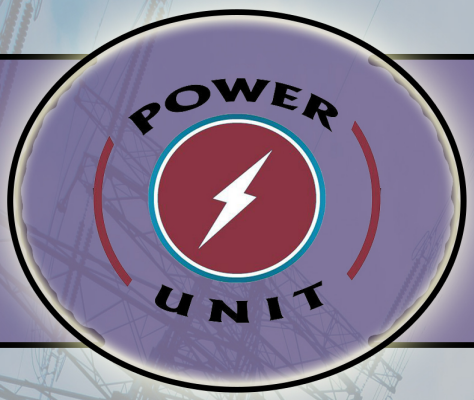


Matlab Notes
Eng. We'am anabousi

By . Sandrine Yamin

#بأفكارنا_نُبدع

1st & second week

Strength of MATLAB :

- Relatively easy to learn
- Easy to do very rapid prototyping
- Matlab code is optimized to be relatively quick when performing matrix operations
- may behave like a calculator or as a programming language
- Matlab is interpreted, errors are easier to fix
- Excellent display capabilities
- widely used for teaching and research in universities and industry.
- Although primarily procedural, Matlab does have some object-oriented elements.

Weaknesses of MATLAB

- Matlab is NOT a general purpose programming language
- Matlab is an interpreted language (slower than C++)
- it's designed for scientific computation and is n't suitable for some things (such as parsing text)
- Not designed for large-scale system development
- Slow for some kinds of processes

→ If there are two words with a space between them and I want to use it as a variable ⇒ use the under score sign " space " isn't allowed

Ex: matLab course
>> matLab_course

→ the default variable of any undefined operation using matLab is ans [From answer]

Ex:
>> 5/10
ans =
0.500
>> 8/10
ans =
0.800

Scalar arithimatic Operations

Math	MatLab
ab	$a*b$
Ex: $5(7+a)$	$5*(7+a)$
$\frac{a}{b}$	a/b right divison
$\frac{a}{b}$	$b\backslash a$ left division

* Note that when dealing with scalar quantities the left and right division are equal ; but when dealing with matricies is NOT

$a/b = b\backslash a$ Scalar

$A/B \neq B\backslash A$ Matrix

Math	Matlab
$a+b$	a+b
$a-b$	a-b
~~a^b~~ a^b	a^b

note that this is exponantiation

(أسية دوال / قوى)

but when dealing with an exponential function , use exp(x)

⇒ Order of precedence

① (( )) ineer most first
② ^
③ *, \, /
④ +, -

عند وجود عمليات حسابية لها نفس الأولوية
احسب من اليسار ثم اليمين

⇒ Remember :

- In assignment operators left side should be a single variable ONLY

Ex: x+20=5 [mathmaticly right, but it's wrong in MATLab]

⇓

X=5-20 ✓✓

⇒ Magic matrix : where all rows, columns add diagonals summing to the same number.

- It's Command >> magic (n)

Where it's size is n×n ; n>3

Ex :

```
>> magic(4)
ans =
    16     3     2    13
     5    10    11     8
     9     6     7    12
     4    15    14     1
```

```
>> magic(3)
ans =
     8     1     6
     3     5     7
     4     9     2
```

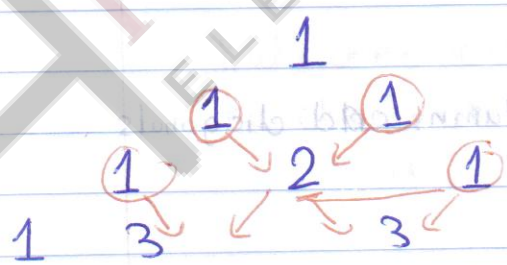
This is called a magic squar because the sum of the elements in each row, column and diagonal was the same

The sum = $\frac{\sum_{n}^{n^2} n}{n}$

⇒ Pascal's Triangle

- The triangle is used to look for the probability of any particular event to occur.

* How to make Pascal's Triangle?



← start with 1
← leave the middle empty
← put the summation of the previous row
⋮
← Repeat

- It's Command
  >> Pascal(n)

* Note: that I can use both the magic matrix or pascal's triangle if I want a matrix without caring what's inside it.

* Commands for managing the work session

Command	Description
clc	Clears the Command window
Clear	Removes all variables from memory
Clear v1 v2	Removes the variables v1 and v2 from memory
exist ('var')	Determines if a file or variable exists having the name 'var' (space ↓) Or you can write exist var
quit or exist	Stops Matlab
Who	Lists all used variables
whos	Lists the variables we used including it's size and if any imaginary parts are included

: Colon : generates an array having regularly spaced elements

, Comma , separates elements of an array

; Semicolon ; suppresses screen printing, also denotes a new row in an array

... Ellipsis ... Continues a line

* Special variables and Constants

Command	Description
ans	Temporary variable containing the most recent answer

For ex if you write in the command window

>> 10/10 (click enter)

ans = 1 ⇐ matlab will save your answer in the avariable ans

eps	Specifies the accuracy of floating point precision $\epsilon = 2.2204460492503131e-016$ $\downarrow$ $= 10^{-6}$
i, j	The imaginary unit $\sqrt{-1}$, ($\angle 90°$)
Inf	Infinity (∞) For ex. $7/0 = \infty$
NaN	Indicates an undefined numerical result (Not a Number) For ex. 0/0
pi	The number π

* note that you can overwrite an existing variable for ex: pi = 5 so pi becomes 5 and not π and to let it go back to the defined value (saved) >> clear pi

* How to write a matrix using matlab

ex: $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$

```
>> V1 = [1, 2, 3; 4, 5, 6]
   or
>> V1 = [1 2 3; 4 5 6]
```

* `>> 8/5+7` (enter) ⇒ is equal to
  `16^2`

بنزل سطر

```
11
8/5+7 16^2
```

* How to represent a matrix with a regular step array

ex: $V_4 = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]$

i write it as

```
V4 = 1:10
```

what if i want the odd numbers

```
V5 = [1:2:10]
```

للتوضيح

1 ↓ Initial Value, 2 ↓ step, 10 ↓ Final value

How to plot a sine wave using matlab

- note that matlab deals with radian with all trigonometric functions

- to plot use the commad

```
» plot(a, b)
```

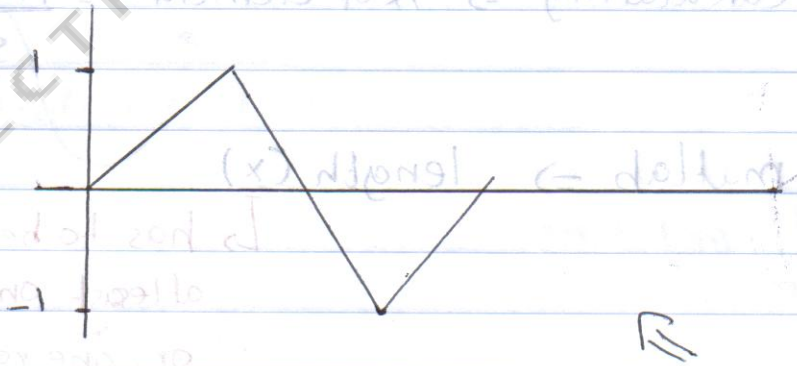
x-axis y-axis

this command takes two arrays, should be the same size

- matlab functions are vectorized functions

لأن يطبق على كل العناصر

Ex:
```
a = [0, Pi/2, Pi, 3*Pi/2, 2*Pi]
b = Sin(a)
plot(a,b)
```



This is what we will get

Why??

لأن عدد النقاط غير كافي حتى يبين the sine wave

So to fix this we use more points

- To do that we will use the colomn operator

```
t= [0 : 0.1 : 2Pi]
```

↳ The step, you can use 0.01 or 0.1

```
V= sin (t)
plot (t,v)
```

This was one of the firs quiz questions

* To know number

```
a= intial : step : final
```

by Calculating ⇒ # of elements = $\frac{\text{final - intial}}{\text{step}} + 1$

by matlab ⇒ length (x)

↳ has to be a vector atleast one line or one row

* Exe Plot One cycle of $v = \sin(\pi t)$

$\omega = \frac{2\pi}{T} = 1$

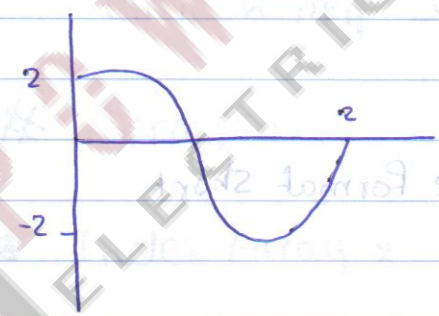
$T = 2\pi \Rightarrow \frac{2\pi}{T} = \pi \Rightarrow \boxed{T = 2}$

```
>> t = [0 : 0.1 : 2]
   v = sin (pi * t)
   plot (t, v)
```

* Exe Plot one cycle of $v = 2\sin(\pi t)$

$T = 2$

```
>> t = [0 : 0.1 : 2]
>> v = 2 * sin (pi * t)
>> plot (t, v)
```



* note on J and i :

in math we write e.g $3 + J4$ but in matlab J4 is considered to be a variable so

we either write it as 3+J*4

or 3+4J

↓

* The number before ↑ or J

but in the case of two variables I have to use the multiplication sign

** 7/2i ⇒ 0-3.500i

7/2*i ⇒ 0+3.500i } Comes from $\frac{1}{i} = -i$

» 4i/2 ⇒ $\frac{2}{4i}$ = 0-0.5i

- Format long and Format short

» Pi

ans =

3.1416 This is the Format short

» Format long

» Pi

ans =

3.141592653589979

to take it back to the short format re write

» Format short

>> format short e
>> format long e
↳ exponential function
هاي بتخلي رقم واحد بس قبل الفاصلة العشرية

Ex:

>> format short
>> 22017
ans =
31.4286

>> format short e
>> 22017
ans =
3.1429e+001

To see the help decumantation for matlab

>> demo

OR

click on help → help product → demo

Arrays:

- Index Array : لتحديد موقع العنصر في المصفوفة

Ex: a = [5 4 0 3]
① ② ③ ④

if i want the first element in the matrix
>> a(1)
ans =
5

This answer is the value of the index number

>> a(0)

??? error massage because the index in matlab starts from 1 not zero and you have to know that the index must be positive integer

>> a(6)

??? Index exceeds matrix dimenssions

Polynomial

$$a_n x^n + a_{n-1} x^{n-1} + \cdots\cdots a x^1 + a_0 x^0$$

⇒ zeros / Roots of Polynomial Function

instead of using numerical ways to find the roots, we just use the command

>> roots (Polynomial)

Ex: $P(x) = 3x^3 + 4x^2 + 2x + 1$

I can't write the Function's mathematical expression so :-

1- define it as an array

>> P = [3 4 2 1]

Write the constants

>> r = roots (P)

r =

_
_
_
_

The answer

* number of Coefficients in the array should be the highest Order + 1

Ex: $f(x) = 3x^3 + 1$

>> f = [3 0 0 1]
>> r = roots (f)
or
>> roots ([3 0 0 1])

※ Math. Function Library

Math	Matlab	
e^x	exp(x)	
$\sqrt{x}$	sqrt(x)	
$\ln x$	log(x)	Natural Logarithem لوغاريتم طبيعي
$\log_{10} x$	log10(x)	
$\sin x$	sin(x)	
$\cos x$	cos(x)	
$\tan x$	tan(x)	
$\sin^{-1} x$	asin(x)	
$\cos^{-1} x$	acos(x)	
$\tan^{-1} x$	atan(x)	

↑ radian

※ How to do files on matlab

We have different types of files such as

① → MAT. Files → if you were working and have variables that you want to save on the work space even after you turn your Pc off use

```
>> save   name
```

② → M. Files

Your variables will be saved in "name" and you can find them in your current directory

→ now if you want to retrive your variable

```
>> load   name
```

The second way is to write your commands other than on your Command window is to creat an M-file

File → new → M-File

or

File Edit Debug Desktop window help

↑ click this

M-files .m → Script File

→ Function File ___ (Chap 3)

* Ex: On an M.File write $f(x) = 3\sin 3t$

$\omega = 3 = 2\pi f$

$T = \frac{1}{f} = \frac{2\pi}{3}$

```
>> t=[0:0.1:2*pi/3]
>> v=3*sin(3*t)
>> plot(t,v)
```

→ Save it

So to run it

① Debug → run (F5)

or ② ▷

or ③ ↓

or ④ From the command window

you will see that no interactive mode in the script file not like the command window

→ Write the name of the file, press enter, it will run by it self

Matlab لل أولويات في أكثر
ex. where will the matlab search if you wrote r !!

① Variables
② Math. Library
③ Current Directory (m.file)
④ Search path
⑤ error massage undefined function or variable

» So if we wrote r , it will start looking from 1→5 when ever it finds it it will bring it and stop !! thats why it's better use unused variable and not overwrite on them

»What , »dir → shows the files in the directory , the difference between them:
dir : shows all files in the current directory
what: shows only matlab files

» Pwd → to see what is [which] your current directory

※ The string variable

ex. I want to write "matlab course"

```
>> V= matlab course   ✗ wrong
```

```
>> V='matlab course'
```

Cause matlab will look for the numerical value of the word so use cotation

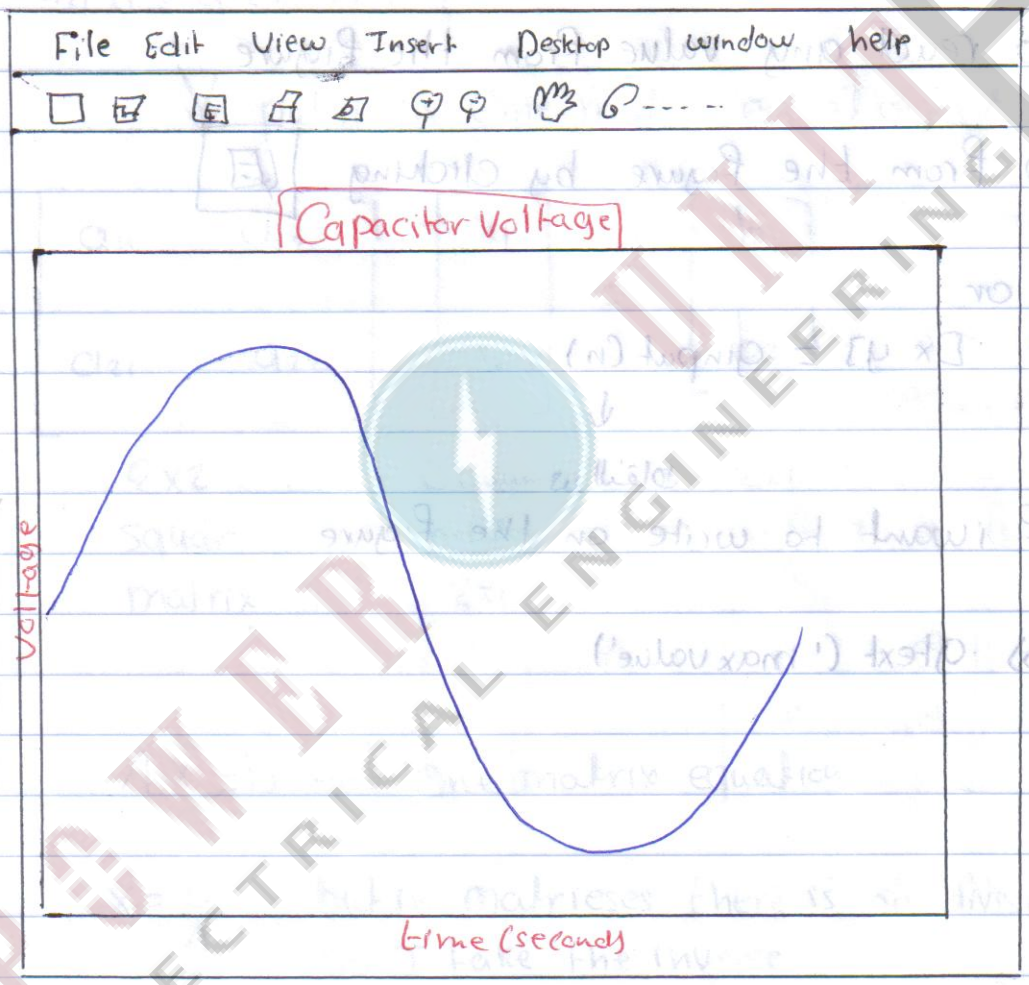
```
size = 1x13

>> V(3)
   ans =
         t

>> V = '5+6'
   V =
      5+6
```

n't 11

※ Commands for Plotting



How to add labels:

>> title ('Capacitor voltage')

↑ The Command

↑ String array

>> xlabel ('time (second)')
>> ylabel ('voltage')

To read any value from the figure

① From the figure by clicking 

or

② [x y] = ginput (n)

↓

عدد النقاط

if i want to write on the figure

>> gtext ('max value')

※ Solving linear Algebric Equations

$a_{11}x_1 + a_{12}x_2 = b_1$ --①

$a_{21}x_1 + a_{22}x_2 = b_2$ --②

⇓ put it in One matrix equation

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$$

2x2 squar matrix | Coulum matrix 2x1 | 2x1

$Ax = b$ ⟶ One matrix equation

$x = \frac{b}{A}$ but in matrieses there is no division so I take the inverse

$x = bA^{-1}$

* Remember the identity matrix $I = AA^{-1}$
* $A^{-1}A \neq AA^{-1}$

* So $A^{-1}Ax = bA^{-1}$ is wrong

$Ax = b$

$A^{-1}Ax = A^{-1}b$

$x = A^{-1}b$

2×2 2×1

x [2x1] size

* $b * A^{-1}$

2×1 2×2

it's wrong

I can't multiply

* Ex: Solving equations by matlab

$3x - 4y = 5$

$5x + 3y = 10$

First write it in matrix form

$$A = \begin{bmatrix} 3 & -4 \\ 5 & 3 \end{bmatrix} \quad b = \begin{bmatrix} 5 \\ 10 \end{bmatrix}$$

$x = A^{-1}b$

2nd use inv(x) which will give you the inverse of a squar matrix

```
>> a = [3, -4; 5, 3];
>> b = [5; 10];
>> q = inv(a) * b
```

x = q(1)

y = q(2)

* Anothe way to Solve it is by usiney the back slash

$$A \backslash B = inv(B) * A$$

Ex: $5x - 4y + 3z = 10$

$3x - z = 5$

$y + z = 3$

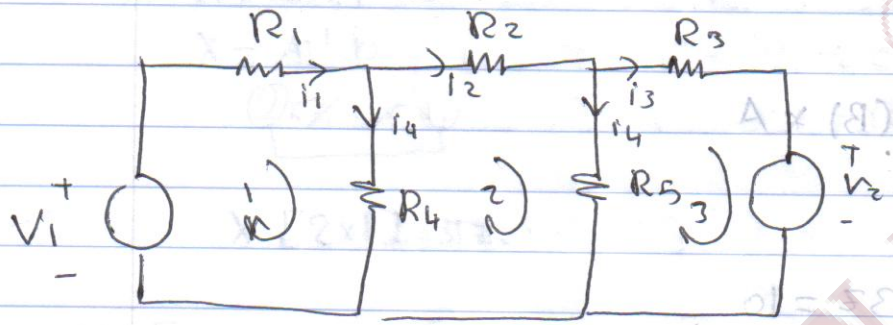
$$A = \begin{bmatrix} 5 & -4 & 3 \\ 3 & 0 & -1 \\ 0 & 1 & 1 \end{bmatrix} \qquad B = \begin{bmatrix} 10 \\ 5 \\ 3 \end{bmatrix}$$

```
>> a = [5, -4, 3; 3, 0, -1; 0, 1, 1];
>> b = [10; 5; 3]
>> q = inv(a) * b
```

OR

```
>> u = a\b
```

Ex8



Find i_1, i_2, i_3, i_4, i_5 using matlab

$$R_1 i_1 + R_4 i_4 = V_1 \quad \text{---} \ (1)$$
$$-R_4 i_4 + R_2 i_2 + R_5 i_5 = 0 \quad \text{---} \ (2)$$
$$-R_5 i_5 + R_3 i_3 = -V_2 \quad \text{---} \ (3)$$

$$i_1 = i_2 + i_4 \quad \text{---} \ (4)$$
$$i_2 = i_3 + i_5$$

→ This is H.W 1
- Solution should be on a script file
- email it to w.anabousi@yahoo.com
- write the title as (H.W 1 - yourname)
- Save the script file with your name
- Due date is on Monday

V_1 = The last number in your university number

V_2 = 2 X The last num in your id num

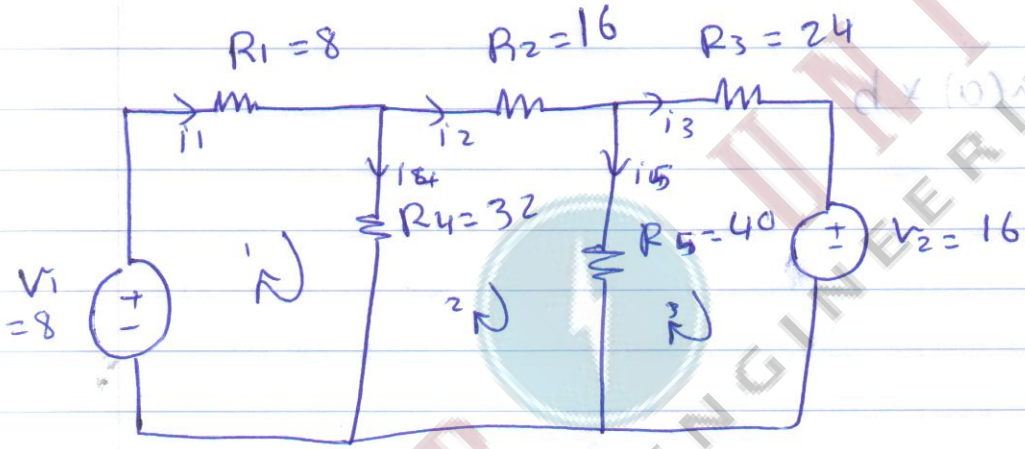
R_1 = the last num in your uni id num

$R_2 = 2x$ //

$R_3 = 3x$ //

$R_4 = 4x$ //

$R_5 = 5x$ //



$-8 + 8i_1 + 32i_4 = 0$

$8i_1 + 32i_4 = 8$ — ①

$-32i_4 + 16i_2 + 40i_5 = 0$ — ②

$-40i_5 + 24i_3 = -16$ — ③

$i_1 - i_2 - i_4 = 0$ — ④

$i_2 - i_3 - i_5 = 0$ — ⑤

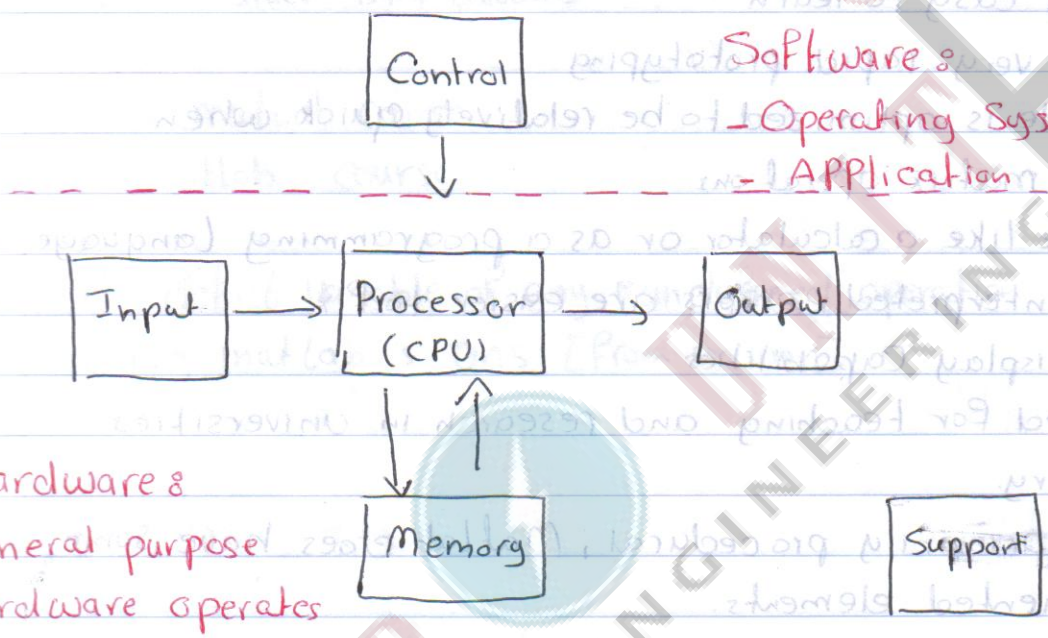
$$A = \begin{bmatrix} 8 & 0 & 0 & 32 & 0 \\ 0 & 16 & 0 & -32 & 40 \\ 0 & 0 & 24 & 0 & -40 \\ 1 & -1 & 0 & -1 & 0 \\ 0 & 1 & -1 & 0 & -1 \end{bmatrix} \qquad B = \begin{bmatrix} 8 \\ 0 \\ -16 \\ 0 \\ 0 \end{bmatrix}$$

```
a = [8,0,0, 32,0; 0,16, 0, -32,40;
     0,0,24,0, -40; 1,-1,0,-1,0;
     0,1,-1, 0,-1];

b = [8; 0; -16; 0; 0];

q = inv(a) * b
```

Computer, Simplified Block Diagram



Came as first two questions in the first quiz

MATLAB: is a high-performance Language for technical Computing. It integrates Computation, visualization and programming in an-easy to use environment where problems and solutions are expressed in familiar mathematical notation. MATLab is an interactive system whose basic data element is an array that doesn't require dimensioning

- MATLAB stands for MATrix LABoratory.

POWER UNIT

Matlab

NoteBook

Eng. We'am Anabousi
By: Sandrine Yamin

#بأفكارنا_نُبدع

3rd $ 4th weeks

* We have two ways to write commands:

1) Script Files
2) Command window

The advantages of using the script files
→ you can save it
→ you can change in it when ever you want

* if you were working on the command window and wanted to save your work use the command diary

» diary space the name you want to save it with

and to stop saving

» diary space oFF

note saving using this method will save your work on a text file [which will save it like a screen shot]

* How to write comments using matlab, which will n't be combiled, bat would be there for the user to read
use % sign

» % what ever you want to write ⇐ will appear in green

Programming style

1- Comment Section
% File name + key words % programer name + date % list of variables % user defined functions
2- input section
3- Calculation section
4- Output section

Input Commands : To let the user choose the variables

⇒ For numeric values

```
>> input('جملة توضيحية لك')
```

String شكل

⇒ For string values

```
>> input ('whatever you want', 's')
```

↑ S here to show it's a string value

Ex 8

```
>> v= input ('input your name :', 's')
>> input your name  Sandrine
>> v * 10
>> ans =
    1150  970  1100
```

you input it after the input Command

→ as you see these number are the ASCII Codes of the letters multiplied by 10 Cause it's not a numerical value

» The Command display
to display any variable you want (numeric or string)

```
>> disp (Variablename)
```

※ The help documentation

→ Write doc on the Command window you will get the help Browser
→ or Click on help
→ or the Command look for

* ex: i want to search the inverse function

>> lookfor inverse
>> help inv
↑
In the help command you have to know the exact spelling of the function

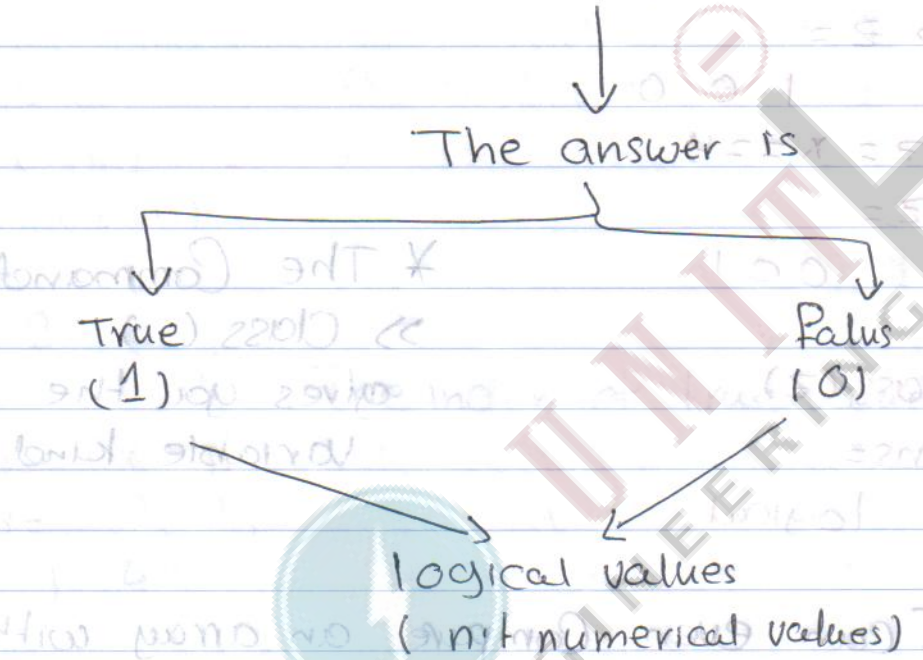
>> doc inv
↳ will open in the help browser

* Relational Operators

>=	greater than or equal
<=	less than or equal
<	less than
>	Greater than
==	equal equal
~=	not equal

note : = assignment operator
== relational operator

>> 5+6 /3 > 5 This is a logical statement



*examples

```
>> 5>6
ans =
     0
>> 5==6
ans =
     0
>> 5~=6
ans =
     1
```

```
>> x=[ 6 3 9];
>> y=[ 14 2 9];
>> z= x>y
>> z =
     0  1  0
```

⇓ will Compare element by element

* note. that x, y should be the same size to not get an error massage.

```
>> z = x<y
>> z =
     1  0  0
>> z = x==y
>> z =
     0  0  1
>> Class(z)
ans =
   logical
```

* The Command
>> Class ( )
gives you the variable kind

→ I can even Compare an array with a scalar variable

```
>> X > 8
ans =
   0  0  1
```

⇒ array بطلع كده
لأن بياخد كل عنصر لحاله

* The Command find
it gives us the index of non-zero elements in the array

```
>> x = [-2 0 4]
>> find(x)
>> ans =
     1  3
```

← The index
it starts from 1 n't zero

Find (logical statement)

```
» x = [ 6   3   9   11 ]
» y = [ 19  2   9   13 ]
» Find (x>y)
  ans=
      2  ←
```

The index of true value

```
» Find (x<y)
  ans=
      1   4
```

So the Find Command give us

→ The array index of non-zero value elements

→ Logical index of true values

Input argument of arrays

* To get elements from an array

→ array variable (Index (Positive Integer))

X(3) x رجعلي العنصر ٣ في المصفوفة

→ X (Index (array))

x ([1 3]) رجعلي العنصر ١ و ٣ في المصفوفة x

→ x (logical statement)

رجعلي منين العناصر اللي عندها القيمة صحيحة

*Ex:

```
>> x = [ 6  3  9 11];
>> y = [ 19 2  9 13];
x (x>y)
ans =
    3
```

note that the difference between the find command and the input arrgument of an array is that one gives you the value and the other gives you the index

```
>> z = [1 2 3 4]
>> z (x<y)
   z ( 6  3  9 11)
>> y (x<y)
   y ( 6 3 11)
```

✳ Conditional statements

1. If statements
2. switch statments (Chap 4)

② How to write if statements

- Simple if statement

```
if    condition
    Commands
end
```

- more Conditions

```
if    Condition 1
    Commands
elseif    Condition 2
    Commands
elseif
    Commands
else
    Commands
end
```

⇒ note that Only one Condition will be Combiled and we write elseif as one word otherwise we have to write end after each one

* Ex : $y(x) = \begin{cases} 15 * \sqrt{4x} + 10 & x \geq 9 \\ 10x + 10 & 0 < x < 9 \\ 10 & x < 0 \end{cases}$

```
x = input('Enter the value of x')

if x >= 9
y = 15 * sqrt(4*x) + 10;
elseif x >= 0 & x < 9
 y = 10 * x + 10
 else
 y = 10
 end
```

this is right but we don't have to write it cause if it was > 9 it won't get to this command

✱ Loop Statement

① For - loop
② while - loop

```
For  i = m : s : n
Commands
end
```

→ this is the counter

m: starting value — s: step — n: final value

loop ①
$i = m$

loop ②
$i = m + s$

$\frac{i = n}{i \le n}$

✱ example

```
m = 0;  x(1) = 10;
For k = 2 : 3 : 11
m = m + 1
x(m+1) = x(m) + k^2;
end
```

لازم نعرف قبل الـ For loop

This means it adds elements on array x

This is considered a simple statement لأن عدد الـ loop قليل

②

While Condition
  Commands
end

→ This is a loop Condition will keep on repeating it self as long as the Condition is satisfied (true) when it stops being true it will step out of the loop.

→ variables have to be defined
→ our variables should reach the false condition to get out of the loop cause if it didn't we will get run-time error

Ex:

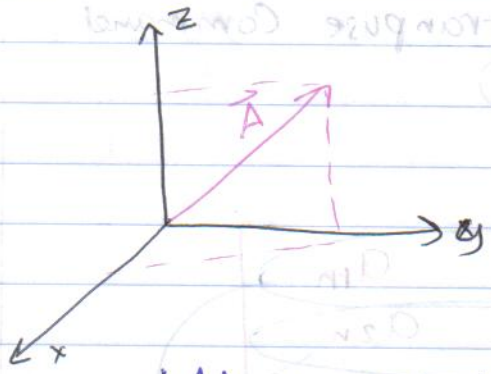
```
>> x=5
>> k=0
>> while  x<25
   k = k+1
   y(k) = 3*x
   x = 2*x-1
   end
```

```
>> y= 15 14 51
>> x = 33
```

↓

it's not an array اعملنا حوتوا over write

✻ Chap 2 ✻



|A| = magnitude

→ To represent a vector

① magnitude + orientation

② take its components from x, y, z

$\vec{v} = x\hat{i} + y\hat{j} + z\hat{k}$

in matlab

One dimentioned array

ex: x=3, y=4, z=8

v = [3 4 8]

So in matlab we write the vectors as:

one raw or on Column

→ One dimentioned matrix [1 * m]
[N * m]

صف واحد او عامود واحد

→ two dimentioned array [N * M]

→ we represent vectors in 3 dimentional arrays

هنا نحتاج نبدل من صف لعمود وبالعكس ←

we use the tranpuse command

①

$$A=\begin{bmatrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2n} \\ \vdots & & & & \\ a_{m1} & \cdots & \cdots & \cdots & a_{mm} \end{bmatrix}$$

$$A'=\begin{bmatrix} a_{11} & a_{21} & & a_{m1} \\ a_{12} & a_{22} & & \\ a_{13} & a_{23} & & \\ \vdots & \vdots & & \\ a_{1n} & a_{2n} & & a_{mn} \end{bmatrix}$$

* ex: $r = \begin{matrix} 3 \\ 5 \\ 8 \end{matrix}$

$r' = \begin{matrix} 3 \\ 5 \\ 8 \end{matrix}$ → note that this didn't change the r to change it $r = r'$

```
>> r = [1;4;5]
r =
     1
     4
     5
r' =
     1   4   5
```

```
* v = 3
      5
      8
```

```
r = 1
    4
    5
```

```
w = [v, r]
w =
     3   1
     5   4
     8   5
```

⇒ I can build a matrix using other matrices

[3x2] matrix that is built based on v and r

```
w1 = [1; 3; v]
w1 =
     1
     3
     3
     5
     8
```

```
w2 = [v; r]
w2 =
     3
     5
     8
     1
     4
     5
```

W3 = [v' r']

W3 =

3 5 8 1 4 5

W3 = [v' ; r']

W3 =

3 5 8
1 4 5

لبقدر نشكل اي matrix اكسترا من اي
array نفس الشي او الـ Size صح!!

W5 = [v' r]

??? error using ==> horzcat
all matrices on a row in the
braketed expression must have
the same number of rows

⇒ $r = m:s:n$

To know the final value in r that will reach to m

$\frac{n-m}{s}$ → it has to be an integer

⇒ number of elements

$\frac{n-m}{step} + 1$

$r = 5 : 0.1 : 8$

this is equal to 31

$\frac{8-5}{0.1} + 1 = 31$

* another way to write the vector when we don't have the step, but we know the number of elements

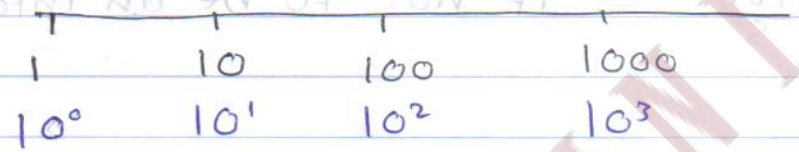
(two adjecent elements in an array with equivelent space)

a = lenspace(m, n, k)

- m → initial value (انتشار spaced element)
- n → final value
- k → number of element (1-N)

⁂ What if we have an array that is linearly spaced logathermically

وهي الأسطر تكون متساوي



if I take $\log_{10}$ to these elements it can be represented as linearly space elements (logathermically space elements)

I use the Commanel

Log space (a, b, n)

10^a 10^b

number of elements

If Im not using matlab i can find the array by

$$\text{Step} = \frac{b-a}{n-1}$$

* Exo

logspace (-1, 1, 4) find the array

10^{-1} $10^{-1+\frac{2}{3}}$ $10^{-1+\frac{2}{3}+\frac{2}{3}}$ 10^{1}

Step = $\frac{1 - -1}{4-1} = \frac{2}{3}$

※ you should be able to know the difference between

① Magnitud & length of a vector

② length & number of elements in a vector

③ amplitude & length with Complex numbers

④ absolute value

* Ex:

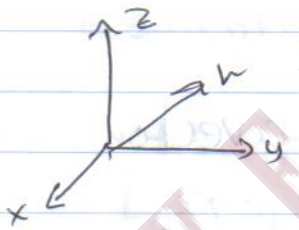
```
x = [2 -4 5]
a = [1 2 3; 4 5 6]
```

» Length (x)

Check it in matlab

» length (a)

» The magnitude of a vector



$mag = \sqrt{x^2+y^2+z^2}$

to find it

```
sqrt( v(1)^2 + v(2)^2 + v(3)^2)
```

but this along way

So we can use

```
sqrt [v * v )
```

$$\text{sqrt}\left(\begin{bmatrix} 2 & -4 & 5 \end{bmatrix} \times \begin{bmatrix} 2 \\ -4 \\ 5 \end{bmatrix}\right) = |v|$$

✱ what if i used (v' * v)

That will n't give me a scalar value 3*1 * 1*3
The size will be 3x3
which is wrong in this case!!

Size التي لا

» Norm of a vector ≡ magnitud (only to vectors)

» norm (vector)

» To get the length of complex vectors use the command abs (absolute)

```
» abs(-4)
ans =
     4
» abs( 4+3i)
ans =
     5

» abs (-4+3i)
ans =
     5
```

$\sqrt{4^2+3^2} = \sqrt{16+9}$
$= \sqrt{25} = 5$

```
>> abs( [2 -4 5+5i])
ans =
    2    4    7.0711

>> norm( [2 -4 5+5i])
ans =
    8.3666
```

⁂ Indexing and addressing

```
>> x = [2 -4 5]
   x(2)
   ans =
        -4

>> x(2:3)
   ans =
        -4  5

>> x(1:3)
   ans =
        2  -4  5
```

What if i want from 2 to -3

x(2:-1:-3) → to write it this way is wrong because it should be positive integer that starts from 1 (not zero)

⁂ How Can i get the index of a matrix element

For ex >> B = pascal (5)

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix}$$

>> b (11)
ans =
1

>> b (end)
ans =
The value of a55
العنصر الاخير في المصفوفة

>> b(2:5)
ans =
1 1 1 1

طلع كل شكل صف
لأن ال output طلع كل شكل ال input
فلان ال Input
is a row
the output is
a row

```
>> b((2:5)')
ans =
     1
     1
     1
     1
```

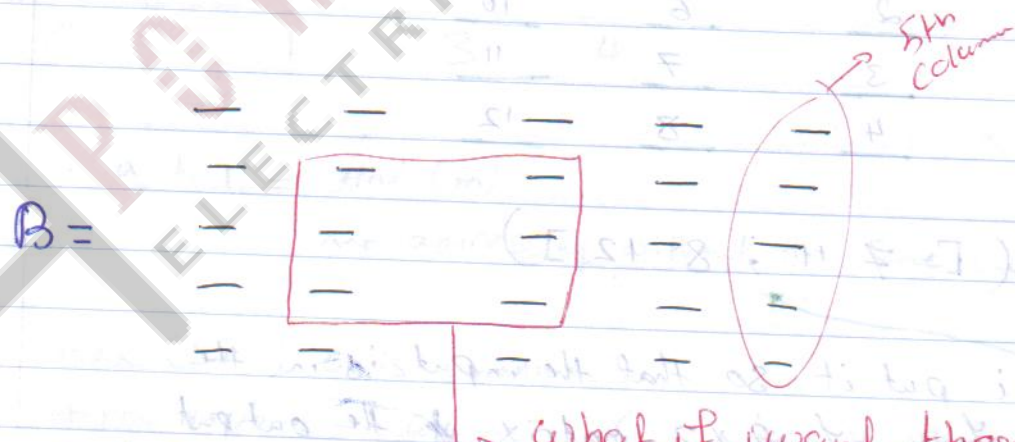
```
>> b(:)
```

The output column vector has all the elements in the matrix

(كل العناصر دائمًا بترجع كـ شكل كاعمود) كـ شكل كاعمود

* another way to get elements from a matrix

y(___ , ___)
صف كاعمود



B(2:4, 2:3)

or

B([2 3 4], [2 3])

or B(:, 2:3)

What if i want the 5th column

B([15 ; 55]')
B([15 ; end]')
} indexing

B (: , 5)
B (1 : 5 , 5)
B (1 : end , end)
} addressing

A =

1	5	9
2	6	10
3	7	11
4	8	12

A ([7 11 ; 8 12])

i put it so that the input is in the form of 2 x 2 matrix & the output is also in the form of 2 x 2 matrix.

* find : index non - zero elements.

[q , b , w] = find (b)

Z = Find (b)
→ index of non- zero elements.

m = [1 0 ; 3 4]

row colom value
[a b c] = find (m)
Same value number

a = 1 2 2

b = 1 1 2

c = 1 3 4

[a b] = find (m)
→ addressing without the same value.

max (b) ; b is amatrix.
⇒ row vector . colom. اكبر عنصر في الصف في كل

max (vector)
→ maximum element in the array.

min (b)

↝ minimum element in every colomn

min (Vector)

minimum element in the vector.

[a , b] = min or max [b]

↓ min or max value يعطي

↘ the index of the elements يعطي

>> size(b) ↝ 5 * 5 (عمود صفوف)

in matlab [5 5]

Sum (b)

Sort command.

m = magic (5)

Sort (m) ترتب ترتيب تصاعدي لكل عامود.

X = [2 - 4 5] ← if i want to change that.

X(3) = 10

X_{new} = [2 - 4 10]

empty matrix

V = [0]   is n't an empty matrix
1x1 matrix this one
has an element

empty matrix means
has no elements

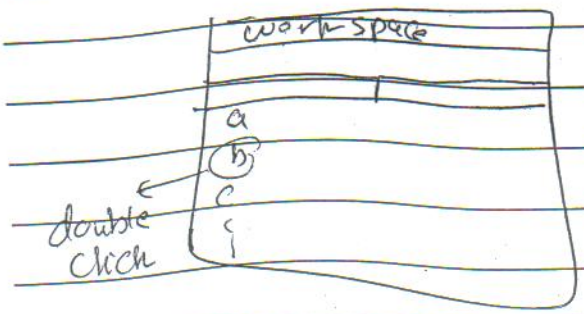
V = [ ]
V =
[ ]

lets say bdy atSalg
mn el 3owamed el
zeedtha abel
3al pascal matrix

b(:, [6 7]) = [ ]

so I use the
empty matrix to
delete elements of
Columns

This all can be done by array editor from work space



Change that you want !!

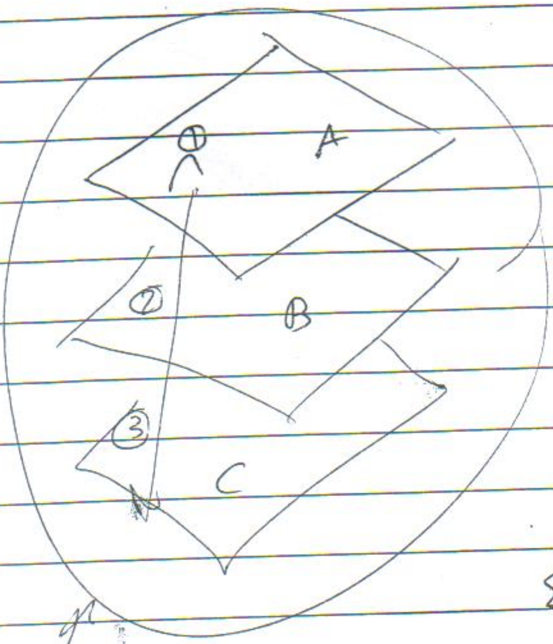
Vectors 1 dimensional Array
matrix 2 " "

how to do 3, 4 -- were gone talk about 3D array

» cat (n, A, B, C, ...)

row * col x □

matrix Z



Z = Cat(3, A, B, C

↑ the 3 matrecies I have

Ex

A = magic(3)

B = pascal(3)

C = [1 1 1; 1 1 1; 1 1 1]

Z = Cat(3, A, B, C)

Z(:, :, 1) =

~~logic~~ magic

So the addressing 3 input arrgument col, row, page

Cause asar 6af a 3amood a page thats the ~~index~~ addresing

Z(:, :, 2) =

pascal

Z(:, :, 3) =

ones

row

wahden

3ala

page

; can W

z_1 = magic(3)

$z_1(:,:,2)$ = pascal(3)

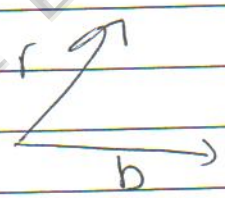
$z_1(:,:,3) = [1\ 1\ 1;\ 1\ 1\ 1;\ 1\ 1\ 1]$

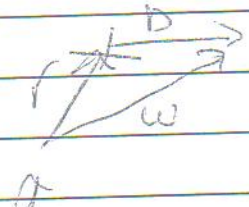
So if ~~ida~~ write

$z_1(:,:,5)$ = pascal(3)

page raqam 4 rah y3beha mn 3ndo agPar

$w = r + b$





by matrix

in matlab

r = [2, 5, 4]

addition and subtraction element by element operation

v = [3, 7, 4]

rw = r + b

w =

5 12 5

w = r − b

−1 −2 3

w = r * r

it's wrong cause 3mlyet el darb 3'alt cause 3

Error
mtimes
Inner matrix dimensions must agree

only be scalar bzbot bekon element by element

⇒ the Dot with darb + 8smen + operator ossos

when u ase it before * darb bseer 3ndy element by element multiplication (array multiplication) el size lazem yt13 nafso thats why lazem both ykono same siz

r*r matrix multiplication (without the dot operator)

⇒ array exponantiation

⇒ array division

P = [1 2 3]

P^2 ← Wrong

Cause el size bkan 3'al 61

to correct it

P.^2

2.^P

>> 2.

ans =

2

25adha 3a 2nha decimal point

>> 2.0^2

This is right

Cause awal wahden decimal el tanyeh operator

r6 * r' Error wrong size.

r * r'

ans =

45 Cause same size

x = [1 2 3]

y = [4 5 6]

$z = e^{y} \sin(x) \cdot \cos^2 x$

z =

13.4119 23.3707 55.7981 exp(y) * sin(x) * (cos(x))^2

Size(z)

ans =

1 3

This wrong Cause x and y are not Scalar so b7ob dot 3ndi kol 3mliyet darb kol 3mliyt 2ossos kol 3mliyet 8smen

Come in the second quiz

Correct it by

z = exp(y) .* sin(x) .* cos(x).^2

Sunday 13/7

exponatiation

operator → .^ element by element exponantiation

$A*B$ matrex multiplication
$A.*B$ array multiplication

$A*B \overset{??}{=} B*A$ No ✗

$A.*B \overset{??}{=} B.*A$ ✓ yes

→ But we have special matrices that it works

⇒ The identy matrix

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

eye(n)

↑ To creat the identy matrix

eye(n,m)

ex: eye(3,2)

ans =

1 0
0 1
0 0

$AI = IA = A$

It's also called unity matrix

m = magic(n)

eye(size(m))

⇒ Zero matrix (it's not the empty matrix)

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$A \cdot 0 = 0A = 0$

the input argument
1 → square matrix
2 → n × m matrix
size

>> zeros( )

⇒ One's matrix

$$m_1 = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

m1 = ones(size)

* Random matrix :

» Rand (n)

» Ranel (n, m)

» Ranel (size (n))

Ex: rand(3)

click it twice you will get (different elements) different matrices
(zndha 3sha 2yer)

low bdy random matrix
tkon el argam mn 5 → 10 only

rand (n) * (b-a) + a

ex: rand (3) * 5 + 5

↑ from 5 to 10

>> magic(3) .* eye (3)

ans =

8 0 0

0 5 0

0 0 2

Cause it's the multiplication so mahtis hye

>> magic(3) * eye(3)

The answer

>> magic of (3) matrix

ans =

8 1 6

3 5 7

4 9 2

>> to do rotation

>> rot90(m) Zay k2no b2lbel ar8am 90°

>> triu(m) lower triangle

>> tril(m) upper triangle

>> fliplr(m)

>> fliprL(m) * is undefined command / function

>> flipud(m)

~~>> repmat~~

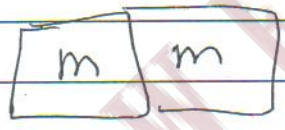
>> repmat (m, 1, 2)

بالعمودي — بالأفقي

بتعمل نسخ

This is the size

ely bhaded Baddadha



3x6

$V_1 = [$

$V_2 = [$

The dot product command

→ dot(V_1, V_2)

→ Cross (V_1, V_2) cross product

→ det(m) determine

→ inv(m)

[V D] = eig (m) ← matrix

eigen value + eigen vector

rank (m)

$VA = \lambda V$

The ~~scalar~~ value is the eigen value

There is an exercise Solve it

* Polynomial multiplication and division

$P_1(x) = 3x^3 + 1$

$P_2(x) = x + 2$

P1 = [3 0 0 1];

P2 = [1 2];

>> Conv

Z = Conv(P1, P2)

↑ mabtrez el tartib

Z =

3, 6, 0, 1, 2

neither matrix multiplication nor . multiplication works here

Esmeh

$x+2 \overline{)\, 3x^2 + 1}$

3akes elcon

array el 1st question

>> deconv(P1, P2) ← btrez2 el tratieb

>> roots(P1)

I have the roots
bdy argas 9shkel
el polynomial

poly(r)

in this examp

r = roots (P1)

then poly(r)

ans =

1 0 -0 0.33

This is the
normalize
eno 8a3mo
3ala ma3amel
akbar as
so ysn 8asmo

3a1 3

* Evaluation of a polynomial

z = 3 * z^f1 - mathmatical expression

but I want from the array

So

Value of the polynomial 3rd x means

V = polyval (P1, x)

↑ el poly ely ddy yah

↑ el 8emeh el 3ndha

v = polyval (P1, 2)

ans = 25

scalar value

V = polyval (p1, [1, 2])

ans =

4 25

How to plot a polynomial without using mathematical expression

P1 → معرفنا شكل Array

X → متغير ما array for ex -10, to

X = [-10 : 0.1 : 10]

Y = polyval (P1, X)

Plot (x, y)

Make sure

Cell array

A = "mat lab class"

B = [10 20 30 40]

C = 10

D = 1 : 100

Bdy agm3

اجمعهم ضمن matrix cell

A + B + C + D in one cell array

A	B
C	D

Cell array
Lagab Elel
26/a3

ليس كيف يحملها

Z(1,1) = {

a = 'matlab class' ;
b = [10 20; 30 40];
c = 10
d = 1:100 ;

z (1,1) = {a}
z (1,2) = {b}
z (1,3) = {c}
z (1,4) = {d}

z = [2x2double] [matlab class] [10] [1x1cell]

each cell has a matrix

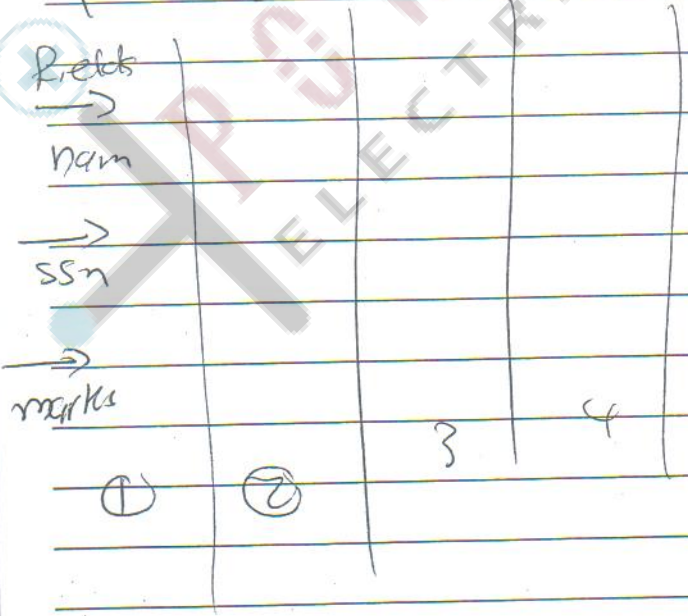
Structure array

Data Base of achar

(Small data Base)

ex :

Student



How to write it on matlab

Student.name = 'ahmad';

↑ دعو اسم structure array called studen

↑ the first field in i).

Student.SSn = '3 3 8 5 6';

↑ bzo6tha ka string array la2no ma7136 beh

↑ 1 for the first student

studen(2).name

* Chap 3

pi, i, j ⟶ in m file,

m-files (.m) → script file
→ function file

Zaal klnaeh
lazem brnamgak
yblash feh
klmet function
other than that it's
a script file

mazya
① has input and output arguments
② return value
③ local veriables

defined fundions

from

Slides

abs(3+4i)

= 5

angle

~~solo~~

↳

Compex number

Conj(c)

~~Ramp(2.7)~~

Round(2.7) لقريب

ans =

3

دي اقرب لاقرب عدد صحيح كمزاجي

x=[2.3 2.7 -2.3 -2.7 4.9]

round(x)

ans =

2 3 -2 -3 5

Ceil(x)

اقرب عدد صحيح
باتجاه ans=
الـ ∞

3 3 -2 -2 5

floor(x)

اقرب عدد صحيح
باتجاه -∞

2 2 -3 -3 4

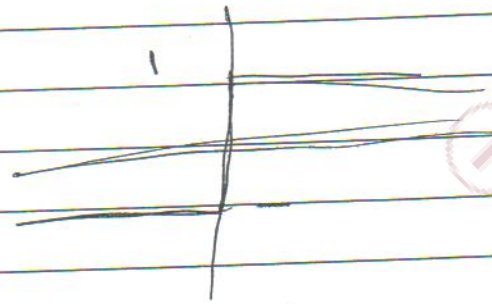
fix(x)

اقرب عدد صحيح ans=
باتجاه
الصفر

2 2 -2 -2 4

زي كأنو شلتنا
الأعداد العشرية
من الرقم

Sign(x) Sgum Function



ans

1 1 -1 -1 1

Sign ([6 -5])

0 ⟶ 0

-ve ⟶ -1

+ve ⟶ 1

* To represent Complex numbers

$x = a_1 + jb = A_1 \angle \theta_1$

$y = c + jd = A_2 \angle \theta_2$

$x \pm y = (a \pm c) \pm j(b \pm d)$

$x * y = A_1 A_2 \angle \theta_1 + \theta_2$

$x / y = A_1 / A_2 \angle \theta_1 - \theta_2$

⇒ To verify this using matlab

x ---

y ---

abs(x*y)

abs(x) * abs(y)

angle(x*y)

=

angle(x) + angle(y)

ref by zowei

in degrees

in radians

~~x = (2 45~~

x = [2 -4 5]

length(sin(x))

↳ sin(x) = [_ _ _]

ans =

3

if iwant el 3ongor el tany min sin x

» sin(x(2)) ⇐

اكتب رقم الاندكس

sin(30) ↳ Radian

sind(30) → bdeer in degrees

$sin^2(x)$ ⇒ sin^2(x) ⇐ Wrong !!

sin(x).^2

• عشان اضرب اسبق حد فيهم

Sin(sqrt(x)+1)

مافي داعي اصلاً

Sin and sqrt لأن

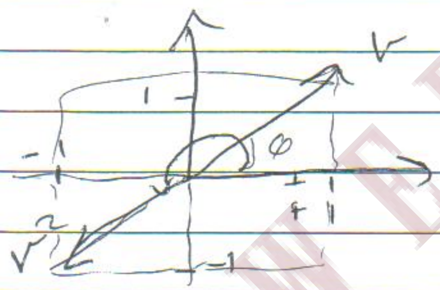
are vectorized functions

~~Sin~~

⇒ $\tan^{-1}(x)$ ⟶ atan(x)

atan2(y, x)

have two functions — y/x



$\theta = 45^\circ = \tan^{-1}\frac{1}{1}$

theta1 = atan(1/1)

theta1 = 0.7854

theta2 = atan(-1/-1)

= 0.7854

thats why we use 2 atans

لبيعتن معه (لو) استعمل vectors

3ashan 2 input arrguments

theta = atan2(-1,-1)

= -2.3562

4466

350

رجع الزاوية بالراديان الصحيح

Hyperbolic Functions

	Inverse
sinh(x)	asinh(x)
cosh(x)	acosh(x)
⋮	
f	

* User defined Functions

Editor

Command Section

function [outputvariables] = Functionnam( ) ⟸ suits a function file

inputvariables

Only Comments are allowed to be written before the Word function, in user defined Function.

* Ex

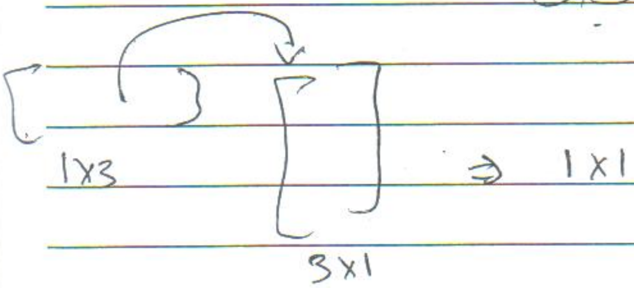
```
a = Fun (x, y)
```

```
Function [z] = Fun (x, y)
u = 3 * x
z = u + 6 y.^2
end
```

bzalet I have one output argument bzdar astany 3an el squar brakets but more than have to put them

Dot ال dot غلط
wazt el matrix multiplication

metl 3af عمود
او عمود بعض



Save your program

script file I can run it
after saving it

Kona nstad3eh by typing it
name
but in user define
you should put the
input arrgument

fun(3, 7)
u =
9
z =
303
ans =

local variables

φ = Fun([1:5] @ [2 4 6 5 15])

length(φ)

ans = 5

x = 3, y = 7

φ = Fun(φ x, y)

12:40 - 2:40

function esmo circle

yehseb el mo7eb

+ el masaha

```
function [C, A] = Circle(r)
C= 2*pi*r;
A= ~~2*pi*r^2~~
   pi*r.*^2
end
```

لو مابين انزل

ح ج) او

input او nor output like ascript file

function اسم (The name)

el farq beton ehe

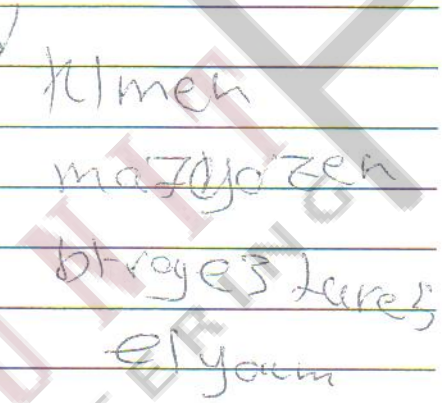
el user defined variables

beton local

Function Show-date

Today = date

end



>> Show - date

today =

15 - Jul - 2014

Re write ~~date~~

>> today

Undefined function or variable (remember, it's called variable)

u = Show-date

Error cause the function has zero output argument

* inv(A) matrix

sin (x) → radian

3 functions there input argument is other function

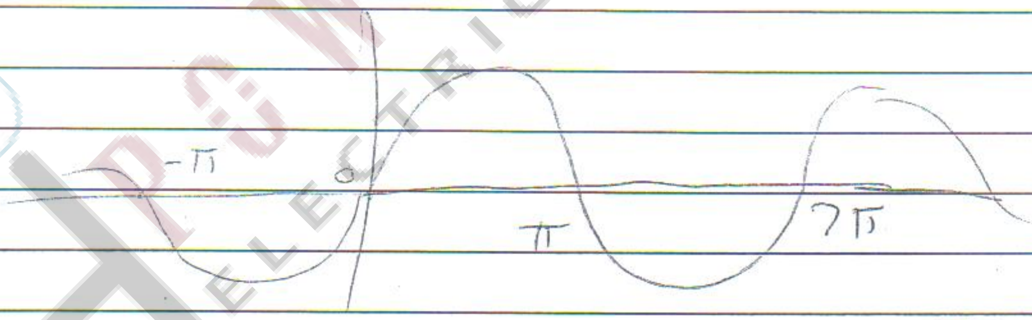
its nos is function function

① fzero { gets you zeros of the function }

fzero(function name , x_0)

↓

for ex. sin



$\pm n\pi$

number of zeros = infinity

x_0 bdakh t36eh element awalyen

adesh 3emel el axes
el kan 3ndha el function
= zero

x = fzero(sin(x), 0.2)

Remember
this is wrong
sin(x) mesh mo3rafeh

so 3asham nstad3 el sin

x = fzero('sin', 0.2)

We have 4-ways → Charater array
→ String expression