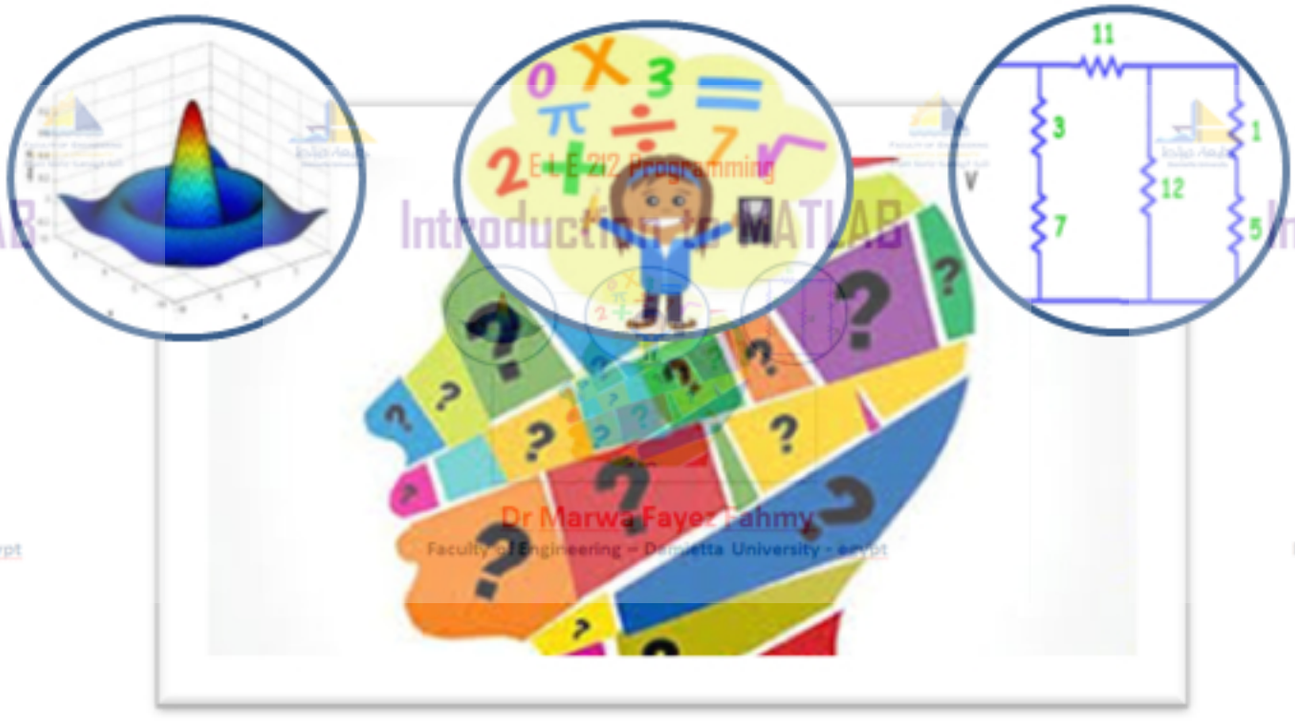
E L E 212 Programming

Introduction to MATLAB



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Lecture 6

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Chapter 4

Arrays : Vectors & Matrices

التعامل مع المصفوفات:

Example 29:

```
>> A = [1 2 3; 4 5 6; 7 8 9]
A =
     1   2   3
     4   5   6
     7   8   9
>> A (3, 3) = 0
A=
     1   2   3
     4   5   6
     7   8   0
>> A(2,6)=1
A =
     1   2   3   0   0   0
     4   5   6   0   0   1
     7   8   0   0   0   0
```

جعل العنصر في الموقع (2, 6) قيمة 1
وبما أن المصفوفة A لا تمتلك ستة
أعمدة، لذلك سيقوم البرنامج بتوسيعها
حسب الضرورة ويضع بقي العناصر صفر

Example 30:

```
>> A = [1 2 3; 4 5 6; 7 8 9]
A =
     1   2   3
     4   5   6
     7   8   9
>> A (:, 5) = 4
A=
     1   2   3   0   4
     4   5   6   0   4
     7   8   9   0   4
A (:, 4) = [7; 5; 6]
A =
     1   2   3   7   4
     4   5   6   5   4
     7   8   9   6   4
```

- Set column 5 by 4 and add column 4 by zeros
- Sets column 4 by [7,5,6]

Example 31:

```
>> A = [1 2 3; 4 5 6; 7 8 9]
A =
     1   2   3
     4   5   6
     7   8   9
>>  diag (A)
ans =
     1
     5
     9
>>  diag (A,2)
ans =
     3
>> [i, j] = find (A > 6)
i =
     3
     3
     3
j =
     1
     2
     3
```

القطر الرئيسى :diag(A)
بداية من الصف الاول
والعمود الاول

- القطر diag(A,2)
الرئيسى بداية من الصف
الاول والعمود الى بعد
الثاني (الثالث)

Example 32:

```
>> v = rand (1, 6)
v =
    0.3046    0.1897    0.1934    0.6822    0.3028    0.5417
>> max (v)
ans =
    0.6822
>> [mx, i] = max (v)
mx =
    0.6822
i =
     4
>> min (v)
ans =
    0.1897
>> [mn, j] = min (v)
mn =
    0.1897
j =
     2
```

- القيمة العظمى max
- القيمة الصغرى min

Example 33:

```
>> B=[2 3;5 1;4 6];
>> max (B)
ans =
     5   6
```

→ داله **القيمة العظمى** في المصفوفة الثنائية ينتج عنها القيمة العظمى فى كل عمود

- لو مطلوب القيمة العظمى فى المصفوفة الثنائية كلها نكتب :

```
>> m=max(max(B))   or   m=max(B(:))
m=
     6
```

- لو مطلوب مكان القيمة العظمى فى المصفوفة الثنائية كلها نكتب :

```
>>[I,j]=find(B==max(max(B)))   or   [I,j]=find(B==max(B(:)))

i=
     3
J=
2
```

Example 34:

```
>> A = [1 2 3 4; 5 6 7 8]
A =
     1     2     3     4
     5     6     7     8
>> numel (A)
ans =
     8
>> S = size (A)
S =
     2     4
>> [r, c] = size (A)
r =
     2
c =
     4
>> length (A)
ans =
     4
```

- numel عدد العناصر الكلى
- عدد الصفوف وعدد الأعمدة size
- Length عدد الاعمدة
- Length(A(:,1)) عدد الصفوف

➢Deleting a Row or a Column in a Matrix:

You can delete an entire row or column of a matrix by assigning an empty set of square braces [ ] to that row or column. Basically, [ ] denotes an empty array.

Example 35:

let us delete the fourth row of a

```
>>a = [ 1 2 3 4 5; 2 3 4 5 6; 3 4 5 6 7; 4 5 6 7 8];
a( 4 , : ) = []
```

```
a =
     1     2     3     4     5
     2     3     4     5     6
     3     4     5     6     7
```

Example 36:

let us delete the fifth column of a .

```
>>a = [ 1 2 3 4 5; 2 3 4 5 6; 3 4 5 6 7; 4 5 6 7 8];
a(: , 5)=[]
```

MATLAB will execute the above statement and return the following result :

```
a =
     1     2     3     4
     2     3     4     5
     3     4     5     6
     4     5     6     7
```

Example 37:

In this example, let us create a 3-by-3 matrix m, then copy the second and third rows of this matrix twice to create a 4-by-3 matrix. Create a script file with the following code :

```
a = [ 1 2 3 ; 4 5 6; 7 8 9];
new_mat = a([2,3,2,3],:)
```

When you run the file, it displays the following result :

```
new_mat =
     4     5     6
     7     8     9
     4     5     6
     7     8     9
```

➢Matrix Operations:

Addition and Subtraction of Matrices

You can add or subtract matrices. Both the operand matrices must have the **same number of rows and columns.**

Example 38:

```
a = [ 1 2 3 ; 4 5 6; 7 8 9];
b = [ 7 5 6 ; 2 0 8; 5 7 1];
c = a + b
d = a - b
```

When you run the file, it displays the following result :

```
c =
    8  7  9
    6  5 14
   12 15 10
d =
   -6 -3 -3
    2  5 -2
    2  1  8
```

➢Determinant of a Matrix

Determinant of a matrix is calculated using the **det** function of MATLAB. Determinant of a matrix A is given by **det(A).**

Example 39:

```
a = [ 1 2 3; 2 3 4; 1 2 5]
det(a)
```

```
a =
     1  2  3
     2  3  4
     1  2  5
ans = -2
```

➢Inverse of a Matrix

The inverse of a matrix A is denoted by A^{-1} such that the following relationship holds :

$$AA^{-1} = A^{-1}A = 1$$

- ✓ The inverse of a matrix does not always exist. If the determinant of the matrix is zero, then the inverse does not exist and the matrix is singular.
- ✓ Non-square matrices (m-by-n matrices for which m ≠ n) do not have an inverse.
- ✓ Inverse of a matrix in MATLAB is calculated using the **inv** function. Inverse of a matrix A is given by **inv(A)**.

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Example 40:

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}^{-1} = \frac{1}{ad-bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$

determinant

$$\begin{bmatrix} 4 & 7 \\ 2 & 6 \end{bmatrix}^{-1} = \frac{1}{4\times6-7\times2} \begin{bmatrix} 6 & -7 \\ -2 & 4 \end{bmatrix}$$

$$= \frac{1}{10} \begin{bmatrix} 6 & -7 \\ -2 & 4 \end{bmatrix}$$

$$= \begin{bmatrix} 0.6 & -0.7 \\ -0.2 & 0.4 \end{bmatrix}$$

$$\begin{bmatrix} 3 & 4 \\ 6 & 8 \end{bmatrix}^{-1} = \frac{1}{3\times8-4\times6} \begin{bmatrix} 8 & -4 \\ -6 & 3 \end{bmatrix}$$

$$= \frac{1}{24-24} \begin{bmatrix} 8 & -4 \\ -6 & 3 \end{bmatrix}$$

Example 41:

Create a script file and type the following code.

```
a = [ 1 2 3; 2 3 4; 1 2 5]
inv(a)
```

```
a =
     1     2     3
     2     3     4
     1     2     5

ans =
   -3.5000    2.0000    0.5000
    3.0000   -1.0000   -1.0000
   -0.5000         0    0.5000
```

➢ Division of Matrices

You can divide two matrices using left (\) or right (/) division operators. Both the operand matrices must have the same number of rows and columns. [a/b=a*inv(b)]

Example 42:

```
a = [1 2 3 ; 4 5 6; 7 8 9];
b = [7 5 6; 2 0 8; 5 7 1];
c = a / b
x1=mrdivide(a,b)
d = a \ b
x2=mrdivide(b,a)
```

```
c =
   -0.52542   0.68644   0.66102
   -0.42373   0.94068   1.01695
   -0.32203   1.19492   1.37288
d =
   -3.27778  -1.05556  -4.86111
   -0.11111   0.11111  -0.27778
    3.05556   1.27778   4.30556
```

Example 43:

```
>>g = [1 2 3 4 ; 5 6 7 8 ]
h = [1 2 3 4; 4 5 6 7]
c = g ./ h
```

When you run the file, it displays the following result :

```
c =
   1.0000    1.0000    1.0000    1.0000
   1.25000   1.2000    1.1667    1.1429
```

ملاحظة:

إذا سبقت إحدى إشارة القسمة بنقطة، عندها سيقوم برنامج بتقسيم المصفوفتين عنصرا بعنصر. أما إذا كانت القسمة بدون نقطة، فإننا ستحدد قسمة مصفوفات عادية.

Multiplication of matrices :

Consider two matrices A and B. If A is an m x n matrix and B is an n x p matrix, they could be multiplied together to produce an m x n matrix C. Matrix multiplication is possible only **if the number of columns n in A is equal to the number of rows n in B.**

In matrix multiplication, the elements of the rows in the first matrix are multiplied with corresponding columns in the second matrix.

Each element in the $(i,j)^{th}$ position, in the resulting matrix C, is the summation of the products of elements in i^{th} row of first matrix with the corresponding element in the j^{th} column of the second matrix. Matrix multiplication in MATLAB is performed by using the * operator.

Example 44:

Create a script file with the following code

```
a = [ 1 2 3; 2 3 4; 1 2 5]
b = [ 2 1 3 ; 5 0 -2; 2 3 -1]
prod = a * b
```

```
a =
     1     2     3
     2     3     4
     1     2     5

b =
     2     1     3
     5     0    -2
     2     3    -1

prod =
    18    10    -4
    27    14    -4
    22    16    -6
```

Multiplication is done : if the number of columns n in A is equal to the number of rows n in B.

Example 45:

```
>>g = [1 2 3 4 ; 5 6 7 8 ]
h = [1 2 3 ; 4 5 6 7]
c = g .* h
```

```
c =
     1     2     3     4
    10    12    14    16
    27    30    33    36
```

➢Transpose of a Matrix:

The transpose operation switches the rows and columns in a matrix. It is represented by a single **quote(').**

Example 46:

Create a script file with the following code .

```
a = [ 10 12 23 ; 14 8 6; 27 8 9]
b = a'
```

```
a =
    10    12    23
    14     8     6
    27     8     9

b =
    10    14    27
    12     8     8
    23     6     9
```

Quiz

Create A=[2 3 4 ; 5 6 7 : 8 9 10] , then

a- find the difference between the following functions" illustrate your answer by taking screen shots of your screens":

diag(a)	max(a)	min(a)
flipud(a)	fliplr (a)	tril(a)
numel(a)	triu(a)	trace(a)

b – write matlab code to find the following

- find maximum value in a
- The values in A that are greater than 4 and less than 9

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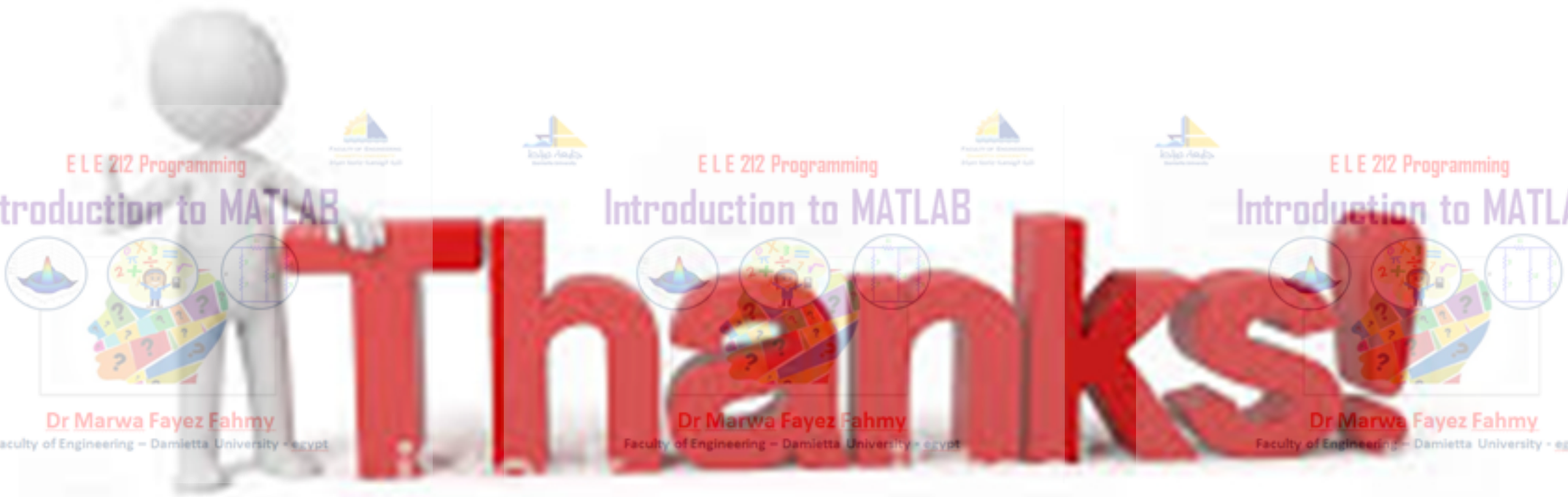

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