

MATLAB ASSIGNMENT-4

EIGEN VALUES AND EIGEN VECTORS

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- **SLOT: - L15 +L16**
- **SESSION: - WINTER SEMESTER 2018-2019**
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➤ **DATE: - 9th JANUARY 2019**

Q1. Prove the following statements:

(a) The sum of the eigen values of a matrix is the sum of the elements of the principal diagonal.

(b) If λ is an eigenvalue of a matrix A , then $1/\lambda$ is the eigenvalue of A^{-1} .

(c) If $\lambda_1, \lambda_2, \dots, \lambda_n$ are the eigenvalues of a matrix, then A^m has the eigenvalues $\lambda_1^m, \lambda_2^m, \dots, \lambda_n^m$ (m being a positive integer).

Sol: -

(a)

The screenshot shows the MATLAB R2019a environment. The Editor window displays a script named 'Eigenvalue.m' with the following code:

```
1 - clc
2 - clear all
3 - A=input('Enter the matrix: ');
4 - EV=eig(A);
5 - disp('Eigenvalues')
6 - disp(EV)
```

The Command Window shows the execution results:

```
Enter the matrix:
[2 4 5;3 -4 5;6 2 -7]
Eigenvalues
    6.6685
   -6.1340
   -9.5345
```

The Workspace window shows the following variables:

NAME	VALUE	SIZE	CLASS
A	[2,4,5,3,-4,5,6,2,-7]	3x3	double
B	-9	1x1	double
C	-9	1x1	double
EV	[6.6685,-6.1340,-9.5345]	3x1	double

The Command Window also shows the following commands and their outputs:

```
>> B=sum(EV)
B =
    -9

>> C=sum(diag(A))
C =
    -9
```

(b)

The MATLAB IDE interface shows the following components:

- Editor:** Contains the script `Eigenvalue.m` with the following code:


```
1 - clc
2 - clear all
3 - A=input('Enter the matrix: ');
4 - EV=eig(A);
5 - disp('Eigenvalues')
6 - disp(EV)
```
- Command Window:** Shows the execution output:


```
Enter the matrix:
[3 4;4 -3]
Eigenvalues
-5
5

>> B=inv(A)

B =

    0.1200    0.1600
    0.1600   -0.1200

>> EVG=eig(B);
>> display('eigenvalues')
eigenvalues
>> display(EVG)

EVG =
```
- Workspace:** Lists the variables in the workspace:

NAME	VALUE	SIZE	CLASS
A	[3,4,4,-3]	2x2	double
B	[0.1200,0.1600,...]	2x2	double
EV	[-5,5]	2x1	double
EVG	[-0.2000,0.2000]	2x1	double

The MATLAB IDE interface shows the following components:

- Editor:** Contains the script `Eigenvalue.m` with the following code:


```
1 - clc
2 - clear all
3 - A=input('Enter the matrix: ');
4 - EV=eig(A);
5 - disp('Eigenvalues')
6 - disp(EV)
```
- Command Window:** Shows the execution output:


```
>> B=inv(A)

B =

    0.1200    0.1600
    0.1600   -0.1200

>> EVG=eig(B);
>> display('eigenvalues')
eigenvalues
>> display(EVG)

EVG =

   -0.2000
    0.2000

>> |
```
- Workspace:** Lists the variables in the workspace:

NAME	VALUE	SIZE	CLASS
A	[3,4,4,-3]	2x2	double
B	[0.1200,0.1600,...]	2x2	double
EV	[-5,5]	2x1	double
EVG	[-0.2000,0.2000]	2x1	double

(c)

The screenshot shows the MATLAB IDE with the 'Eigenvalue.m' script open in the Editor. The script contains the following code:

```

1 - %%%
2 - clear all
3 - A=input('Enter the matrix: ');
4 - EV=eig(A);
5 - disp('Eigenvalues')
6 - disp(EV)
7

```

The Command Window shows the execution results:

```

Enter the matrix:
[7 -2 2;-2 1 4;-2 4 1]
Eigenvalues
    7.0000
    5.0000
   -3.0000

```

The Workspace window displays the following variables:

NAME	VALUE	SIZE	CLASS
A	[7,-2,2;-2,1,4;-2,4,1]	3x3	double
B	[49,-8,8;-24,21,4;-24,12,13]	3x3	double
C	[2401,-464,464;-2401,464,464;-2401,464,464]	3x3	double
EV	[7.0000;5.0000;-3.0000]	3x1	double
Ev	[49.0000;25.0000;9.0000]	3x1	double
EVG	[2401,-464,464;-2401,464,464;-2401,464,464]	3x3	double
EVg	[2.4010e+03;62.0000;-3.0000]	3x1	double

The screenshot shows the MATLAB IDE with the 'Eigenvalue.m' script open in the Editor. The script contains the following code:

```

1 - %%%
2 - clear all
3 - A=input('Enter the matrix: ');
4 - EV=eig(A);
5 - disp('Eigenvalues')
6 - disp(EV)
7

```

The Command Window shows the execution results:

```

Enter the matrix:
[7 -2 2;-2 1 4;-2 4 1]
Eigenvalues
    7.0000
    5.0000
   -3.0000

```

The Workspace window displays the following variables:

NAME	VALUE	SIZE	CLASS
A	[7,-2,2;-2,1,4;-2,4,1]	3x3	double
B	[49,-8,8;-24,21,4;-24,12,13]	3x3	double
C	[2401,-464,464;-2401,464,464;-2401,464,464]	3x3	double
EV	[7.0000;5.0000;-3.0000]	3x1	double
Ev	[49.0000;25.0000;9.0000]	3x1	double
EVG	[2401,-464,464;-2401,464,464;-2401,464,464]	3x3	double
EVg	[2.4010e+03;62.0000;-3.0000]	3x1	double

Q2. Using Cayley-Hamilton theorem,**(a) find the inverse of $A = \begin{bmatrix} 1 & 1 & 3; 1 & 3 & -3; -2 & -4 & -4 \end{bmatrix}$.****Sol.:-****CODE:-**

```

1 - clc
2 - clear
3 - A=input('Enter the Matrix: ');
4 - %Verification of Cayley-Hamilton theorem
5 - cf=poly(A);
6 - n=length(cf);
7 - CHT=cf(1)*A^(n-1);
8 - for i=2:n
9 -     CHT=CHT+cf(i)*A^(n-i);
10 - end
11 - disp('R.H.S of C-H Theorem: ')
12 - disp(round(CHT))
13 - %to find the inverse
14 - INV=cf(1)*A^(n-2);
15 - for i=2:n-1
16 -     INV=INV+cf(i)*A^(n-i-1);
17 - end
18 - INV=INV/(-cf(n));
19 - disp('Inverse of A: ')
20 - disp(INV)

```

CURRENT FOLDER

- Published(my site)
- Caleyhamilton.m
- Eigenvalue.m
- Eigenvalue.m
- Harmonic.m
- harmonics2.m
- INTRO.m
- intro.m
- intro1.m

WORKSPACE

NAME	A	VALUE	SIZE	CLASS
A	[1,1,3,1,3,-3,2,...	3x3	double	
cf	[1,-8.0000,12,-8...	1x4	double	
CHT	[-1.7764e-15,-1....	3x3	double	

INPUT & OUTPUT:-

```

>>
Enter the Matrix:
[1 1 3;1 3 -3;-2 -4 -4]
R.H.S of C-H Theorem:
     0     0     0
     0     0     0
     0     0     0
Inverse of A:
    0.0000    -2.0000    -1.5000
    0.2500     1.2500     0.7500
    0.2500     0.2500     0.2500
>>

```

WORKSPACE

NAME	A	VALUE	SIZE	CLASS
A	[1,1,3,1,3,-3,2,...	3x3	double	
cf	[1,-8.0000,12,-8...	1x4	double	
CHT	[-1.7764e-15,-1....	3x3	double	
i	3	1x1	double	
INV	[0.0000,-2.0000...	3x3	double	
n	4	1x1	double	

(b) find A^8 , if $A = \begin{bmatrix} 1 & 2; 2 & -1 \end{bmatrix}$

CODE:-

```

1 - clc
2 - clear
3 - A=input('Enter the Matrix: ');
4 - %Verification of Cayley-Hamilton theorem
5 - cf=poly(A);
6 - n=length(cf);
7 - CHT=cf(1)*A^(n-1);
8 - for i=2:n
9 -     CHT=CHT+cf(i)*A^(n-i);
10 - end
11 - disp('R.H.S of C-H Theorem: ')
12 - disp(round(CHT))
13 - %to find the inverse
14 - INV=cf(1)*A^(n-2);
15 - for i=2:n-1
16 -     INV=INV+cf(i)*A^(n-i-1);
17 - end
18 - INV=INV/(-cf(n));
19 - disp('Inverse of A: ')
20 - disp(INV)

```

WORKSPACE

NAME	VALUE	SIZE	CLASS
A	[1,2,-1]	2x2	double
cf	[1,0,-5.0000]	1x3	double
CHT	[-8.8818e-16,0,...]	2x2	double
i	2	1x1	double
INV	[0.2000,0.4000,...]	2x2	double
n	3	1x1	double
X	[625,0,0,625]	2x2	double

INPUT AND OUTPUT: -

```

Enter the Matrix:
[1 2; 2 -1]

R.H.S of C-H Theorem:
     0     0
     0     0

Inverse of A:
    0.2000    0.4000
    0.4000   -0.2000

>> X=A^8
|
X =

    625     0
     0    625

>>

```

WORKSPACE

NAME	VALUE	SIZE	CLASS
A	[1,2,-1]	2x2	double
cf	[1,0,-5.0000]	1x3	double
CHT	[-8.8818e-16,0,...]	2x2	double
i	2	1x1	double
INV	[0.2000,0.4000,...]	2x2	double
n	3	1x1	double
X	[625,0,0,625]	2x2	double

-----THANK YOU-----