ESO208A: Computer Assignment-3

Marks: 100   Due Date: Wednesday, October 20, 2021

Write a computer program for finding eigenvalues of a matrix A. The program should have the following features:

Input: The program should read - (i) the elements of the matrix A, (ii) maximum iterations, (iii) threshold on approximate relative error, and (iv) shifting scalar, if needed.

Options: The user should have the option of selecting one of the following methods–
   a. Direct power method (to find the eigenvalue having the maximum magnitude and the corresponding eigenvector)
   b. Inverse power method (to find the eigenvalue having the minimum magnitude and the corresponding eigenvector)
   c. Shifted-power method (to find intermediate eigenvalues [based on Gershgorin disc] and corresponding eigenvectors)
   d. QR method (to find all eigenvalues of a matrix; write your own program for Gram-Schmidt process)

Output: The output from the program should be written in a text file. This file should contain eigenvalues and the corresponding normalized eigenvectors (unit length) for options (a) to (c), and only eigenvalues for option (d). Number of iterations required should also be written as an output.

Note: Use a column vector of appropriate size with each element unity as the guess vector for initiating the power methods.

Submission

Make a single zip folder with all your program file(s) name it roll number_CA3.zip (e.g., If your roll number is 123456, the folder name should be '123456_CA3.zip'). The folder should include -

(i) All the computer program file(s), input file(s) and output file(s)

(ii) A PDF file of the plots and the solution of the test cases given in this assignment.

Upload the zip file on mooKIT. In case of any difficulties with mooKIT upload, you may email the solution to eso208.sec*@gmail.com, where * is section number 1-10. Example: for section J5, it is eso208.sec5@gmail.com; for section J10, it is eso208.sec10@gmail.com. The subject line of the email should be same as your folder name.

Test data:

$$A = \begin{bmatrix} 8 & -1 & -1 \\ -1 & 4 & -2 \\ -1 & -2 & 10 \end{bmatrix}$$

maximum iterations = 100

tolerance on approximate relative error (%) = 0.001

shifting scalar = 8.0

Sample input file

```
3
8.0     -1.0    -1.0
-1.0    4.0     -2.0
-1.0    -2.0    10.0
100
0.001
8.0
```

Sample output files

1. Direct power method

   Eigenvalue
   10.7787

   Eigenvector
   -0.2509
   -0.2397
    0.9379

   Iterations
   30

2. Inverse power method

    Eigenvalue
    3.0749

    Eigenvector
    0.2482
    0.9205
    0.3017

    Iterations
    12

3. Shifted power method

    Eigenvalue
    8.1461

    Eigenvector
    0.9356
     -0.3085
     0.1718

    Iterations
    6

4. QR method

    Eigenvalues
    10.7788
    8.1462
    3.0749

    Iterations
    23