ESO208A: Computer Assignment-3

Marks: 100 Due Date: Saturday, October 01, 2016

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

Due date: Saturday, 01 October by 5:00 pm

Submit a single zip folder in the Brihaspati server under Assignment-3. The name of the zip-folder should be "your roll-number_CA3" (e.g. If your roll no. is 99999, the folder name should be '99999_CA3.zip'). The folder should include -

(i) All the computer program file(s)
(ii) Input file for the test data and output file for the test data generated by your program(s)

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
10.7789
8.1462
3.0749

Iterations
17