# COSC 4364 Spring 2018

## Assignment 8

**Out: April 10, Due date: April 19.** e-mail your report and code.

| Problem | a) | b) | c) | Total |
|---|---|---|---|---|
| 1 | 4 | 4 | | 8 |
| 2 | 2 | 2 | 2 | 6 |
| 3 | 4 | | | 4 |
| 4 | 4 | | | 4 |
| 5 | 8 | | | 8 |
| 6 | 20 | 20 | 30 | 70 |
| Total | | | | 100 |

**Problem 1.** (a), and b) 4 points each) Find all the Gershgorin discs for the following matrices. Indicate on a plot the smallest region(s) that contain all of the eigenvalues. Then, by using a Matlab function compute the eigenvalues and mark them in the plot.

a) $\begin{bmatrix} 1-i & 1 & i \\ 0 & 2i & 2 \\ 1 & 0 & 2 \end{bmatrix}$ b) $\begin{bmatrix} 4 & 0 & -2 \\ 1 & 2 & 0 \\ 1 & 1 & 9 \end{bmatrix}$

**Problem 2.** (3x2 points) Let A be a nxn non-singular matrix and x a non-zero vector such that $Ax=\lambda x$. Which equation(s) of the following is/are true? Prove your answer.

a) $A^k x = \lambda^k x$, b) $\lambda^{-k} x= A^{-k} x$, c) $p(A)x = p(\lambda)x$ for any polynomial p.

**Problem 3.** (4 points) For which of the following *s* values is the matrix I-svv* unitary where v is a column vector of unit length?

a) s=0, s=1 b) s=0, s=2, c) s=1, s=2, d) s=0 s= sqrt(2), e) none of these s values

**Problem 4.** (4 points) Name the method that the pseudocode below encodes. What is the expected final output, where $x_1$ and $y_1$ are the first components of the vectors x and y respectively?

**integer** n,kmax, **real** r
**real array** $(A^{-1})$1:nxn, (x)1:n, (y)1:n
**for** k=1 to 30
  $y \Leftarrow A^{-1}x$
  $r \Leftarrow y_1/x_1$
  $x \Leftarrow y/||y||$
  **output** r,x
**endfor**

**Matlab exercises.**

**Problem 5.** (8 points) Determine the eigenvalues, the singular values and the condition number for the following matrix. It is acceptable to use Matlab routines to find the eigenvalues and the singular values. Write your own code to find the condition number.

$$\begin{bmatrix} -149 & -50 & -154 \\ 537 & 180 & 546 \\ -27 & -9 & -25 \end{bmatrix}$$

**Problem 6**. (a) and b) 20 points each, c) 30 points) Write your own code to find the eigenvalues and normalized eigenvectors for the matrix

$$\begin{bmatrix} -4 & 14 & 0 \\ -5 & 13 & 0 \\ -1 & 0 & 2 \end{bmatrix}$$

a) Use the power method to find the maximum in magnitude eigenvalue and associated normalized eigenvector
b) Use the inverse power method to find the smallest in magnitude eigenvector and associated normalized eigenvector of the matrix
c) Use the deflation method to find the third eigenvector and associated normalized eigenvector