Intensive computation

Prof. A. Massini

Mid Term Exam – April 18, 2018

- Student's Name -

_____

- *Matricola* number -

_____

Exercise 1 (6 points)	
Question 1 (4 points)	
Exercise 2 (6 points)	
Question 2 (4 points)	
Question 3 (4 points)	
Exercise 3 (4 points)	
Exercise 4 (4 points)	
Total (32 points)	

Exercise 1 (6 points) - Sparse matrices

Consider the sparse matrix 10x10 here below

0,9502	0,1712	0	0,8003	0	0	0	0	0	0
0	0,0344	0,7060	0	0,1419	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0,5469	0,8491	0	0,3816	0,2769	0	0,9157	0	0	0
0	0,9575	0,9340	0	0,7655	0,0462	0	0,7922	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0,1576	0,7577	0	0,1869	0,8235	0	0,6557
0	0	0	0	0,9706	0,7431	0	0,4898	0,6948	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0,4854	0,6555	0	0,6463

a) Write which arrays you need when the DIAG compressed representation is used. Show the DIAG representation (using symbolic names m_{ij} for nonzero elements).

b) Show the DIAG representation after the insertion of element $m_{4,6}$.

c) Compare the memory occupation of the compressed representation before and after the insertion.

d) Write which arrays you need when the Skyline compressed representation is used.
Show the Skyline representation, using symbolic names m_{ij} for nonzero elements.

e) Show the Skyline representation after the insertion of element $m_{4,6}$.

f) Compare the memory occupation of the compressed representation before and after the insertion.

Question 1 (4 points) - Linear systems

Briefly describe the **Jacobi** method and the **Gauss Seidel** method.

Exercise 2 (6 points) - Linear systems

Solve the system

$$\begin{cases} 5x_1 - 2x_2 + 3x_3 = -1 \\ -3x_1 + 9x_2 + x_3 = 2 \\ 2x_1 - x_2 - 7x_3 = 3 \end{cases}$$

with the **Jacobi** method and the **Gauss Seidel** method, using $\boldsymbol{x}^{(0)} = (0, 0, 0)$ as starting solution.

Complete the table below, doing three iterations.

	the Jacobi method			**Gauss Seidel method**		
k	$x_1^{(k)}$	$x_2^{(k)}$	$x_3^{(k)}$	$x_1^{(k)}$	$x_2^{(k)}$	$x_3^{(k)}$
0	0	0	0	0	0	0
1						
2						
3						

Question 2 (4 points) Briefly describe the iterative Power method to find the maximum eigenvalue and the corresponding eigenvector and how to use it to find the minimum eigenvalue and the corresponding eigenvector.

Question 3 (4 points) Briefly describe the iterative Cholesky method.

Exercise 3 (4 points) - **Linear systems**

Apply the Cholesky factorization method to the matrix $\begin{pmatrix} 25 & 15 & -5 \\ 15 & 18 & 0 \\ -5 & 0 & 11 \end{pmatrix}$.

Exercise 4 (4 points) - Errors

Show the contribution of ***computational error*** and ***propagated data error*** when computing sin(5π/6), considering two different approximations for function sin(x), namely Taylor series stopping after one term and after two terms.