Intensive computation

Prof. A. Massini

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Part A

- Student's Name -

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- *Matricola* number -

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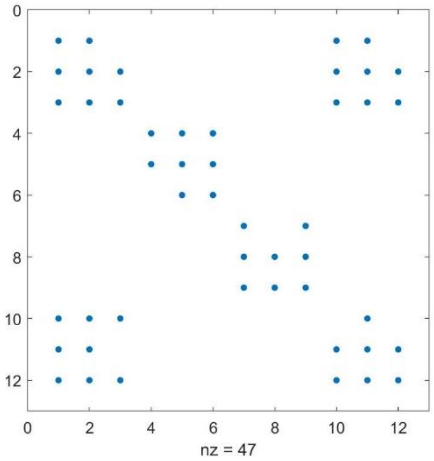
Exercise 1 (6 points)	
Exercise 2 (4 points)	
Exercise 3 (4 points)	
Exercise 4 (5 points)	
Exercise 5 (5 points)	
Question 1 (4 points)	
Question 2 (4 points)	
Total (32 points)	

Exercise 1 (6 points)

a) Consider the sparse matrix here below, whose pattern is shown on the right.

	1	2	3	4	5	6	7	8	9	10	11	12
1	169	191	0	0	0	0	0	0	0	128	125	0
2	191	255	132	0	0	0	0	0	0	219	249	255
3	99	132	90	0	0	0	0	0	0	95	113	139
4	0	0	0	184	129	82	0	0	0	0	0	0
5	0	0	0	129	110	61	0	0	0	0	0	0
6	0	0	0	0	61	46	0	0	0	0	0	0
7	0	0	0	0	0	0	45	0	27	0	0	0
8	0	0	0	0	0	0	71	120	39	0	0	0
9	0	0	0	0	0	0	27	39	19	0	0	0
10	128	219	95	0	0	0	0	0	0	0	163	0
11	125	249	0	0	0	0	0	0	0	163	229	225
12	177	255	139	0	0	0	0	0	0	184	225	255



Specify which arrays you need for the following compressed representations and how many bytes they occupy in memory.

CSR

Ellpack-Itpack

b) Explain how arrays change after the insertion of element $m_{10,10}$=30 and what is the new memory occupation.

CSR

Ellpack-Itpack

c) Explain what operation must be executed for deleting element $m5_{,6}$

CSR

Ellpack-Itpack

Exercise 2 (4 points) Errors

a) Given y'=19,7 as the approximation of e^3, compute the ***absolute*** and ***relative*** forward error and ***absolute*** and ***relative*** backward error.

absolute forward error

relative forward error

absolute backward error

relative backward error

b) Compute the value of the condition number.

Exercise 3 (4 points) - Errors

Show the contribution of ***computational error*** and ***propagated data error*** when computing sin(7π/8).

Exercise 4 (5 points) Methods for Differential equations

Consider the initial value problem $y' = x + 2y \qquad y(0) = 0$

Use Euler's Method for four iterations (e.g compute the approximation y_4) with a step size of h = 0.10 to find approximate values of the solution at x = 0.40. The exact solution is: $y = \frac{1}{4}e^{2x} - \frac{1}{2}x - \frac{1}{4}$

Repeat with a step size of h = 0.20 for two iterations.

Use two fractional digits (decimal places).

Compare approximate solutions obtained for x = 0.40 using h = 0.20 and h = 0.10 with the exact value of the solution giving the percentage error in both cases.

Exercise 5 (5 points) - Eigenvalues and eigenvectors

Apply three iterations of the Power Method to the matrix: $\begin{pmatrix} 0 & 11 & -5 \\ -2 & 17 & -7 \\ -4 & 26 & -10 \end{pmatrix}$

Start with x0 = [1 1 1]'.

Question 1 (4 points) Methods for Differential equations

Explain the Verlet method and the Velocity Verlet method for solving second order differential equations**.**

Question 2 (4 points) Explain the Jacobi method for solving linear systems.