Intensive computation

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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 (5 points)	
Question 1 (5 points)	
Exercise 3 (5 points)	
Exercise 4 (5 points)	
Question 2 (5 points)	
Total (31 points)	

Exercise 1 (6 points) - Sparse matrices

Consider the sparse matrix 10x10 here below

	c1	*c2*	*c3*	*c4*	*c5*	*c6*	*c7*	*c8*	*c9*	*c10*
r1	9	11	0	0	6	19	0	0	0	0
r2	2	14	0	0	5	1	0	0	0	0
r3	0	0	0	0	14	10	10	4	0	0
r4	0	0	0	0	17	9	4	6	0	0
r5	0	0	4	5	0	0	0	0	14	15
r6	0	0	6	14	0	0	0	0	14	20
r7	0	0	9	6	0	0	4	14	0	0
r8	0	0	11	14	0	0	15	11	0	0
r9	2	3	0	0	13	10	0	0	2	3
r10	7	13	0	0	8	1	0	0	7	13

a) Explain which arrays are used for the **Ellpack-Itpack** format.
Show the **Ellpack-Itpack** representation of the matrix above (you can use symbolic names m_{ij} for nonzero elements).

b) Explain which arrays are used for the **Block Sparse Row** format.
Show the **Block Sparse Row** representation of the matrix above (you can use symbolic names m_{ij} for nonzero elements).

c) Show **Block Sparse Row** representation after the insertion of elements $m_{7,2}$ and $m_{8,1}$.

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

Exercise 2 (5 points) – Errors

Describe what are the ***computational error*** and ***propagated data error.*** Show the contribution of ***computational error*** and ***propagated data error*** when computing cos(5π/8), considering two different approximations for function cos(x), namely Taylor series stopping after two term and after three terms.

Question 1 (5 points) - Linear systems

Briefly describe the Gauss elimination method and the possible strategies of pivoting.

Exercise 3 (5 points) - Linear systems

Solve the system

$$\begin{cases} 4x_1 - x_2 + x_3 = 3 \\ -2x_1 + 6x_2 + x_3 = 9 \\ -x_1 + x_2 + 7x_3 = -6 \end{cases}$$

using the **Jacobi** method **OR** the **Gauss Seidel** method (at your choice), using $\boldsymbol{x}^{(0)} = (0, 0, 0)$ as starting solution.

Briefly **explain how the chosen method works**.

Complete the table below, doing **at least two** iterations.

k	$x_1^{(k)}$	$x_2^{(k)}$	$x_3^{(k)}$
0	0	0	0
1			
2			
3			

Exercise 4 (5 points) – errors

a) Given y'=9,7 as the approximation of π^2, 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.

Question 2 (5 points) Eigenvalues and eigenvectors

a) Explain what the Deflation method is.

b) Discuss what problems you can encounter when applying the Deflation method.