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 (5 points)	
Exercise 3 (5 points)	
Question 1 (6 points)	
Question 2 (4 points)	
Question 3 (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	8	15	0	0
r6	0	0	6	14	0	0	14	20	0	0
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 **skyline** format.
    Show the **skyline** representation of the matrix above (you can use symbolic names m_{ij} for nonzero elements).

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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).

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c) Show **Block Sparse Row** representation after the insertion of elements $m_{7,6}$ and $m_{8,5}$.

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.

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Exercise 3 (5 points) – Errors

a) Given y'=9,95 as the approximation of π^2, compute the **absolute** and **relative** forward error and **absolute** and **relative** backward error.

absolute forward error

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relative forward error

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absolute backward error

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relative backward error

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b) Compute the value of the condition number.

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Question 1 (5 points) - Linear systems

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

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Question 2 (4 points)

Describe the Cholesky factorization method.

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Question 3 (6 points) Eigenvalues and eigenvectors

a) Explain how the Power method works.
b) Explain what the Deflation method is.
c) Discuss what problems you can encounter when applying the Power method and the Deflation method.