Assignment 4

Regulations:

1. Show all steps for your answers.
2. You should answer all questions on paper with your handwriting.
3. Make sure you have your name and ID written on top of every sheet of paper having your answers.
4. Submissions are accepted through moodle only (Assignments section , Assignment 4)
5. Submission must be as a single .zip file containing a pdf file for your answers and a python file .py or .ipynb.
6. Deadline: Thursday 29th of May 2025 11:59 PM .

1. For the matrix

$$B = \begin{pmatrix} 0 & 1 & 2 \\ 1 & 0 & 3 \\ 4 & -3 & 8 \end{pmatrix},$$

   (a) Find the inverse matrix of the matrix B.

   (b) Find the matrix A such that

$$B^{-1}AB = \begin{pmatrix} 0 & 1 & 2 \\ 1 & 0 & 3 \\ 4 & -3 & 8 \end{pmatrix}.$$

2. Find the matrix A if $(\frac{1}{3}A^T)^{-1} = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 4 & 5 & 3 \end{bmatrix}$.

3. Given the matrix:

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & 1 \\ 2 & 2 & 3 \end{bmatrix},$$

   (a) Compute $B = A^2$ and then find B^{-1} (if it exists) using A^{-1}.

   (b) Solve for X in the equation $AX = C$, where $C = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 1 \end{bmatrix}$.

4. Using Gauss-Jordan elimination procedure, find the general solution of the following systems of linear equations:

   (a)
$$3x_1 + 8x_2 + 3x_3 + 14x_4 = 2$$
$$2x_1 + 3x_2 + x_3 + 2x_4 = 1$$
$$x_1 + 2x_2 + x_3 + 10x_4 = 0$$
$$x_1 + 5x_2 + 2x_3 + 12x_4 = 1$$

   (b)
$$2y + 3z + 4w = 1$$
$$x - 3y + 4z + 5w = 2$$
$$-3x + 10y - 6z - 7w = -4$$

   (c)
$$x_1 - 3x_2 + 4x_3 = -4$$
$$3x_1 - 7x_2 + 7x_3 = -8$$
$$4x_1 - 6x_2 - x_3 = 7$$

Apply the following in python.

1- Vectors

Find the dot product of :-
1- (2,2) , (3,4)
2- (1,2,3) , (2,3,4)
3- (1,2,3,4) , (2,3,4,5)

Find the Norm of :-
1- (1,2)
3- (3,4,5)

Find the distance between the following vectors :-

1- (7, 1, 0, 0), (3, 2, 1, 0)
2- (2, -1, 0), (5, 3, 1)
3- (1, 2, 3), (2, 1, 0)

Find Angles between these vectors:
1 - [1,2,3] , [3,4,5]
2 - [4,6,1] , [1,2,3]
3 - [5,4,7] , [3,4,5]
4 - [2,5,3] , [1,-1,-2]

2- Linear Systems (Solve each system and find the unknowns, if it's a singular matrix state this in the output).

$$3x_1 + 8x_2 + 3x_3 + 14x_4 = 2$$
$$2x_1 + 3x_2 + x_3 + 2x_4 = 1$$
$$x_1 + 2x_2 + x_3 + 10x_4 = 0$$
$$x_1 + 5x_2 + 2x_3 + 12x_4 = 1$$