

## Linear Algebra Questions ( Make sure to attend the Online session )

1. Given the matrices:

$$A = \begin{bmatrix} -1 & 23 & 10 \\ 0 & -2 & -11 \end{bmatrix}, \quad B = \begin{bmatrix} -6 & 2 & 10 \\ 3 & -3 & 4 \\ -5 & -11 & 9 \\ 1 & -1 & 9 \end{bmatrix}, \quad C = [-3 \quad 2 \quad 9 \quad -5 \quad 7]$$
$$D = \begin{bmatrix} -2 & 6 \\ -5 & 2 \end{bmatrix}, \quad E = [3], \quad F = \begin{bmatrix} 3 \\ 5 \\ -11 \\ 7 \end{bmatrix}, \quad G = \begin{bmatrix} -6 & -4 & 23 \\ -4 & -3 & 4 \\ 23 & 4 & 1 \end{bmatrix}$$

- What is the dimension of each matrix?
- Which matrices are square?
- Which matrices are symmetric?
- Which matrix has the entry at row 3 and column 2 equal to -11?
- Which matrices has the entry at row 1 and column 3 equal to 10?
- Which are column matrices?
- Which are row matrices?
- Find AT,CT,ET,GT. (T -> Transpose)

2. A, B, C, D and E are matrices given by:

$$A = \begin{bmatrix} -1 & 1 & -2 \\ 0 & -2 & 1 \end{bmatrix}, \quad B = \begin{bmatrix} -1 & 2 & 0 \\ 0 & -3 & 4 \\ -1 & -2 & 3 \end{bmatrix}, \quad C = [-3 \quad 2 \quad 9 \quad -5 \quad 7]$$
$$D = \begin{bmatrix} -2 & 6 \\ -5 & 2 \end{bmatrix}, \quad E = \begin{bmatrix} 3 \\ 5 \\ -11 \end{bmatrix}, \quad F = \begin{bmatrix} -1 & 0 & 2 \\ -2 & -3 & 4 \\ 1 & 4 & -3 \end{bmatrix}$$

Find if possible:

- AB
- BC
- AD
- EF
- FE

3. Find the determinant of the matrix M :

$$M = \begin{pmatrix} 15 & 10 \\ 3 & 2 \end{pmatrix} \quad M = \begin{pmatrix} 2 & 3 & 1 \\ -1 & 2 & 3 \\ 3 & 2 & -1 \end{pmatrix}$$

4. Find the inverse matrix A-1 to the matrix A :

$$A = \begin{pmatrix} -3 & -2 \\ 3 & 3 \end{pmatrix} \quad A = \begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$$

5. What does it mean if three equations are linearly independent?

- a. Two of the equations can be combined to come up with the third equation.
- b. There is no way to combine any two equations to come up with the third equation.
- c. The graphical representations of the equations are lines that do not intersect.
- d. The graphical representations of the equations are lines that do intersect.

6. Let

$$f(\mathbf{x}, \mathbf{y}) = \mathbf{x}^\top \mathbf{A} \mathbf{y} + \mathbf{x}^\top \mathbf{B} \mathbf{x} - \mathbf{C} \mathbf{y} + D$$

with  $\mathbf{x} \in \mathbb{R}^M$ ,  $\mathbf{y} \in \mathbb{R}^N$ , function  $f : \mathbb{R}^M \times \mathbb{R}^N \rightarrow \mathbb{R}$ .

Compute the dimensions of the matrices  $\mathbf{A}, \mathbf{B}, \mathbf{C}, D$  for the function so that the mathematical expression is valid.