

Lesson Two: Types of Matrices

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Types of matrices Covered earlier in lesson One

1. Row Matrix
2. Column Matrix

3. Square Matrix

Square Matrix

Number of rows and columns are the same.

$$A = [a_{ij}]_{n \times n}$$

eg $C = \begin{bmatrix} 0 & 1 \\ 3 & 5 \end{bmatrix}$ A square matrix of order 2

4. Diagonal Matrix

Diagonal Matrix

- We only consider one ^{diagonal} ~~matrix~~ the main/leading/principle diagonal

$$\begin{bmatrix} 0 & 1 \\ 3 & 5 \end{bmatrix}$$

- So if all elements except the ones in the leading diagonal are zero
- An extension of the square matrix

$$X [a_{ij}]_{n \times n} \quad \text{or } i \neq j$$

$$C = \begin{bmatrix} 8 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 5 \end{bmatrix}_{3 \times 3}$$

or

$$C = \text{diag} [8, -1, 5]$$

$$D = \begin{bmatrix} 1 & 0 \\ 0 & 5 \end{bmatrix}_{2 \times 2}$$

or

$$D = \text{diag} [1, 5]$$

5. Scalar Matrix

Scalar matrix

A diagonal matrix in which all diagonal elements are equal

Fig A $\begin{bmatrix} 5 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{bmatrix}_{3 \times 3}$

$$B = \begin{bmatrix} 1 & 0 \\ 0 & 5 \end{bmatrix}_{2 \times 2}$$

B is not a scalar matrix

$$A = [a_{ij}]_{m \times n}, \begin{cases} a_{ij} = 0 & i \neq j \\ a_{ii} = k & \forall i \end{cases}$$

$a_{ii} = k \forall i$ where k is some constant

6. Identity Matrix

Identity matrix (unit matrix) I symbol.

A square matrix where each diagonal entry is one and non-diagonal elements are zero.

$$I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}_{3 \times 3}$$

$$I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}_{2 \times 2}$$

Mathematical representation:

$$A = [a_{ij}]_{n \times n}, \begin{cases} i=j, a_{ii}=1 \\ i \neq j, a_{ij}=0 \end{cases}$$

7. Null Matrix

Null matrix (zero matrix)

A matrix whose all elements are zero.

This must not be a square matrix

eg $A = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}_{2 \times 2}$

$$B = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}_{2 \times 3}$$

$$C = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}_{2 \times 3}$$

denoted by a 0

$$A = [a_{ij}]_{m \times n}, a_{ij} = 0$$

8. Upper Triangular Matrix

Upper triangular matrix

A square matrix in which all the entries below the main diagonal are zero

e.g. $C = \begin{bmatrix} 5 & 1 & 0 \\ 0 & 4 & 2 \\ 0 & 0 & 2 \end{bmatrix}_{3 \times 3}$

$M = \begin{bmatrix} 5 & 8 \\ 0 & 4 \end{bmatrix}_{2 \times 2}$

$$a_{ij} = 0 \quad \forall i > j$$

9. Lower Triangular Matrix

Lower Triangular Matrix -

A square matrix in which all entries above the main diagonal are zero

e.g. $C = \begin{bmatrix} 4 & 0 \\ 8 & 5 \end{bmatrix}_{2 \times 2}$

$A = \begin{bmatrix} 3 & 0 & 0 \\ 4 & 2 & 0 \\ 6 & 0 & 1 \end{bmatrix}_{3 \times 3}$

$$a_{ij} = 0 \forall i < j$$

Questions? Comments?

**Read about the Hermitian matrix and the Skew
Hermitian Matrix.**

**Give examples and provide the mathematical
Representation of the matrix**