

7 Types of Matrices

The Hierarchy of Constraints

JEE CLASS 12 MATHEMATICS

One-Dimensional Arrays

Column Matrix

$$\begin{bmatrix} 0 \\ \sqrt{3} \\ -1 \\ 1/2 \end{bmatrix}$$

$$m \times 1$$

Restricted to exactly ONE column.

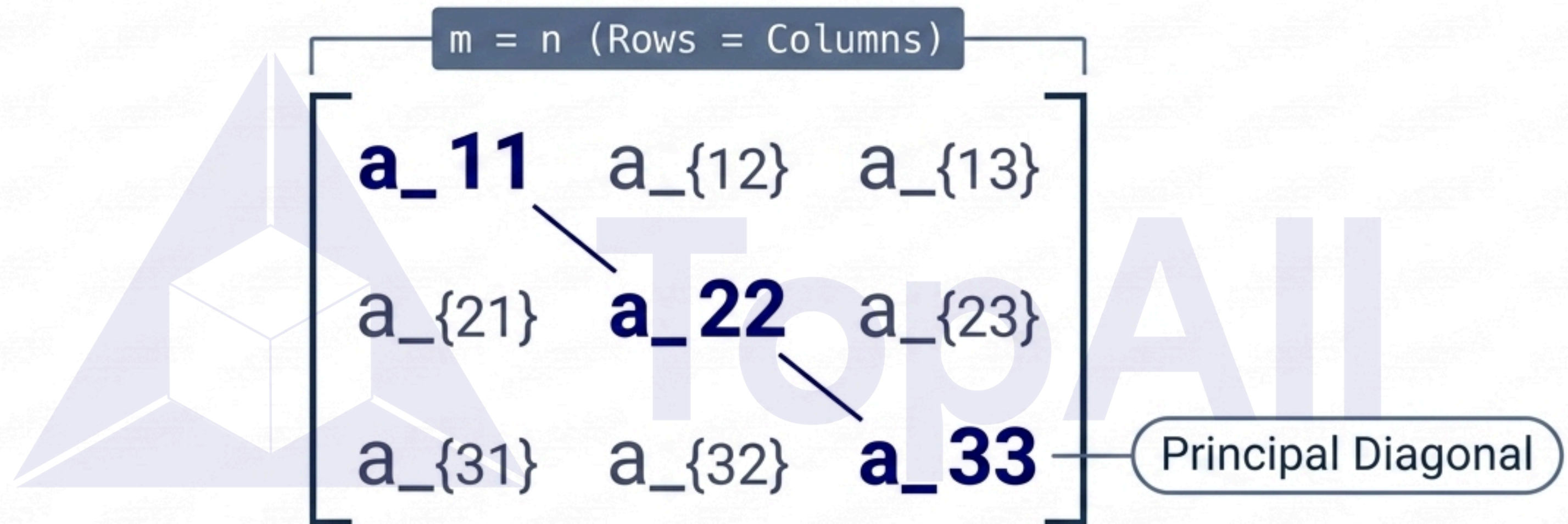
Row Matrix

$$\begin{bmatrix} -1/2 & \sqrt{5} & 2 & 3 \end{bmatrix}$$

$$1 \times n$$

Restricted to exactly ONE row.

The Foundation: Square Matrix



Caution: Diagonals are ONLY defined for square matrices. A rectangular matrix has no diagonal.



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$$E=mc^2$$



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Restricting the Off-Diagonal

Diagonal Matrix


$$\begin{bmatrix} d_1 & 0 & 0 \\ 0 & d_2 & 0 \\ 0 & 0 & d_3 \end{bmatrix}$$

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

JEE Trap: The diagonal elements **can** be zero too! The rule $a_{\{ij\}} = 0$ strictly applies only to non-diagonal elements. Therefore, a zero square matrix is also a diagonal matrix.

Locking the Diagonal

Scalar Matrix



$$\begin{bmatrix} \mathbf{k} & 0 & 0 \\ 0 & \mathbf{k} & 0 \\ 0 & 0 & \mathbf{k} \end{bmatrix}$$

[Diagonal Matrix]

+

[Equal Diagonal Entries]

=

[Scalar Matrix]

$$\begin{aligned} a_{ij} &= 0 & \text{if } i \neq j \\ a_{ij} &= k & \text{if } i = j \end{aligned} \quad (\text{for some constant } k)$$

The Ultimate Constraint

Identity Matrix



$$\begin{bmatrix} \mathbf{1} & 0 & 0 \\ 0 & \mathbf{1} & 0 \\ 0 & 0 & \mathbf{1} \end{bmatrix}$$

Denoted by I_n . Acts as the multiplicative identity in matrix algebra.

$$\begin{aligned} a_{ij} &= 1 && \text{if } i = j \\ a_{ij} &= 0 && \text{if } i \neq j \end{aligned}$$

Note: Every identity matrix is clearly a scalar matrix (where the constant $k = 1$).

The Empty Canvas

Zero (Null) Matrix



$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

All entries zero.

Unlike Diagonal, Scalar, or Identity matrices, a Zero matrix does NOT need to be a square matrix. Shape does not matter, only the void inside.

The Hierarchy of Constraints

Square Matrix ($m = n$)

Diagonal Matrix (Off-diagonals = 0)

Scalar Matrix (Diagonals are equal k)

Identity Matrix ($k = 1$)

- Every Identity Matrix is a Scalar Matrix.
- Every Scalar Matrix is a Diagonal Matrix.
- Every Diagonal Matrix is a Square Matrix.

Reverse is NOT true.

Identity $\subset$ Scalar $\subset$ Diagonal $\subset$ Square



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