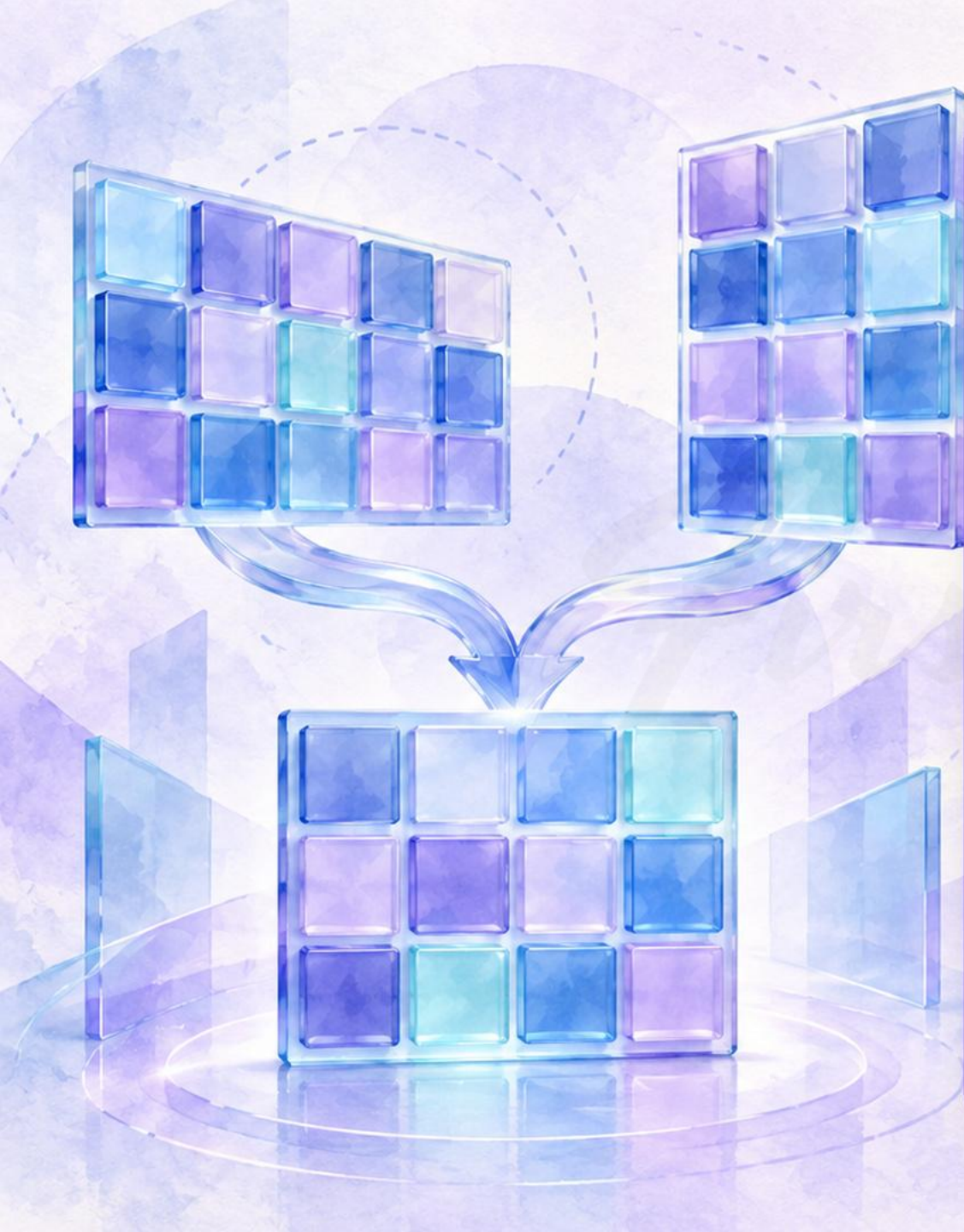




MATHEMATICS • CLASS 12

3

CHAPTER

Matrices

CHAPTER NOTES

MATRICES & THEIR ORDER

An organised array

A matrix is an ordered rectangular array of numbers or functions. Its items are called elements or entries. Horizontal lines are rows; vertical lines are columns.

$$A = [a_{ij}]_{m \times n}; \text{ order} = m \times n; \text{ number of entries} = mn.$$

The first index gives the row and the second gives the column.

a_{ij} is in row i , column j ; $1 \leq i \leq m$, $1 \leq j \leq n$.

We use capital letters for matrices. In this chapter, entries are real numbers or real-valued functions.

Notebooks and pens

Rows: Radha, Fauzia, Simran.

Columns: notebooks, pens.

$$A = \begin{bmatrix} 15 & 6 \\ 10 & 2 \\ 13 & 5 \end{bmatrix}, \text{ order } 3 \times 2.$$

$$a_{32} = 5.$$

This entry records Simran's pens.

$$B = \begin{bmatrix} 15 & 10 & 13 \\ 6 & 2 & 5 \end{bmatrix}, \text{ order } 2 \times 3.$$

Interchanging what the rows and columns represent gives a different matrix.

Matrices organise data and help solve linear equations. They are also used in economics, genetics, transformations and cryptography.

CONSTRUCTING A MATRIX

Possible orders

The number of entries equals the product of the number of rows and columns.

$$mn = 8 \Rightarrow 1 \times 8, 2 \times 4, 4 \times 2 \text{ or } 8 \times 1.$$

These are all possible orders for a matrix with eight entries.

Build each entry from its indices

$$A = [a_{ij}]_{3 \times 2}, \quad a_{ij} = \frac{1}{2} |i - 3j|.$$

Use each allowed row and column index in the formula.

First column

$$j = 1$$

$$a_{11} = \frac{1}{2} |1 - 3| = 1$$

$$a_{21} = \frac{1}{2} |2 - 3| = \frac{1}{2}$$

$$a_{31} = \frac{1}{2} |3 - 3| = 0$$

Second column

$$j = 2$$

$$a_{12} = \frac{1}{2} |1 - 6| = \frac{5}{2}$$

$$a_{22} = \frac{1}{2} |2 - 6| = 2$$

$$a_{32} = \frac{1}{2} |3 - 6| = \frac{3}{2}$$

$$A = \begin{bmatrix} 1 & 5/2 \\ 1/2 & 2 \\ 0 & 3/2 \end{bmatrix}$$

Keep every calculated entry in its correct row and column.

ROW, COLUMN & SQUARE MATRICES

Row matrix

A matrix with only one row.

Order: $1 \times n$

$$A = \left[-\frac{1}{2}, \sqrt{5}, 2, 3 \right],$$

order 1×4 .

A point can be represented as a row matrix.

$$P(x, y) \leftrightarrow \begin{bmatrix} x & y \end{bmatrix}$$

$$P(0, 1) \leftrightarrow \begin{bmatrix} 0 & 1 \end{bmatrix}$$

Column matrix

A matrix with only one column.

Order: $m \times 1$

$$B = \begin{bmatrix} 0 \\ \sqrt{3} \\ -1 \\ \frac{1}{2} \end{bmatrix}, \text{ order } 4 \times 1.$$

A point can also be represented as a column matrix.

$$P(x, y) \leftrightarrow \begin{bmatrix} x \\ y \end{bmatrix}$$

Square matrix

The numbers of rows and columns are equal.

$m = n$; order $n \times n$.

$$C = \begin{bmatrix} 1 & -3 & 1 \\ 2 & 4 & -1 \\ 3 & 5 & 6 \end{bmatrix}, \text{ order } 3 \times 3.$$

The entries from top left to bottom right form the main diagonal.

$a_{11}, a_{22}, \dots, a_{nn}$; here: 1, 4, 6.

The order always lists rows first and columns second.

SPECIAL MATRICES

Diagonal matrix

A square matrix whose off-diagonal entries are zero.

$$a_{ij} = 0 \quad \text{when } i \neq j$$

$$D = \begin{bmatrix} -1 & 0 \\ 0 & 2 \end{bmatrix}$$

Scalar matrix

A diagonal matrix with the same value on every diagonal position.

$$a_{ij} = 0 \quad (i \neq j), \quad a_{ii} = k$$

$$S = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} = -I_2$$

Identity matrix

A scalar matrix with every diagonal entry equal to one.

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

$$a_{ij} = 1 \quad \text{if } i = j, \quad \text{and } 0 \quad \text{if } i \neq j.$$

Its order is written as a subscript when needed.

Zero or null matrix

Every entry is zero. It may have any order.

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

Every identity matrix is scalar; every scalar matrix is diagonal.

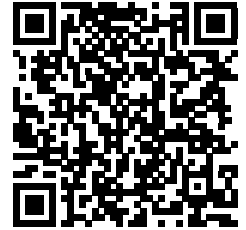


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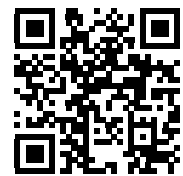


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