A set of m X n numbers (real or imaginary) arranged in the form of a rectangular array of r rows and c columns is called a (m X n) matrix.

$$A = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ \vdots \\ m \end{array} \begin{array}{c} \begin{array}{cccc} 1 & 2 & \dots & n \end{array} \\ \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ a_{31} & a_{32} & \dots & a_{3n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix} \end{array}$$

| Row matrix<br><br>A matrix having only one row is known as a row matrix. | Column matrix<br><br>A matrix having only one column is called a column matrix. |
|---|---|
| $A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} & \dots & a_{1n} \end{bmatrix}_{1 \times n}$ | $A = \begin{bmatrix} a_{11} \\ a_{21} \\ a_{31} \\ a_{41} \\ \vdots \\ a_{n1} \end{bmatrix}_{n \times 1}$ |

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Square matrix :
A matrix in which the number of columns and number of rows say ‘ n ‘ are equivalent to each other is known as square matrix.

For eg. :-

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$

This matrix is a 4 x 4 square matrix.

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Diagonal Matrix is a square matrix $A = [a_{ij}]_{nn}$ is called a diagonal matrix if all the elements, except those in the leading diagonal, are zero.

Here $a_{ij} = 0$ if $i \neq j$.

$$A = \begin{bmatrix} a_{11} & 0 & 0 & \cdots & 0 \\ 0 & a_{22} & 0 & \cdots & 0 \\ 0 & 0 & a_{33} & \cdots & 0 \\ \vdots & \vdots & \vdots & & \vdots \\ 0 & 0 & 0 & \cdots & a_{nn} \end{bmatrix}_{n \times n}$$

Examples $\begin{bmatrix} 3 & 0 \\ 0 & 4 \end{bmatrix}$ $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -4 \end{bmatrix}$

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Scalar Matrix

A square matrix $A = [a_{ij}]_{mn}$ is called a scalar matrix, if

(i) $a_{ij} = 0$ for all $i \neq j$

(ii) $a_{ii} = c$ for all i, where $c \neq 0$.

In other words, a diagonal matrix in which all the diagonal elements are equal is called the scalar matrix.

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

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Identity Or Unit Matrix:-

A square matrix $A = [a_{ij}]_{mn}$ is called an identity or a unit matrix, if

(i) $a_{ij} = 0$ for all $i \neq j$ and,

(ii) $a_{ii} = 1$ for all i

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

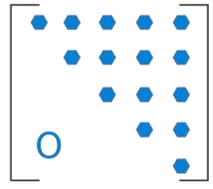
In other words, a square matrix each of whose diagonal elements is unity and each of whose non-diagonal elements is equal to zero is called an identity or unit matrix.
The identity matrix of order n is denoted by $I_n$ .

NULL MATRIX:-

A matrix whose all elements are zero is called a null matrix or a zero matrix.

UPPER TRIANGULAR MATRIX:-

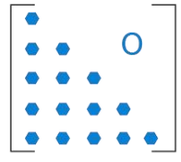
A square matrix $A = [a_{ij}]$ is called an upper triangular matrix if $a_{ij} = 0$ for all $i > j$.
Thus, in an upper triangular matrix, all elements below the main diagonal are zero.




Upper Triangular Matrix

LOWER TRIANGULAR MATRIX:-

A square matrix $A = [a_{ij}]$ is called a lower triangular matrix if $a_{ij} = 0$ for all $i < j$.
Thus, in a lower triangular matrix, all elements above the main diagonal are zero.




Lower Triangular Matrix

TRACE OF A MATRIX:-

Let A = [ij]n be a square matrix. Then, the sum of all diagonal elements of A is called the trace of A and is denoted by tr (A).
Thus, $tr(A) = \Sigma a_{ij}$.

EQUALITY OF MATRICES:-

Two matrices $A = [a_{ij}]_{m \times n}$ and
$B = [b_{ij}]_{r \times s}$ are equal
if,
(i) m = r, i.e., the number of rows in A equals the number of rows in B
(ii) n = s, i.e., the number of columns in A equals the number of columns in B
(iii) $a_{ij} = b_{ij}$ for i = 1, 2,..., m and j = 1, 2,....n.

Then, two matrices A and B are equal, we write A = B, otherwise we write $A \neq B$.