# Matrices and its Applications

## MATRICES

### What is a Matrix?

A matrix is a two-dimensional arrangement of numbers in rows and columns enclosed bya pair of square brackets ([ ]), in the form shown below.

### Application of Matrices in Real Life:

Matrices are nothing but the rectangular arrangement of numbers, expressions, symbols which are arranged in columns and rows.
The numbers present in the matrix are called as entities or entries.
A matrix is said to be having 'm' number of rows and 'n' number of columns.
Matrices find many applications in scientific fields and apply to practical real life problems as well, thus making an indispensable concept for solving many practical problems.

Some of the main applications of matrices are briefed below:

- In physics related applications, matrices are applied in the study of electrical circuits, quantum mechanics and optics.
In the calculation of battery power outputs, resistor conversion of electrical energy into another useful energy, these matrices play a major role in calculations.
Especially in solving the problems using Kirchoff's laws of voltage and current, the matrices are essential.

- In computer based applications, matrices play a vital role in the projection of three dimensional image into a two dimensional screen, creating the realistic seeming motions.
Stochastic matrices and Eigen vector solvers are used in the page rank algorithms which are used in the ranking of web pages in Google search.
The matrix calculus is used in the generalization of analytical notions like exponentials and derivatives to their higher dimensions.
One of the most important usages of matrices in computer side applications are encryption of message codes.
Matrices and their inverse matrices are used for a programmer for coding or encrypting a message.
A message is made as a sequence of numbers in a binary format for communication and it follows code theory for solving.
Hence with the help of matrices, those equations are solved.
With these encryptions only, internet functions are working and even banks could work with transmission of sensitive and private data's.

- In geology, matrices are used for taking seismic surveys.
They are used for plotting graphs, statistics and also to do scientific studies in almost different fields.

# Types of Matrices

1. **Row Matrix:**

A row matrix is formed by a single row.

$$\begin{pmatrix} 2 & 3 & -1 \end{pmatrix}$$

2. **Column Matrix:**

A column matrix is formed by a single column.

$$\begin{pmatrix} -7 \\ 1 \\ 6 \end{pmatrix}$$

3. **Rectangular Matrix:**

A rectangular matrix is formed by a different number of rows and columns, and its dimension is noted as: **mxn**.

$$\begin{pmatrix} 1 & 2 & 5 \\ 9 & 1 & 3 \end{pmatrix}$$

4. **Square Matrix:**

A square matrix is formed by the same number of rows and columns.

$$\begin{pmatrix} 1 & 2 & -5 \\ 3 & 6 & 5 \\ 0 & -1 & 4 \end{pmatrix}$$

5. **Zero Matrix:**

In a zero matrix, all the elements are zeros.

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

6. **Upper Triangular Matrix:**

In an upper triangular matrix, the elements located below the diagonal are zeros.

$$\begin{pmatrix} 1 & 7 & -2 \\ 0 & -3 & 4 \\ 0 & 0 & 2 \end{pmatrix}$$

**7. Lower Triangular Matrix:**

In a lower triangular matrix, the elements above the diagonal are zeros.

$$\begin{pmatrix} 2 & 0 & 0 \\ 1 & 2 & 0 \\ 3 & 5 & 6 \end{pmatrix}$$

**8. Diagonal Matrix:**

In a diagonal matrix, all the elements above and below the diagonal are zeros.

$$\begin{pmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 6 \end{pmatrix}$$

**9. Scalar Matrix:**

A scalar matrix is a diagonal matrix in which the diagonal elements are equal.

$$\begin{pmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{pmatrix}$$

**10. Identity Matrix**

An identity matrix is a diagonal matrix in which the diagonal elements are equal to 1.

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

**11. Transpose Matrix**

Given matrix A, the transpose of matrix A is another matrix where the elements in the columns and rows have switched. In other words, the rows become the columns and the columns become the rows.

$$A = \begin{pmatrix} 2 & 3 & 0 \\ 1 & 2 & 0 \\ 3 & 5 & 6 \end{pmatrix} \qquad A^t = \begin{pmatrix} 2 & 1 & 3 \\ 3 & 2 & 5 \\ 0 & 0 & 6 \end{pmatrix}$$

**12. Symmetric matrix:**

In linear algebra, a symmetric matrix is a square matrix that is equal to its transpose. Formally, matrix *A* is symmetric if

$$A = A^{\top}.$$

Because equal matrices have equal dimensions, only square matrices can be symmetric.

$$\begin{bmatrix} 1 & 7 & 3 \\ 7 & 4 & -5 \\ 3 & -5 & 6 \end{bmatrix}.$$