IT 1002 – Mathematics for Computing

Matrices

Matrix

- Matrix is a rectangular array of numbers arranged in rows & columns
- The individual items in a matrix are called entries or elements
- Eg:

$$\begin{bmatrix} 1 & 9 & 6 \\ 20 & 5 & -6 \end{bmatrix}$$

This is a matrix with 2 rows & 3 columns

m by n matrix

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix}.$$

- There are m rows and n rows in this matrix

Square Matrix

- Matrix with same number of rows and columns is called a square matrix
- Eg: 2x2 , 3x3 , 4x4 and 5x5 matrices
- The diagonal elements of a square matrix are those elements where the row and column index are same.
- Eg: the diagonal elements of 3x3 matrix m11 , m22 , m33. the other elements are non diagonal elements

Diagonal Matrix

- If all non diagonal elements in a matrix are zero then the matrix is a diagonal matrix
- Eg: $\begin{bmatrix} 3 & 0 & 0 & 0 \\ 0 & 4 & 0 & 0 \\ 0 & 0 & -5 & 0 \\ 0 & 0 & 0 & 7 \end{bmatrix}_{4x4}$

Identity Matrix

- Identity matrix of size n is the n x n square matrix with 1's on the main diagonal and 0's elsewhere
- It is denoted by I_n or I
- $I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}_{3x3}$

Upper Triangular Matrix

- It is a square matrix where all the entries below the main diagonal are zero
- Eg: $\begin{bmatrix} 6 & 4 & 2 & 1 \\ 0 & 6 & 4 & 2 \\ 0 & 0 & 6 & 4 \\ 0 & 0 & 0 & 6 \end{bmatrix}_{4x4}$

Lower Triangular Matrix

- It is a square matrix where all the entries above the main diagonal are zero
- Eg: $\begin{bmatrix} 4 & 0 & 0 & 0 \\ 10 & 5 & 0 & 0 \\ -3 & 21 & 6 & 0 \\ -15 & -2 & 18 & 7 \end{bmatrix}_{4x4}$

Symmetric Matrix

- Square matrices for which $a_{ij} = a_{ji}$
- Eg: $A = \begin{bmatrix} -3 & 2 & 1 \\ 2 & 0 & 2 \\ 1 & 2 & 0 \end{bmatrix}$

$$A^T = \begin{bmatrix} -3 & 2 & 1 \\ 2 & 0 & 2 \\ 1 & 2 & 0 \end{bmatrix}$$

- If a matrix is symmetric $A = A^T$

Symmetric Matrix/skew symmetric

- Square matrix for which $a_{ij} = - a_{ji}$
- The diagonal entries of an anti symmetric matrix must be zero
- $A = \begin{bmatrix} 0 & -2 & 1 & -5 \\ 2 & 0 & 7 & 1 \\ -1 & -7 & 0 & 0 \\ 5 & -1 & 0 & 0 \end{bmatrix}$ $A^T = \begin{bmatrix} 0 & 2 & -1 & 5 \\ -2 & 0 & -7 & -1 \\ 1 & 7 & 0 & 0 \\ -5 & 1 & 0 & 0 \end{bmatrix}$

Vectors

- Matrix with one row or one column are called vectors
- 1 x n matrix is known as a row vector and n x 1 matrix is known as a column vector
- Row vectors are written horizontally $[1,2,3,4]_{1x4}$
- Column vectors are written vertically $\begin{bmatrix} -3 \\ 2 \\ 1 \end{bmatrix}_{3x1}$