Assignment No. 3

Name - Sumit Gulab Bhamare
Div - A Roll no - 8
Sub - Data Structure Lab

Aim: To study & understand the concept of matrix realization using Python

Problem definition:
Write a Python program to compute following computation on matrix:
a) Addition of two matrices
b) Subtraction of two matrices
c) Multiplication of two matrices
d) Transpose of a matrix.

Learning Objectives:
To understand concept matrix using python.

Learning Outcome:
Students will be able to use algorithms on various linear data structure using sequential organization to solve real life problems.

Theory:
Matrix:
We say a matrix is m×n if it has m rows & n columns. These values are sometimes called the dimensions of the matrix. Note that, in contrast to Cartesian coordinates, we specify the number of rows (the vertial

dimension) & then the number of columns (the horizontal dimension). In most contexts, the rows & columns are numbered starting with 1. Several programming APIs, however, index rows & columns from 0. We use a_{ij} to refer to the entry in ith row & jth column of the matrix A.

The Order of a Matrix is its size or dimensions. The order is always given as the number of rows by the number of columns (R×C).

$\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$ This matrix is a 3×2 matrix
rows by columns

$\begin{bmatrix} 1 & 5 & 6 & 7 & 8 \\ -2 & 3 & 5 & 4 & -1 \end{bmatrix}$
2×5 matrix

For two matrices to be added or subtracted, the dimensions must be the same. If they are the same, then the corresponding entries are added or subtracted whichever the operation.

$$\begin{bmatrix} 2 & 5 \\ 3 & -6 \\ 4 & 0 \end{bmatrix} + \begin{bmatrix} -1 & 7 \\ 2 & 4 \\ -4 & 5 \end{bmatrix} = \begin{bmatrix} 1 & 12 \\ 5 & -2 \\ 0 & 5 \end{bmatrix}$$

For two matrices to be multiplied, their dimensions need to be analyzed to determine if it is possible. The number of columns of the first matrix MUST EQUAL the number of rows of the second matrix.

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} \cdot \begin{bmatrix} 1 & 5 & 6 & 7 & 8 \\ -2 & 3 & 5 & 4 & -1 \end{bmatrix}$$

3×2 & 2×5

They are same so we can multiply these two matrices.

The outside numbers tell the dimensions or the order of the resulting matrix.

$$3 \times 2 \quad \& \quad 2 \times 5$$

$$3 \times 5$$

The answer will be a 3×5 matrix

The position of each element (row, column) in the answer is a clue to how to multiply.

$$\begin{bmatrix} (1,1) & (1,2) & (1,3) & (1,4) & (1,5) \\ (2,1) & (2,2) & (2,3) & (2,4) & (2,5) \\ (3,1) & (3,2) & (3,3) & (3,4) & (3,5) \end{bmatrix}$$

This entry is in the 1st row & 5th column so it labeled (1,5)

To do the multiplication of the two matrices, a calculation must be completed with the row & columns as follows: To obtain each entry in the solution matrix, we will look at the row in the first matrix & the column in the second matrix that correspond to the solution matrix entry. So, for the entry that belongs in the solution matrix in the location (1,5) we will use the 1st row in the first matrix & the 5th column in the second matrix.

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} \cdot \begin{bmatrix} 1 & 5 & 6 & 7 & 8 \\ -2 & 3 & 5 & 4 & -1 \end{bmatrix} = \begin{bmatrix} - & - & - & - & - \\ - & - & - & - & - \\ - & - & - & - & - \end{bmatrix}$$

This calculation is for the entry in the 1st row, 5th col.

We will multiply the first entry in each & the second entry in each, then we will add those two results together.

$$1 \cdot 8 + 2 \cdot -1$$
$$8 - 2 = 6$$

$$\begin{bmatrix} - & - & - & - & 6 \\ - & - & - & - & - \\ - & - & - & - & - \end{bmatrix}$$

This process must be done for each entry in the sol^n matrix. Below are a few more examples. Then, the final matrix after all calculations are completed.

Calculating (2,3)

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} \cdot \begin{bmatrix} 1 & 5 & 6 & 7 & 8 \\ -2 & 3 & 5 & 4 & -1 \end{bmatrix} \begin{bmatrix} - & - & - & - & 6 \\ - & - & 38 & - & - \\ - & - & - & - & - \end{bmatrix}$$

$3.6 + 4.5$

$18 + 20 = 38$

The final answer for this matrix multiplication:

$$\begin{bmatrix} -3 & 11 & 16 & 15 & 6 \\ -5 & 27 & 38 & 37 & 20 \\ -7 & 43 & 60 & 59 & 34 \end{bmatrix}$$

Input: Enter the data for first matrix & second matrix.

Output: addition, subtraction & multiplication of entered matrix & transpose of matrix

Algorithm / Pseudo code:

- Addition of two matrices:

```
def addition_matrix(M1,M2,M3,r,c):
    for i in range(r):
        A[]
        for j in range(c):
            A.append(M1[i][j] + M2[i][j])
        M3.append(A)
```

Date

- Subtraction of two matrices:

```
def subtraction_matrix (M1, M2, M3, r, c):
    for i in range(r):
        A=[]
        for j in range (c):
            A.append (M1[i][j] -M2[i][j] )
        M3.append (A)
```

- Multiplication of two Matrices:

```
def multiplication_matrix (M1, M2, M3, r1, c1, c2);
    for i in range (r1):
        A=[]
        for j in range (c2):
            sum=0
            for k in range (c1):
                sum = sum+ (M1[i][k] * M2[k][j])
            A.append (sum)
        M3.append (A)
```

- Transpose of matrix:

```
def find_transpose_matrix (M, r, c, T):
    for i in range(c):
        A=[]
        for j in range(r):
            A.append(M[j][i])
        T.append(A).
```

Software required: Open Source Python, Programming tool like Jupyter Notebook, Spyder.

Conclusion: Thus, we have studied & implemented the matrix & performed different operations on it.