Experiment No.: 3

Aim: 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

Software Requirements: 64-bit Open source Linux
Python IDE like spyder

Hardware Requirement: C2D, 2GB RAM, 500 GB HDD.

Objectives: To understand matrix operation using python programming

Outcomes: Student will able to solve mathematical problems using programming

Theory:
A matrix represents a collection of numbers arranged in an order of rows and columns. It is necessary to enclose the elements of a matrix in parentheses or brackets

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

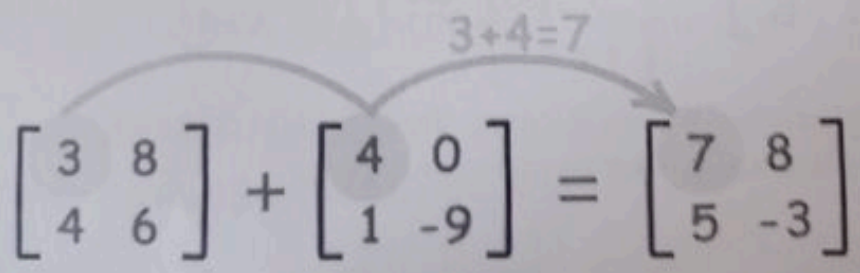
This Matrix [M] has 3 rows and 3 columns. In programming, each element of matrix [M] can be referred to by its row and column number. M[1][2]=6

Order of a Matrix - The order of a matrix is defined in terms of its number of rows and columns.

Order of a matrix = No. of rows ×No. of columns

Therefore Matrix [M] is a matrix of order 3 × 3

Matrix Addition - To add two matrices: add the numbers in the matching positions.



These are the calculations:

3+4=7 8+0=8

4+1=5 6−9=−3

Matrix subtraction - To subtract two matrices: subtract the numbers in the matching positions:

$$\begin{bmatrix} 3 & 8 \\ 4 & 6 \end{bmatrix} - \begin{bmatrix} 4 & 0 \\ 1 & -9 \end{bmatrix} = \begin{bmatrix} -1 & 8 \\ 3 & 15 \end{bmatrix}$$

3−4=−1

These are the calculations:

3−4=−1 8−0=8

4−1=3 6−(−9)=15

Matrix multilication -

to multiply a matrix by another matrix we need to do the "dot product" of rows and columns ... what does that mean? Let us see with an example:

To work out the answer for the **1st row** and **1st column**:

"Dot Product"

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \mathbf{x} \begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix} = \begin{bmatrix} 58 & \end{bmatrix}$$

The "Dot Product" is where we multiply matching members, then sum up:

$$(1, 2, 3) \bullet (7, 9, 11) = 1\times7 + 2\times9 + 3\times11$$
$$= 58$$

We match the 1st members (1 and 7), multiply them, likewise for the 2nd members (2 and 9) and the 3rd members (3 and 11), and finally sum them up.

Thus we get,

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \mathbf{x} \begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix} = \begin{bmatrix} 58 & 64 \\ 139 & 154 \end{bmatrix}$$

Matrix Transpose - To "transpose" a matrix, swap the rows and columns.

We put a "T" in the top right-hand corner to mean transpose:

$$\begin{bmatrix} 6 & 4 & 24 \\ 1 & -9 & 8 \end{bmatrix}^T = \begin{bmatrix} 6 & 1 \\ 4 & -9 \\ 24 & 8 \end{bmatrix}$$

List to represent matrix - nested list is used to represent a matrix in python.
e.g. M= [[1, 2, 3], [4, 5, 6]]

Algorithm:

1. We first define three matrices A, B, C and read their respective row and column numbers in variable r and c
2. Select options - a) Addition of two matrices b) Subtraction of two matrices
   c) Multiplication of two matrices d) Transpose of a matrix
3. For option a,
   1. First, start a loop for getting row elements of A and B
      Secondly, inside it again start a loop for column of A and B
   2. Then, we store their corresponding addition by C[i][j]=A[i][j] + B[i][j] into C[i][j]
   3. At the end of loop, the result of addition is stored in Matrix C
4. For option b] First, start a loop for getting row elements of A and B
   - Secondly, inside it again start a loop for column of A and B
   - Then, we store their corresponding subtraction by formula: C[i][j]=A[i][j] - B[i][j].
   - When the loop ends for all rows and columns, the result will be stored in Matrix C[i][j]
5. For option c] We check if the matrix can be multiplied or not, if n is not equal to q matrix can't be multiplied and an error message is generated.
   - Read matrices A and B.
   - First, start a loop which goes upto m giving row elements of A
     Secondly, inside it again start a loop which goes upto p giving row elements of B.
     At last, we define a loop which goes upto p giving column element of B
   - Then, we store their corresponding multiplication by sum= sum + A[i][k] * B[k][j], which gets updated each time till k reaches p, which acts as the mathematical formula of multiplication used for matrix.
   - sum is assigned into C[i][j] and likewise, C stores the multiplication result of matrix A and B
6. for option d] we declare two variables i, j and intialize them to 0
   - After this we start a loop of i, till it reaches n which gave us the column indexes and include it a loop of j which gives us the elements of the row.
7. Stop

Conclusion: Thus implemented program to get result of different matrix operation using concet of nested list in python and nested for loops

Questions:

1. Define Matrix

A matrix is a rectangular arrangement of number into rows and columns

2. Represent any matrix using list in python

A = matrix([1,2,3],[4,5,6],[7,8,9])

3. Whether diagonal elements of matrix changes in transpose operation?

No diagonal elements of matrix are not changes in transpose operation.

4. What are different operations on matrix?

1) Addition.
2) Substraction.
3) Multiplication.
4) Transpose.
5) Inverse.

Staff Signature & Date