



CS103-Computer Programming 2  
Programming Exercise 3  
2<sup>nd</sup> Semester 2023-2024

Write a program that will read from a file “**matrix.in**” the dimensions and values of the elements of a matrix **A**. The program will get the transpose of the given matrix and then calculates the sum of elements of each row and column of the original matrix and its transpose. It should also get the sum of all the elements in the matrix. Write as functions with the 2D array as parameter the tasks of finding the matrix transpose and the getting of the sum of the elements of each row and column, and sum of all the elements of the matrix.

Additionally, if the matrix is a square matrix, output also the sum of the elements for the following: main diagonal, upper triangular matrix, lower triangular matrix

\*Transpose of a matrix **A** is defined as converting all rows into columns and columns into rows as shown in the example below.

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

Transpose of a matrix

Sample content of input file “**matrix.in**”: (square matrix)

```
4 4
4 2 6 1
1 9 -3 12
13 7 11 -2
0 4 9 70
```

The integer values 4 and 5 in the 1<sup>st</sup> row corresponds to the row and column dimension of the matrix, and the succeeding rows are the values of the elements in the matrix.

Sample output on the screen:

```
Original Matrix: Square Matrix
                                Sum-of-Row
      4  2  6  1 | 13
      1  9 -3 12 | 19
     13  7 11 -2 | 29
      0  4  9 70 | 83
-----
Sum-of-Columns:18 22 23 81 | 144

Sum of the Main Diagonal: 94
Sum of the Upper Triangular Matrix: 16
Sum of the Lower Triangular Matrix: 34

*****
Transpose of the matrix:
                                Sum-of-Row
      4  1 13 0 | 18
      2  9  7 4 | 22
      6 -3 11 9 | 23
      1 12 -2 70 | 81
-----
Sum-of-Columns:13 19 29 83 | 144

Sum-of-Columns: 18 22 23 81 | 144
Sum of the Main Diagonal: 94
Sum of the Upper Triangular Matrix: 34
Sum of the Lower Triangular Matrix: 16
```

Sample content of input file “matrix.in”: (rectangular matrix)

```
4 5
4 2 6 1 8
1 9 -3 12 25
13 7 11 -2 5
0 4 9 70 37
```

The integer values 4 and 5 in the 1<sup>st</sup> row corresponds to the row and column dimension of the matrix, and the succeeding rows are the values of the elements in the matrix.

Sample output on the screen:

```
Original Matrix: Rectangular Matrix
                                Sum-of-Row
      4  2  6  1  8 | 21
      1  9 -3 12 25 | 44
     13  7 11 -2  5 | 34
      0  4  9 70 37 | 120
-----
Sum-of-Column: 18 22 23 81 75 | 219

Transpose of the matrix:
                                Sum-of-Row
      4  1 13  0 | 18
      2  9  7  4 | 22
      6 -3 11  9 | 23
      1 12 -2 70 | 81
      8 25  5 37 | 75
-----
Sum-of-Column: 21 44 34 120 | 219
```