

## Advanced Programming Techniques Introduction to Java Exercise 1

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You are required to implement the below set of classes as a part of a system that uses matrices in its operations. Also, you have to write a test main function to show how to use these classes. The classes are described below.

**Class: Matrix**

This class have to be implemented as a generic class that allows the matrix to carry any type of numbers: integers, doubles, floats,...

**Data Members:**

- 1- Numbers: A 2D array that carries the numbers of the matrix
- 2- M: number of rows of the matrix
- 3- N: number of columns of the matrix

**Methods:**

- 1- Constructor: takes the number of rows and columns to initialize the data members and allocates a memory for the numbers 2D array accordingly.
- 2- SetNumbers: takes a 1D array of numbers containing all the values of the matrix recorded row by row. It returns true if setting the matrix numbers has finished correctly, else it returns false.

For example: if the matrix is

2  
3 4

The input array will be {1,2,3,4}

- 3- Print: it prints the elements of the matrix each row in a separate line and each row elements are separated by spaces.
- 4- Transpose: it formulates the transpose  $\text{Numbers}^T$  of the 2D array numbers by writing the rows of Numbers as the columns of  $\text{Numbers}^T$ . After executing this function, Numbers array should carry its transpose and the number of rows and columns are swapped.

For Example,

The original matrix

1 2  
3 4  
5 6

The transposed matrix

1 3 5  
2 4 6

**Class: IdentityMatrix**

This class inherits from class Matrix. It represents the identity/unit matrix that is a square matrix carrying ones on its diagonal and the other elements are zeros.

**Data Members:**

No extra data members

**Methods:**

- 1- Constructor: takes the number of rows and columns to pass them to its parent class.
- 2- SetNumbers: overrides the SetNumbers method in Matrix class. It sets the numbers as done in class Matrix and performs extra checks on the special properties of the identity matrix.
- 3- Transpose: overrides the Transpose method in Matrix class. As known, the transpose of the identity matrix is the original matrix itself because it's a symmetric matrix.