**Programming Fundamental**

**Assignment 6**

**Question 1**

Design an **immutable** class for representing two-dimensional **sparse matrices**. Note that for space efficiency you should be storing only non zero elements of a matrix.

a) It should support following methods

1. return transpose of the matrix
2. check whether it is a symmetrical matrix
3. add two matrices
4. multiply two matrices

b) What is the time complexity of each of the methods?

Things to keep in mind

1. Object should be immutable
2. Write junit test cases
3. Methods should be efficient

**Sparse Matrix -**

In computer programming, a matrix can be defined with a 2-dimensional array. Any array with 'm' columns and 'n' rows represents a m X n matrix. There may be a situation in which a matrix contains more number of ZERO values than NON-ZERO values. Such matrix is known as sparse matrix.

**// sparse matrix of class 5x6 with 6 non-zero values**  
 int sparseMatrix[5][6] =  
 {  
 {0 , 0 , 0 , 0 , 9, 0 },  
 {0 , 8 , 0 , 0 , 0, 0 },  
 {4 , 0 , 0 , 2 , 0, 0 },  
 {0 , 0 , 0 , 0 , 0, 5 },  
 {0 , 0 , 2 , 0 , 0, 0 }  
 };

To **Transpose** a matrix, we can simply change every column value to the row value and vice-versa.

A square matrix, A, is **symmetric** if it is equal to its nonconjugate transpose, A = A.'

In terms of the matrix elements, this means that

*ai*, *j*=*aj*, *i*