**Scientific Programming**

# Assignment: Data Structure and STL.

Anand Kamble

[amk23j@fsu.edu](mailto:amk23j@fsu.edu)

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**1. Introduction:**

The SparseMatrix Operations program is designed to demonstrate the functionality of a sparse matrix class. The sparse matrix is represented by a vector of elements, each containing information about its row, column, and value. The program implements various operations such as scaling, multiplication, addition, and I/O operations for sparse matrices.

**2. Implemented Operations:**

**2.1 Scaling Operation:**

The program successfully demonstrates the scaling operation (scale \* matrix). It initializes a SparseMatrix, scales it by a specified factor, and prints the result.

**2.2 Matrix Multiplication Operation:**

Matrix multiplication (matrix \* matrix) is implemented and tested with two example matrices. The result is a new SparseMatrix with the product of the input matrices.

**2.3 Matrix Addition Operation:**

The program supports matrix addition (matrix + matrix). It creates two example matrices, adds them, and outputs the resulting SparseMatrix.

**2.4 I/O Operations:**

The program showcases the ability to read from and write to files using the << and >> operators. It saves a SparseMatrix to a file and reads it back, demonstrating successful I/O operations.

**3. Random SparseMatrix Generation:**

A function is provided to generate a SparseMatrix with random values in the range [0, 1]. The random number generator is initialized, and random values are assigned to the matrix elements.

**4. Testing and Results:**

The program's main function thoroughly tests the implemented operations. It creates matrices, performs operations, and outputs the results. Additionally, the I/O operations are tested by saving a matrix to a file, reading it back, and displaying the results.

**5. Conclusion:**

The SparseMatrix Operations program successfully implements and tests various matrix operations, including scaling, multiplication, addition, and I/O operations. The provided random number generator enhances the program's flexibility for generating matrices with random values.

**6. Recommendations for Future Improvements**:

Implement error handling for invalid user inputs.

Explore optimization opportunities for matrix multiplication.

Enhance the program's user interface for a more interactive experience.