Data Structure and Algorithms Lab

Lab Program 7

1. Design and implement a Java program to sort a list of numbers using both **Quick Sort** and **Merge Sort** algorithms. The program should allow the user to input an array of elements, apply each sorting technique, and display the array before and after sorting. After implementing both the algorithms, find the **time complexity** of Quick Sort and Merge Sort.

2. Design and implement a Java program to construct a **Huffman Coding Tree** for data compression. The program should allow the user to input a set of characters along with their frequencies, build the Huffman tree, and generate the corresponding binary codes for each character. The program should also display the Huffman codes and the encoded string for a given input. Analyze and find the **time complexity** of the Huffman coding algorithm.

Additional Questions:

1. A mobile messaging application wants to reduce the size of text messages transmitted over the network in order to save bandwidth and storage. To achieve this, the system must assign shorter binary codes to frequently used characters (such as spaces, vowels, and common letters) and longer codes to less frequent characters. This requires building a **Huffman Coding Tree**, where each character is stored along with its frequency, and the tree generates prefix-free binary codes for efficient encoding. You are required to design and implement a program that constructs such a coding tree from a given set of characters and their frequencies, generates the Huffman codes, and encodes a sample message. The program should also support decoding the binary string back to the original message to verify correctness, and finally, determine the **time complexity** of the coding process.