Symbiosis Institute of Technology

Faculty of Engineering

CSE- Academic Year 2024-25

Data Structures – Lab Batch 2023-27

Lab Assignment No:- 3	
Name of Student	Faheemuddin Sayyed
PRN No.	23070122196
Batch	23-27
Class	CSE C-1
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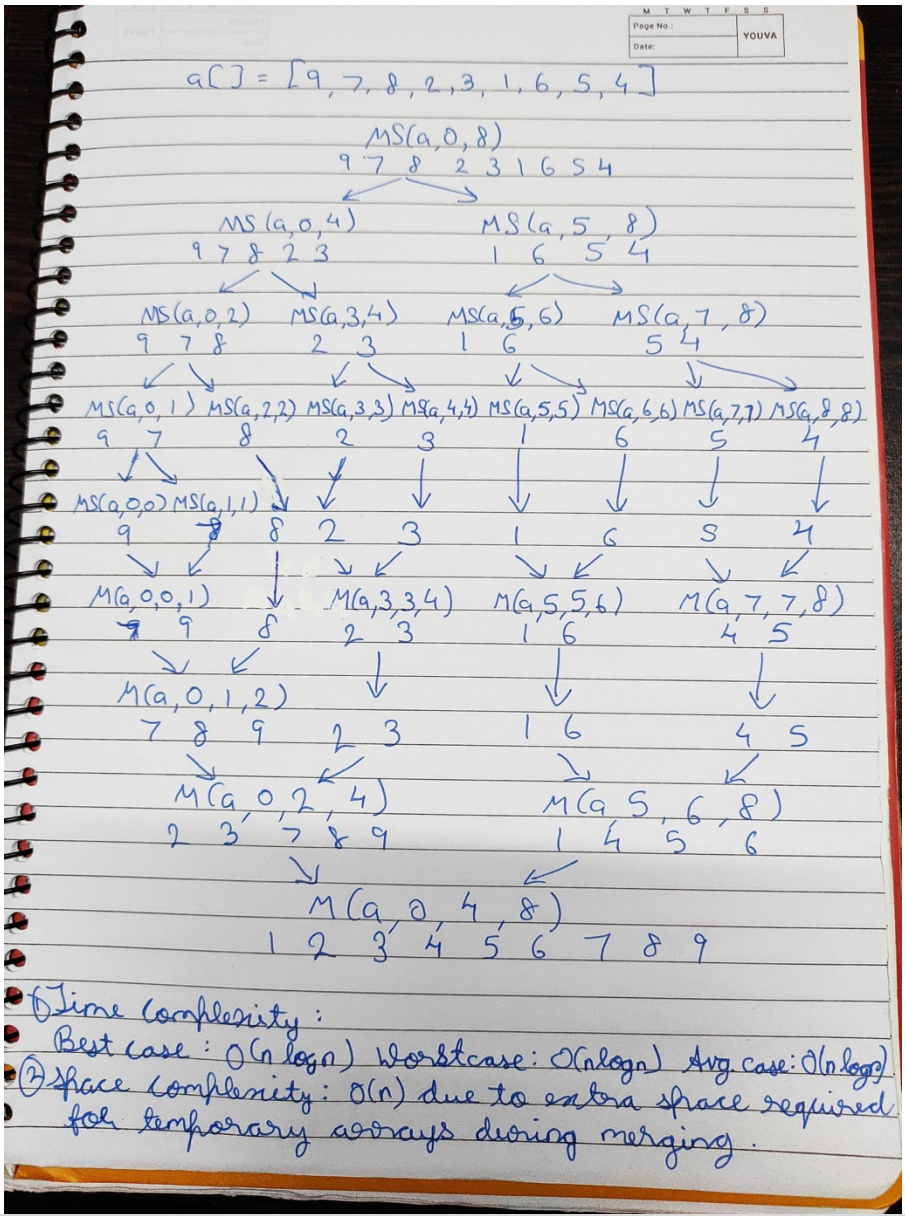
Title of Assignment:	Implement following sorting techniques find the time complexity: Merge
Theory Questions:	1. Apply merge Sort on 9 input items and show the partial pass-wise sorting done. Analyze its Time Complexity (Best, Worst, and Average Case) & Space Complexity 2. Discuss time complexity of merge sort and quick sort in detail. **Answer 2:** Merge Sort: • Time Complexity: • Best Case: O(n log n) – Always divides the array into halves and requires merging. • Worst Case: O(n log n) – Similar to the best case; the algorithm consistently requires log n levels of merging. • Average Case: O(n log n) – Same as best and worst cases. Quick Sort: • Time Complexity: • Best Case: O(n log n) – Occurs when the pivot divides the array into nearly equal parts. • Worst Case: O(n^2) – Occurs when the pivot is the smallest or largest element, causing unbalanced splits (eg, when the array is already sorted).

• Average Case: O(n log n) – Generally occurs with random pivots.

Summary:

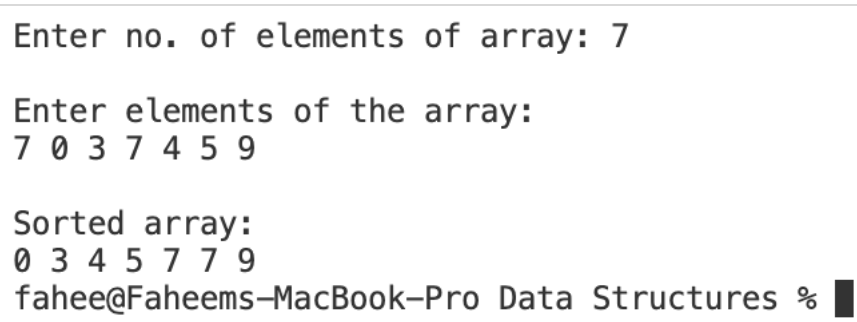
• Merge Sort has a stable O(n log n) time complexity for all cases but requires additional space.
• Quick Sort is faster on average but can degrade to O(n^2) in the worst case, although it is usually more space-efficient than Merge Sort.

Answer 1:



Source Code/Algorithm/Flow Chart:

```c
#include <stdio.h>
#include <stdlib.h>

void Merge(int a[], int l, int mid, int h){
    int i = l, j = mid + 1, k = l;
    int b[100];

    while(i <= mid && j <= h){
        if(a[i] < a[j])
            b[k++] = a[i++];
        else
            b[k++] = a[j++];
    }
    for(; i <= mid; i++)
        b[k++] = a[i];
    for(; j <= h; j++)
        b[k++] = a[j];

    for(i = l; i <= h; i++)
        a[i] = b[i];
}

void MergeSort(int a[], int l, int h){
    int mid;

    if(l < h){
        mid = (l + h) / 2;
        MergeSort(a, l, mid);
        MergeSort(a, mid + 1, h);
        Merge(a, l, mid, h);
    }
}

int main(){
    int *A;
    int n;
    printf("\nEnter no. of elements of array: ");
    scanf("%d", &n);
    A = (int *)malloc(n * sizeof(int));

    printf("\nEnter elements of the array:\n");
    for(int i = 0; i < n; i++)
        scanf("%d", &A[i]);

    MergeSort(A, 0, n - 1);
    printf("\nSorted array:\n");
    for(int i = 0; i < n; i++)
```

	``c printf("%d ", A[i]); printf("\n"); return 0; } ```
Output Screenshots	
Practice questions	1. Implement Quick sort 2. o/p screenshot
Conclusion	Thus we have studied different sorting algorithms and their time complexities.