BRAC University (Department of Computer Science and Engineering) CSE 221 (Algorithms) for Fall 2022 Semester

Assignment 1

Time Complexity

1. Find out the complexity of the given code.

```
(n << input)
handshakes = 0
for (k = n ; k >= 1 ; k = k-1){
   for (i = k-1 ; i >= 1; i = i-1){
      handshakes = handshakes + 1
}
print(f"Total number of handshakes are {handshakes}")
```

2. Sort the functions T(n) from slowest to fastest from the perspective of running time.

$\sqrt[3]{n}$, n^2, $n!$, $\sqrt[3]{n\log(n)}$, 7^n, $e^{\ln(n)}$

3. Show that $2n^3 + 5n^2 + 6n + 18$ is in = $\Theta(n^3)$.

Searching and Sorting

4.Write the algorithm of Merge Sort in brief and show the steps of sorting this array of integers using Merge Sort. [43, 65, 23, 19, 32, 39, 42, 26, 52, 28, 36, 58, 12, 15, 49]

5.You are given an array of integers. The size (n) of the array is greater than or equal to 10. You are going to implement an efficient searching algorithm which needs to sort the array at first. But you are told that the element to be searched is always going to be among the first 10 elements of the sorted array. Among Selection, Bubble and Insertion sorting, which one are you going to use and why?

6.Search 42 in the sorted array of Q. No. 4 using ternary search algorithm. Show the values of low, mid1, mid2, high at each step.

7.On this given sorted array perform the search operation to find out the element 13 using binary and ternary search algorithms showing proper steps and find out the time complexities of both algorithms. [5+5=10 maks]

5	9	11	12	14	19	22	28

8.Propose a Quick Sort algorithm using the last element of each partition as pivot.
Let, A = [5, 8, 2, 9, 7, 3, 1]
Show the steps of the Quick Sort algorithm using the first element as pivot to sort 'A' array in descending order.
Discuss the best case running time of the Quick Sort algorithm.

Recursive Time Complexity : Use any method (Recursive Tree/Master's/Substitution Method)

a) $T(n) = 2T(n/2) + n^3$

b) $T(n) = T(n/4) + T(5n/8) + n$

c) $T(n) = T(n-1) + T(n-2) + C, T(1)=1$

d) $T(n) = 8T(n/2) + n^2, T(1)=1$