CSE102: Data Structures and Algorithm
Assignment-1

Max Marks: 15 **Due Date**: 06/02/2024, 11:59 PM

Instructions

- Use C++ programming language only.
- Plagiarism might be checked.
- Upload a Zip folder named <RollNo>_<YourName>. If not named appropriately, it will not be evaluated.
- For the coding questions, you must ensure that your code compiles and runs otherwise these will be awarded **zero marks**.
- Students might be required to give a demo of their codes.
- Inside the Zip folder, there should be 4 files named`<RollNo>_Q1.cpp`, `<RollNo>_Q2.cpp`, `<RollNo>_Q4.cpp`, `<RollNo>_<YourName>.pdf`.
- `<RollNo>_Q1.cpp` - Code for Q1.1 (Exclude object files)
- `<RollNo>_Q2.cpp` - Code for Q2.1 (Exclude object files)
- `<RollNo>_Q4.cpp` - Code for Q4.1 (Exclude object files)
- `<RollNo>_<YourName>.pdf` - Report including answers for Q1.2, Q1.3, Q2.2, Q3

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1. (7 points) (a) (3 marks) Write a code for the Tower of Hanoi Algorithm using two temporary pegs I.e. There is a source pole/peg named T1, two temporary pegs named T2 and T3; a destination pole/peg named T4. Take the number of disks as input from the user.

   (b) (2 marks) Give the sequence of moves required to move 8 disks from source to destination, using the above algorithm. Explain how the code is working with 8 disks.

   (c) (2 marks) Compare the answer you have received in Q1.2 with the answer you will receive with the traditional Tower of Hanoi Setup (1 source pole, 1 temporary pole, 1 destination pole)I.e. compute and compare their time complexities.

```
Output format for Q1.1
>> Enter the number of disks : 1
>> The sequence of steps are:-
T1 -> T4
```

```
>> Enter the number of disks : 2
>> The sequence of steps are:-
T1 -> T2
T1 -> T4
T2 -> T4

>> Enter the number of disks : 3
>> The sequence of steps are:-
T1 -> T2
T1 -> T3
T1 -> T4
T3 -> T4
T2 -> T4
```

2. (3 points) (a) (2 marks) Write a recursive and an iterative code for Merge sort. Take the array to be sorted as input from the user. Assume it to be an integer array only. Print the sorted array from both recursive call and iterative call.

   (b) (1 marks) Explain the iterative code by an example.

```
Output format for Q2.1
>> Enter the array to be sorted with elements separated by comma: 32,42,1,4,32,15,6
Sorted array by Recursion is : 1,4,6,15,32,42
Sorted array by Iteration is : 1,4,6,15,32,42
```

3. (3 points) Arrange the following functions in a sequence $f_1, f_2, \ldots, f_{24}$ so that $f_i = O(f_{i+1})$ for $1 \leq i \leq 23$.

$n \log n$	$n2^{100}$	n^{-1}	$n^{-1/2}$	$(\log n)/n$	$\binom{n}{64}$
$n!$	$2^{2^{100}}$	2^{2^n}	2^n	3^n	$n2^n$
2^{n+1}	$2n$	$3n$	$\log n!$	$\log_2 n$	$\log_{10} n$
$2.1^{\sqrt{n}}$	2^{2n}	4^n	n^{64}	n^{65}	n^n

4. (2 points) (a) (2 marks) Shinigami took Light Yagami's special notebook and issued a challenge. To get it back, Light needs to solve the "Min Max" problem. Light's task: Given an array of 'N' integers, determine the maximum values obtained by taking the minimum element over all possible subarrays of varying sizes from 1 to 'N'.

   (b) (**Bonus** 3 marks) Help Light Yagami to solve this problem in **O(n)** time.

```
Consider an array, Arr = [3, 1, 2, 4].
For subarrays of size 1: max(min(3), min(1), min(2), min(4)) = 4
For subarrays of size 2: max(min(3, 1), min(1, 2), min(2, 4)) = 2
For subarrays of size 3: max(min(3, 1, 2), min(1, 2, 4)) = 1
For subarrays of size 4: max(min(3, 1, 2, 4)) = 1

The resulting array is [4, 2, 1, 1].
```