CSE204: Data Structures and Algorithms I Sessional

Assignment 7 on Sorting Algorithms

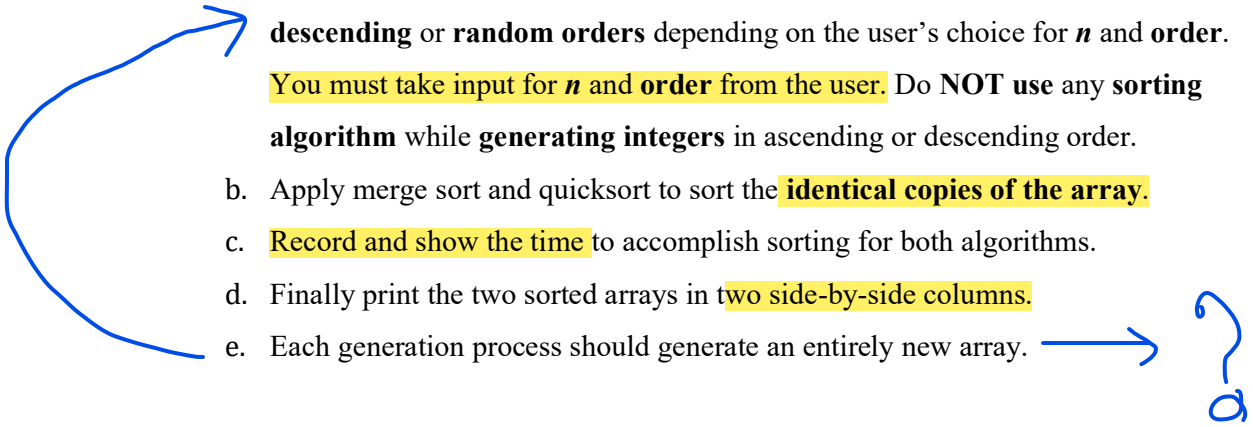
In this assignment you will implement Quicksort and Merge Sort algorithms and compare their performance. The assignment includes **demonstration** of your implementation to the instructor **during evaluation** as well as a **report submission** using pre-generated data. Please carefully read, understand and follow the steps outlined below.

A. Implementation of Sorting Algorithms

1. Implement **Quicksort** and **Merge sort** algorithms for sorting a number of **integers** in **ascending** order.

B. During Evaluation

2. Repeatedly do the following steps until the user quits.
   a. **Generate automatically** an array of ***n*** **integers** in anyone of **ascending**, **descending** or **random orders** depending on the user's choice for ***n*** and **order**. You must take input for ***n*** and **order** from the user. Do **NOT use** any **sorting algorithm** while **generating integers** in ascending or descending order.
   b. Apply merge sort and quicksort to sort the **identical copies of the array**.
   c. Record and show the time to accomplish sorting for both algorithms.
   d. Finally print the two sorted arrays in two side-by-side columns.
   e. Each generation process should generate an entirely new array.



C. Report Generation

3. For each value of $n = 10^1, 10^2, 10^3, \cdots, 10^6$, generate statistics as follows.
   a. Generate **three** arrays of ***n*** **integers** in **ascending**, **descending** and **random orders** (one in each order). These arrays must be generated multiple times for each value of n as explained in **Step c**. Do **NOT use** any **sorting algorithm** while **generating integers** in ascending or descending order.
   b. Apply merge sort and quicksort to sort the arrays. Use **identical copies of arrays** as input to both algorithms.

c. Record the time to accomplish sorting in the following table. For example: You want to get timing for n=10 to sort an array in ascending order with merge sorting. Generate the scenario multiple times (**say, 10 or 20 times**) and take the **average sorting time**. Record **ONLY** the ***average*** sorting ***time*** into the cell. **Please note exactly the same data must be used for the other sorting algorithm.**

Table: ***Average time*** for sorting ***n*** integers in different **input orders**

Input Order	***n* = **Sorting Algorithm**	10	100	1000	10000	100000	1000000
Ascending	Merge	1	2.2	1.2	2.6	15.4	117
	Quick	1	3.2	3.4	129.6	14916.6	1717980
Descending	Merge	2.6	1.6	2.4	2.8	15.8	116
	Quick	2.8	2.8	4.2	130.6	17346.2	1194900
Random	Merge	1.8	2.6	1.8	3	21.2	202.8
	Quick	2.8	3.4	2.6	4.8	40.2	413.2

Time in mili-second

4. **Plot *average*** running ***time*** of both sorting algorithms against the input array size ***n*** for all input orders (e.g., a **single** plot of time vs. n using all statistics). Use appropriate legend, colors, line width, line type, etc. to improve the readability your plot.
5. **Generate the report** containing **complexity analysis** of both algorithms for all input orders, **machine configuration**, **table** (as explained in Step 3) and **plot** ((as explained in Step 4)). The report must be in **pdf format**.

Special Instructions:

Write ***readable, re-usable, well-structured, quality*** code. This includes but is not limited to writing appropriate functions for implementation of the required algorithms, **meaningful naming** of the variables, **suitable comments** where required, proper indentation etc.

Please **DO NOT COPY** solutions from anywhere (your friends, seniors, internet etc.). Any form of plagiarism (irrespective of source or destination), will result in getting -100% marks in

the offline. Also, be informed that for repeated offence of plagiarism, the departmental policies suggest stricter measures.

Submission

1. Create an empty folder named to your student_id (e.g. 1805001)
2. Put all the source code files and reports in that folder
3. Zip that folder. It should give you student_id.zip
4. Submit the zip file to moodle

Submission Deadline: June 11, 2021 11:55 PM