Data Structures and Algorithms Lab

Lab 14 **Marks 06**

Instructions

Work on this lab individually. You can use your books, notes, handouts etc. but you are not allowed to borrow anything from your peer student.

Marking Criteria

Show your work to the instructor before leaving the lab to get some or full credit.

What you must do

Implement a class for **Max Heap**. Each node of this **Max Heap** will contain the **roll number** and **CGPA** of a student. The heap will be organized based on students' **CGPAs** i.e., the student having the **maximum CGPA** will be at the **root** of the heap.

The class definitions will look like:

```
class Student
{
	friend class StudentMaxHeap;

private:
	double cgpa;			//Student's CGPA
	int rollNo;			//Student's roll number
};

class StudentMaxHeap
{
private:
	Student* arr;			//Array of students which, arranged like a Max Heap
	int curSize;			//Current number of students present in the heap
	int maxSize;			//Maximum number of students that can be present in heap

public:
	StudentMaxHeap (int size);	//Constructor
	~StudentMaxHeap();		//Destructor
	bool isEmpty();			//Checks whether the heap is empty or not
	bool isFull();			//Checks whether the heap is full or not
};
```

You are required to implement the following member functions of the **`StudentMaxHeap`** class:

`bool insert (int rollNo, double cgpa)`

This function will insert the record of a new student (with the given roll number and CGPA) in the **Max Heap**. This function should return **true** if the record was successfully inserted in the heap and it should return **false** otherwise, with worst case time complexity of $\boldsymbol{O(lg\ n)}$.

If two students have the same **CGPA** then their records should be stored in a way such that the student with **smaller** roll number comes before the student with **larger** roll number.

`bool remove (int &rollNo, double &cgpa)`

This function will remove the record from the **Max Heap** which has the highest **CGPA**. Before removing the student's record, this function will store the **roll number** and **CGPA** of the removed student in its two arguments. It should return **true** if the removal was successful and it should return **false** otherwise. The worst-case time complexity of this function should also be $\boldsymbol{O(lg\ n)}$.

`void displayStudentList()`

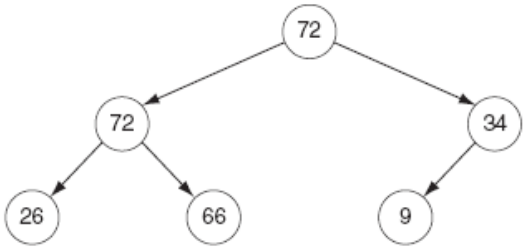
This function will display the students list in **descending order** of **CGPAs**. If two students have the same **CGPA**, then the student with **smaller roll number** will be displayed before the student with **larger roll number**.

This function should not affect the **heap** i.e., after the execution of this function the heap should be left in the same way, as it was when this function was called.

`void levelOrder()`

This function will perform a **level order** traversal of the **StudentMaxHeap** and display the **roll numbers** and **CGPAs** of the students. The output displayed by the level order traversal should follow the format as shown below:

Heap:	**Level order traversal:**

	`72`
	`72 34`
	`26 66 9`

Write a **menu-based** driver function **(menu)** to illustrate the working of different functions of the **StudentMaxHeap** class. The menu should look like:

1. Insert a new student
2. Remove (and display) the student with the Max CGPA
3. Display the list of students (Descending order of CGPA)
4. Display the list of students (Level-order traversal)
5. Exit

Enter your choice:

☺ ☺ ☺ **BEST OF LUCK** ☺ ☺ ☺