Data Structures and Algorithms Lab

Lab 09 **Marks 05**

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

Program the following task in your C++ compiler and then compile and execute them. *Write **main** function first and keep on testing the functionality of each function once created.*

Task 01

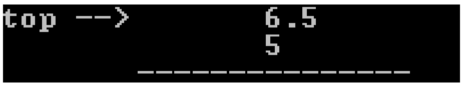
Write the implementation of following generic **Stack** class; it should provide the standard stack structure of *LIFO (Last-in First-out)* as discussed in the class.

```
template <class T>
class Stack
{
public:
	//constructor
	Stack(const int MAX_SIZE = 5);

	//destructor
	~Stack();

	//stack manipulation operations
	void push(const T newItem);	//push a new item
	void pop();			//pop an item
	void clear();			//clear the stack

	//stack accessor
	T getTop() const;		//return item at the top

	//stack status operations
	bool isEmpty() const;		//is stack empty?
	bool isFull() const;		//is stack full?

	//outputs the data in stack. If the stack is empty, outputs “Empty Stack”.
	void showStructure() const;

private:
	//Data members
	T *data;		//array of items to be allocated dynamically as per MAX_SIZE
	int top;		//top of the stack
	const int MAX_SIZE;	//maximum capacity of the stack
};
```

Write **main** function and create some objects of **Stack** for various data types (e.g., int, float, string) and test all the implemented functions. The **showStructure** function must display the **stack status** with its *top* pointing to the correct location on the console.

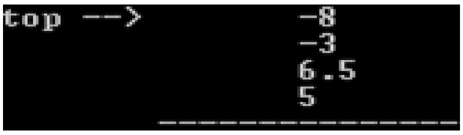
Sample run:

```
stack.Push(5.0);
stack.Push(6.5);
stack.showStructure();
```



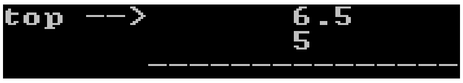
```
top -->          6.5
                 5
          ---------------
```

```
stack.Push(-3.0);
stack.Push(-8.0);
stack.showStructure();
```



```
top -->             -8
                    -3
                    6.5
                    5
             ---------------
```

```
stack.Pop();
stack.Pop();
stack.showStructure();
```



```
top -->            6.5
                   5
             ---------------
```

Task 02

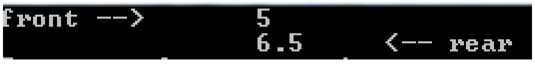
Write implementation of following generic **Queue** class; it should provide the standard queue structure of *FIFO (First-in first-out)* as discussed in the class.

```
template <class T>
class Queue
{
public:
        //constructor
        Queue(const int MAX_SIZE = 5);

        //destructor
        ~Queue();

        //queue manipulation operations
        void enQueue(const T newItem);   //add an element to the rear of queue
        void deQueue();                  //delete element at the front of queue
        void clear();                    //clear the queue

        //queue accessors
        T getFront() const;              //return element at the front
        T getRear() const;               //return element at the rear

        //queue status operations
        bool isEmpty() const;            //is queue empty?
        bool isFull() const;             //is queue full?

        //outputs the data in queue. If the queue is empty, outputs "Empty Queue".
        void showStructure() const;

private:
        //data members
        T *data;                  //array of items to be allocated dynamically as per MAX_SIZE
        int front;                //front index
        int rear;                 //rear index
        const int MAX_SIZE;       //size of queue
};
```

Write **main** function and create some objects of **Queue** for various data types (e.g., int, float, string), test all the implemented functions. The **showStructure** function must display the **queue status** with its *front* and *rear* pointing to the correct locations on the console.

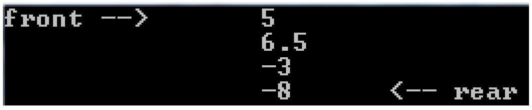
Sample run:

```
queue.enQueue(5.0);
queue.enQueue(6.5);
queue.showStructure();
```



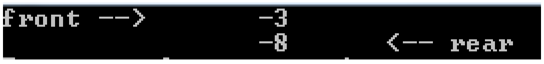
```
front -->        5
                 6.5      <-- rear
```

```
queue.enQueue(-3.0);
queue.enQueue(-8.0);
queue.showStructure();
```



```
front -->        5
                 6.5
                 -3
                 -8       <-- rear
```

```
queue.deQueue();
queue.deQueue();
queue.showStructure();
```



```
front -->        -3
                 -8       <-- rear
```

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