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| **Data Structures & Algorithms**  Diploma in IT, CSF  Year 2 (2024/25) Semester 4 | **Week 5** |
| **1-2 Hours** |
| **Tutorial 5 – Queues** | |

1. After the following statements execute, what are the contents of the queue?

num1 = 5;

num2 = 1;

num3 = 4;

q.enqueue(num2); [1]

q.enqueue(num3); [1, 4]

q.dequeue() [4]

q.enqueue(num1 – num2) [4, 4]

q.dequeue(num1) (Dequeue and assign to num1), num1 = 4 [4]

q.dequeue(num2) (Dequeue and assign to num2), num 2 = 4 []

cout << num2 << " " << num1 << " " << num3 << endl;

[] and all num variables are 4

2. The specification of the Queue ADT implemented using Circular Array is given below.

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| *// Queue.h - Specification of Queue ADT (implemented using Circular Array)*  #pragma once  #include<string>  #include<iostream>  using namespace std;  typedef int ItemType;  class Queue  {  private:  ItemType items[MAX\_SIZE];  int front;  int back;  bool isFull;  public:  // constructor  Queue();  *// enqueue (add) item at back of the queue*  bool enqueue(ItemType item);  *// dequeue (remove) item from front of the queue*  bool dequeue();  *// retrieve (get) and dequeue item from front of the queue*  bool dequeue(ItemType& item);  *// retrieve (get) item from front of queue*  void getFront(ItemType& item);  *// check if the queue is empty*  bool isEmpty();  }; |

Implement the following operations of the Queue ADT

1. Queue();
2. bool enqueue(ItemType item);
3. bool dequeue(ItemType& item);
4. bool isEmpty();

3. The specification of the Queue ADT implemented using Pointers is given below.

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| *// Queue.h - Specification of Queue ADT (implemented using Pointers)*  #pragma once  #include<string>  #include<iostream>  using namespace std;  typedef string ItemType;  class Queue  {  private:  struct Node  {  ItemType item; // item  Node \*next; // pointer pointing to next item  };  Node \*frontNode; // point to the front node  Node \*backNode; // point to the back node  public:  // constructor  Queue();  ~Queue();  *// enqueue (add) item at back of the queue*  bool enqueue(ItemType item);  *// dequeue (remove) item from front of the queue*  bool dequeue();  *// retrieve (get) and dequeue item from front of the queue*  bool dequeue(ItemType& item);  *// retrieve (get) item from front of queue*  void getFront(ItemType& item);  *// check if the queue is empty*  bool isEmpty();  *// returns no of elements in queue*  int getNoOfElements();  }; |

1. Write a client function getLastElement()that returns the last element of the queue while leaving the queue unchanged. This function can call any of the functions in the Queue ADT. Function prototype is given as follows:

bool getLastElement(Queue& q, ItemType& item);

1. Implement a function getNoOfElements() for ADT Queue that returns the no of elements in the queue. Function prototype is given as follows:

int getNoOfElements();

1. Imagine the case if the pointer- based implementation of ADT Queue does not come with a backNode. Discuss how this will affect the efficiency in terms of computation time for enqueue and dequeue functions.