The Queue is a linear data structure or an abstract data type. Queue follows the FIFO – “first in, first out” method to process the data. The data which is inserted first will be accessed first. Unlike Stack, Queue has two ends REAR and FRONT. The REAR end is always used to insert the data i.e., enqueue, and the FRONT end is used to remove the data inserted i.e. dequeue.

Representation of Queue

Linear array is the best and easiest way to represent the Queue. The Queue contains two ends, REAR and FRONT. These ends point to the position from where the insertion and deletion take place. The REAR points to the variable from where the insertion takes place and the FRONT points to the variable from where deletion takes place.

Basic Operations

Queue operations may involve initializing or defining the queue, utilizing it, and then completely erasing it from the memory. Here we shall try to understand the basic operations associated with queues –

- **enqueue()** – add (store) an item to the queue.
- **dequeue()** – remove (access) an item from the queue.

Few more functions are required to make the above-mentioned queue operation efficient. These are –

- **peek()** – Gets the element at the front of the queue without removing it.
- **isfull()** – Checks if the queue is full.
- **isempty()** – Checks if the queue is empty.

In queue, we always dequeue (or access) data, pointed by **front** pointer and while enqueing (or storing) data in the queue we take help of **rear** pointer.

Let's first learn about supportive functions of a queue –

peek()

This function helps to see the data at the **front** of the queue. The algorithm of peek() function is as follows –

Algorithm

```
begin procedure peek
  return queue[front]
end procedure
```

Implementation of peek() function in C programming language –

Example

```
int peek() {
  return queue[front];
}
```

isfull()

As we are using single dimension array to implement queue, we just check for the rear pointer to reach at MAXSIZE to determine that the queue is full. In case we maintain the queue in a circular linked-list, the algorithm will differ. Algorithm of isfull() function –

Algorithm

```
begin procedure isfull
```

```
if rear equals to MAXSIZE
    return true
  else
    return false
  endif

end procedure
```

Implementation of isfull() function in C programming language –

Example

```
bool isfull() {
  if(rear == MAXSIZE - 1)
    return true;
  else
    return false;
}
```

isempty()

Algorithm of isempty() function –

Algorithm

```
begin procedure isempty

  if front is less than MIN  OR front is greater than rear
    return true
  else
    return false
  endif
```

```
end procedure
```

If the value of **front** is less than MIN or 0, it tells that the queue is not yet initialized, hence empty.

Here's the C programming code –

Example

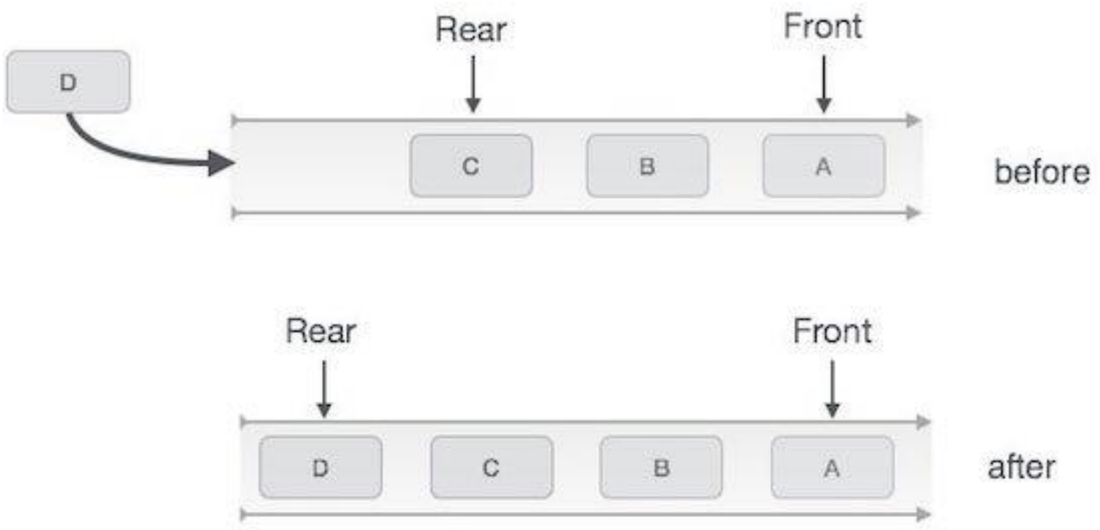
```
bool isempty() {
  if(front < 0 || front > rear)
    return true;
  else
    return false;
}
```

Enqueue Operation

Queues maintain two data pointers, **front** and **rear**. Therefore, its operations are comparatively difficult to implement than that of stacks.

The following steps should be taken to enqueue (insert) data into a queue –

- **Step 1** – Check if the queue is full.
- **Step 2** – If the queue is full, produce overflow error and exit.
- **Step 3** – If the queue is not full, increment **rear** pointer to point the next empty space.
- **Step 4** – Add data element to the queue location, where the rear is pointing.
- **Step 5** – return success.



Queue Enqueue

Sometimes, we also check to see if a queue is initialized or not, to handle any unforeseen situations.

Algorithm for enqueue operation

```
procedure enqueue(data)

  if queue is full
    return overflow
  endif
```

```
rear ← rear + 1
  queue[rear] ← data
  return true

end procedure
```

Implementation of enqueue() in C programming language –

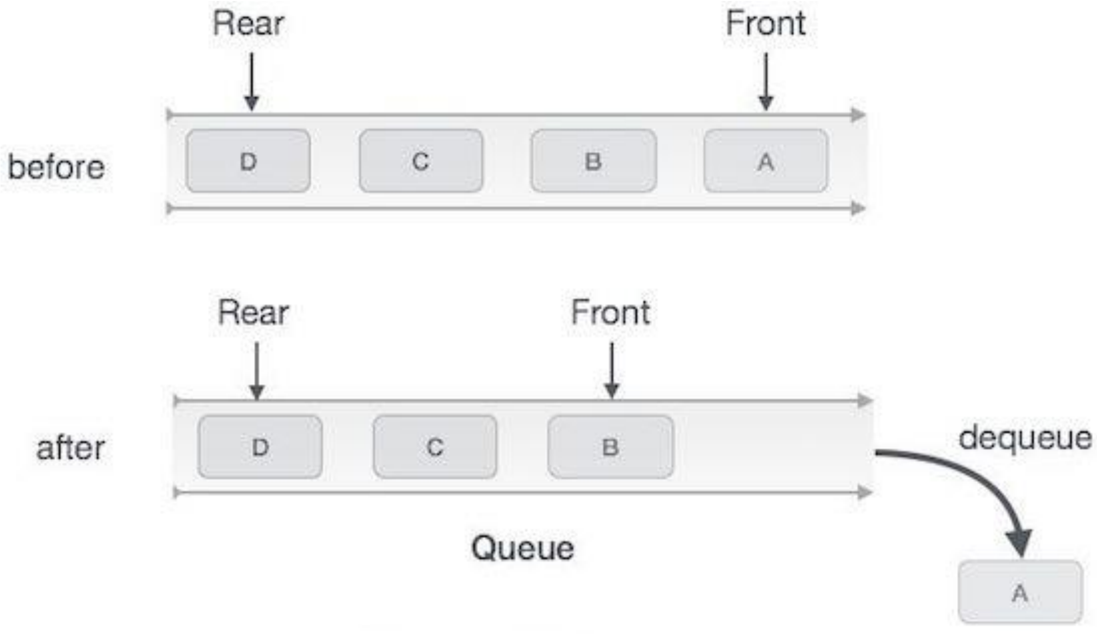
Example

```
int enqueue(int data)
  if(isfull())
    return 0;

  rear = rear + 1;
  queue[rear] = data;

  return 1;
end procedure
```

Dequeue Operation

Accessing data from the queue is a process of two tasks – access the data where **front** is pointing and remove the data after access. The following steps are taken to perform **dequeue** operation –

- **Step 1** – Check if the queue is empty.
- **Step 2** – If the queue is empty, produce underflow error and exit.
- **Step 3** – If the queue is not empty, access the data where **front** is pointing.
- **Step 4** – Increment **front** pointer to point to the next available data element.
- **Step 5** – Return success.



Queue Dequeue

Algorithm for dequeue operation

```
procedure dequeue

  if queue is empty
    return underflow
  end if
  data = queue[front]
  front ← front + 1
  return true

end procedure
```

Implementation of dequeue() in C programming language –

Example

```
int dequeue() {
  if(isempty())
    return 0;

  int data = queue[front];
  front = front + 1;

  return data;
}
```