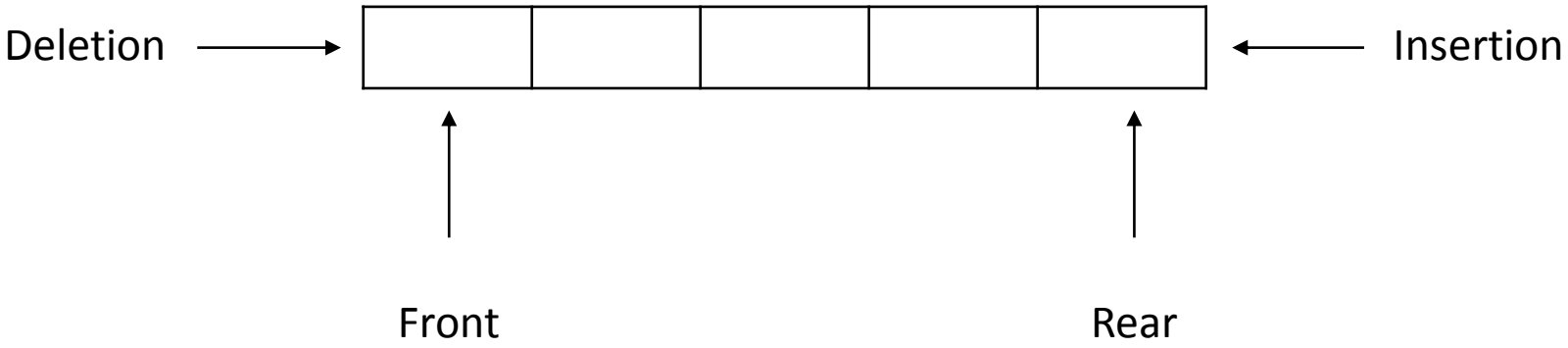
Definition of Queue

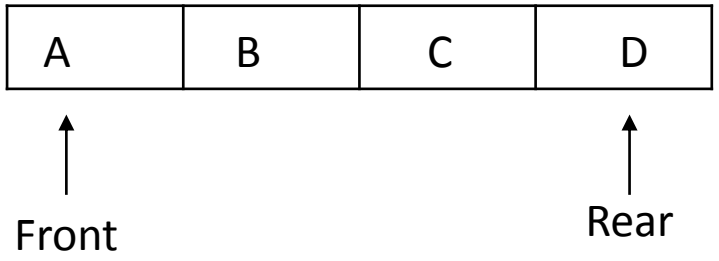
An ordered collection of items from which items may be deleted from one end called the front and into which items may be inserted from other end called rear is known as **Queue**.
It is a linear data structure.
It is called **First In First Out (FIFO)** list. Since in queue, first element will be the first element out.



(a) Insertion and deletion of elements in Queue

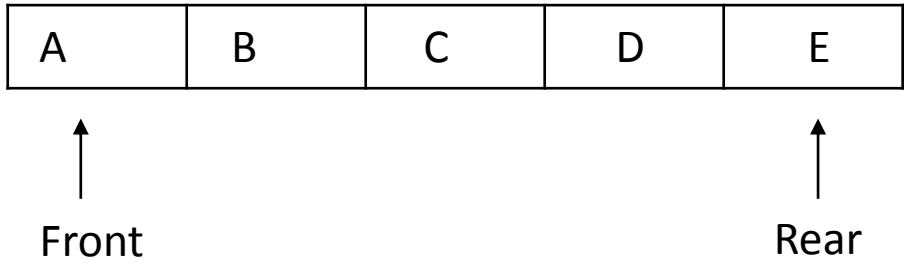
Queue (Example)

Queue with four elements A, B, C and D.
A is at front and D is at rear.



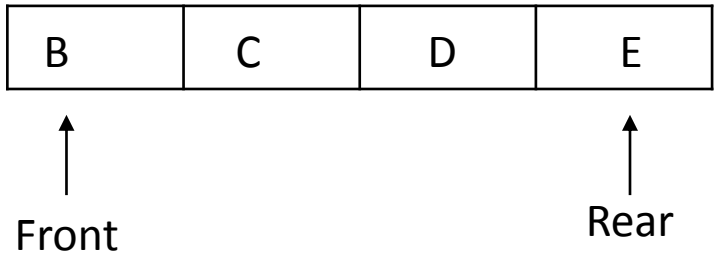
(b) Queue

Element E will be added at the rear end.



(c) Front and near pointer after insertion

Element can be deleted only from the front.
Thus, A will be the first to be removed from the queue.



(d) Front and rear pointer after deletion

Difference between Stack & Queue.

SR	Stack	Queue
1	Stack is a LIFO (Last in first out) data structure.	Queue is a FIFO (first in first out) data structure.
2	In a stack, all insertion and deletions are permitted only at one end of stack called top of stack.	In a queue items are inserted at one end called the rear and deleted from the other end called the front.
3	Stack is widely used in recursion.	Queue is more useful in many of the real life applications.
4	**Example**: A stack of plates, a stack of coin etc.	**Example**: A queue of people waiting to purchase tickets, in a computer system process waiting for line printer etc.

Operations on a Queue.

1. **Create**: Creates empty queue.
2. **Insert**: Add new element at rear.
3. **Delete**: Delete element at front.
4. **Isempty**: Checks queue is empty or not.
5. **Isfull**: Checks queue is full or not.

Algorithm to insert and delete element in the Queue.

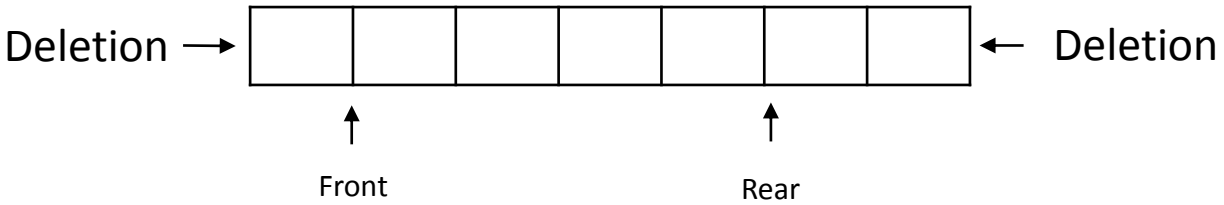
1. Create an empty queue by giving name and
2. Initially assign Rear = -1, front = -1.
3. If choice == Insert then
   if Rear == max-1 then
   print “queue is full”
   else
   Rear = Rear +1
   q [Rear] = element
4. If choice == Delete then
   If front == -1 then
   print “queue is empty”
   else
   front = front +1
5. Stop

Queue as an abstract data type

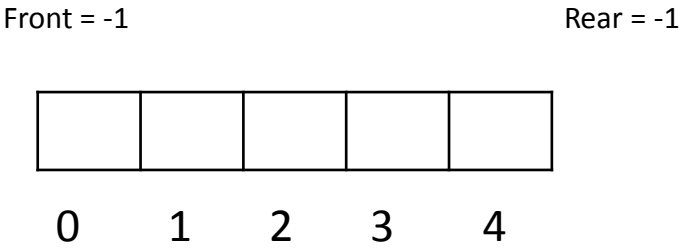
(1) Initialize the queue to be empty.
(2) Check if the queue is empty or not.
(3) Check if the queue is full or not.
(4) Insert a new element in the queue if it is not full.
(5) Retrieve the value of first element of the queue, if the queue is not empty.
(6) Delete the first element from the queue if it is not empty.

Queue abstract data type = Queue elements + Queue operations.

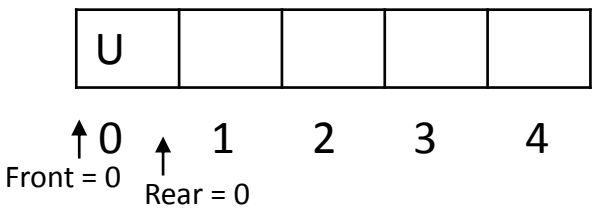
Representation of an Queue as an Array



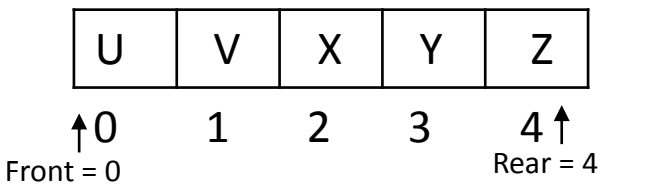
(a) Queue with array



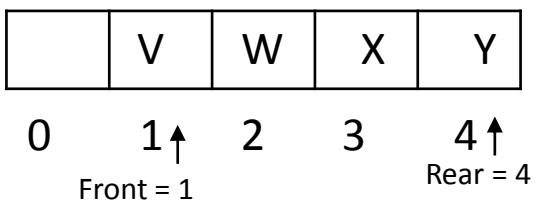
(b) Empty Queue



(c) Queue after adding an element U



(d) Queue after adding 5 element

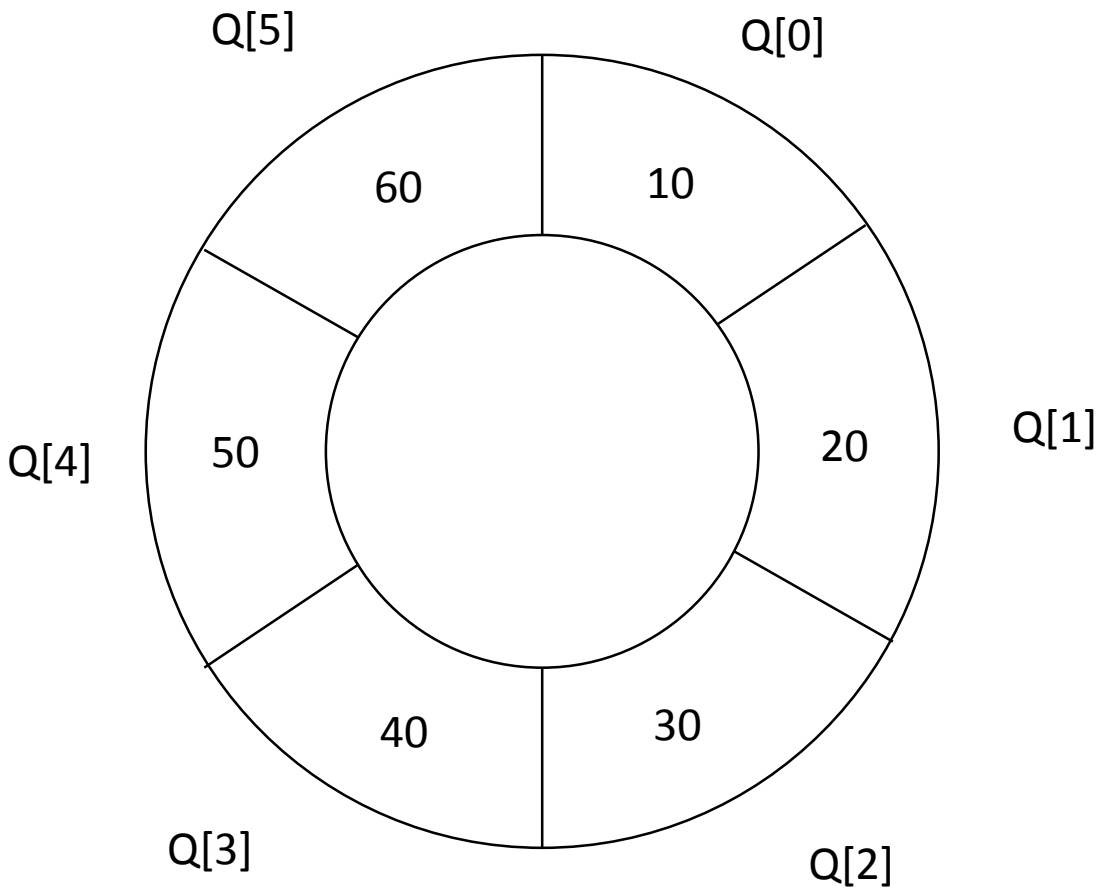


(E) Queue after adding U element

Types of Queue

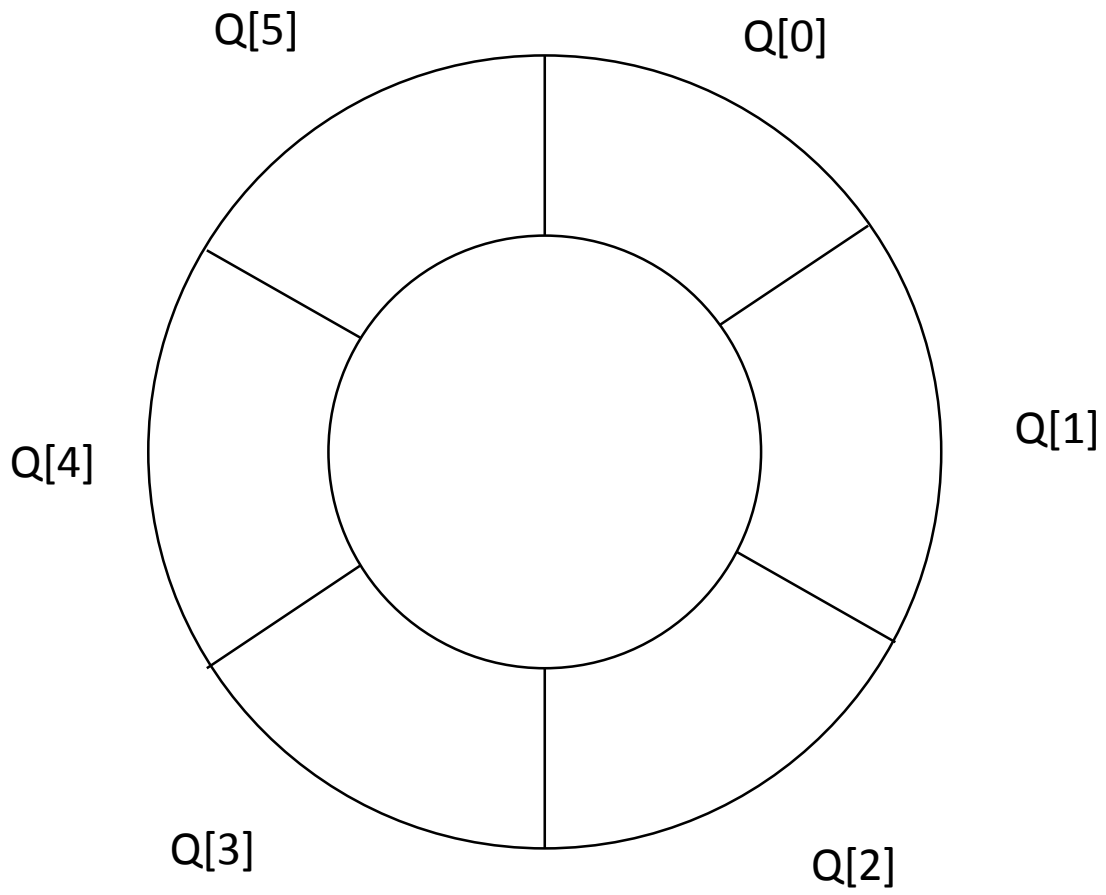
1. Linear Queue.
2. Circular Queue.
3. Double ended Queue.
4. Priority Queue.

Circular Queue full (overflow)



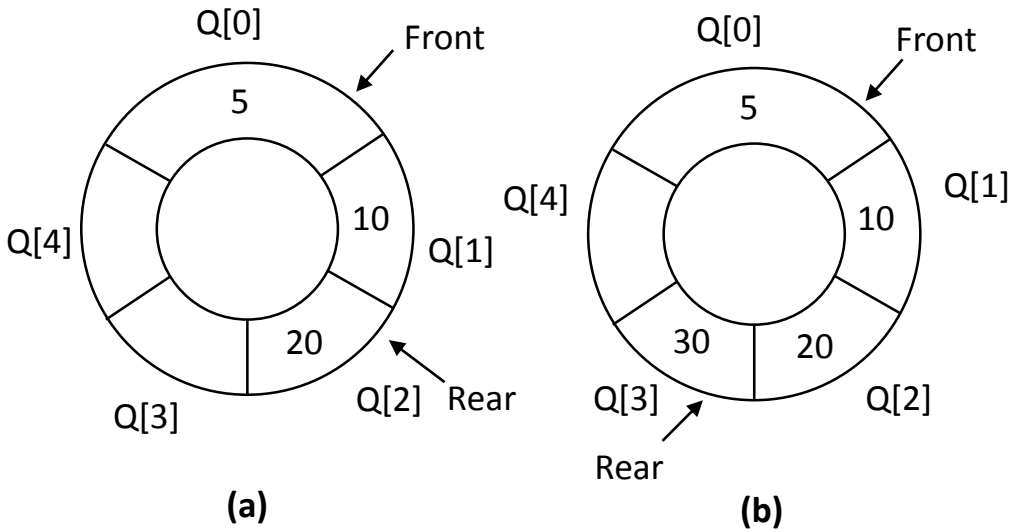
Circular queue full

Circular Queue Empty (underflow)



Circular queue empty

Circular Queue Diagram & Algorithm (to insert)



- If a new element is to be inserted in the queue, the position of the element to be inserted will be calculated by the relation as follows:

Rear = (rear +1) % MAXSIZE

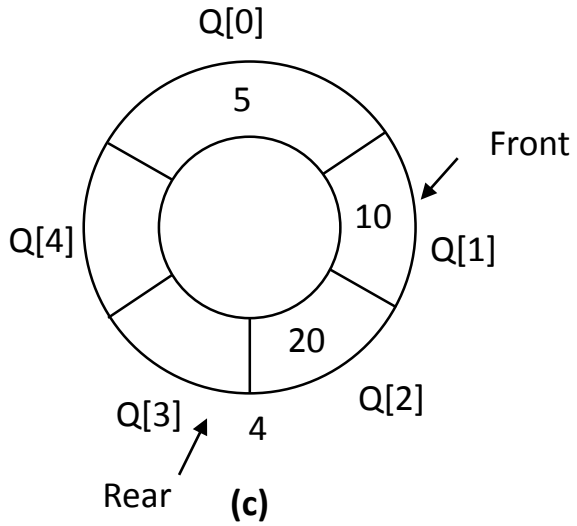
Algorithm to insert an element into circular Queue.

Step 1: If front = 0 and rear = MAX -1 then
write 'circular queue is overflow'
else if front = -1 and rear =-1 then set
front = rear = 0
else if rear = MAX -1 and front !=0
set rear = 0
else
set rear = rear +1
Step 2: Set queue[rear] = val
Step 3: Exit

- If we add an element 30 to the queue. The rear is calculated as follows:

rear = (rear +1) % MAXSIZE
=(2+1) % 5
=3

Circular Queue Diagram & Algorithm (to delete)



The front is calculated as follow:
front = (0 + 1) % 5 = 1

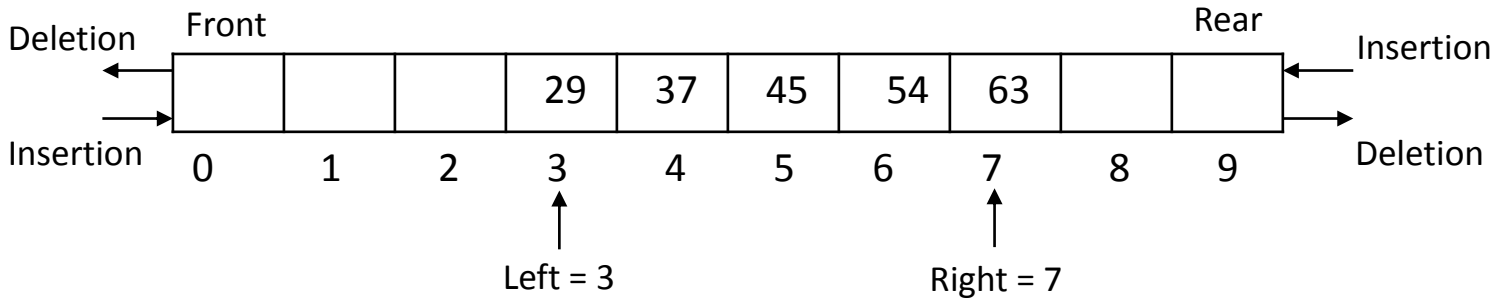
Algorithm to delete an element into circular Queue.

Step 1: If front = -1 the write ‘queue underflow’

Step 2: Set val = queue[front]
Step 3: if front = rear
set front = rear = -1
else
if front = MAX – 1
set front = 0
else
set front = front = -1
Step 4: Exit

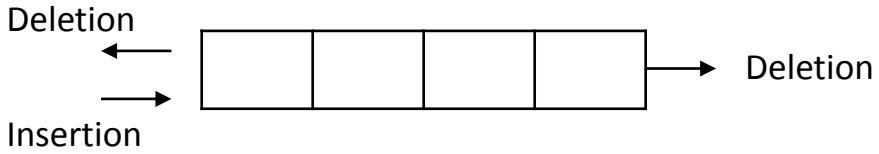
Double ended Queue & Type

A deque is a list in which the elements can be inserted or deleted at either end.
In a dequeue two pointers are maintained LEFT and RIGHT which point to either end of the dequeue.



(a) Double-ended queue

(1) Input Restricted dequeue: In this dequeue, insertion can be done only at one of the dequeue while deletions can be done from both ends.



(b) Input restricted dequeue

Double Ended Queue Algorithm to Insert at the Rear & Front End

Algorithm to insert at the Rear End.

Step 1: if (Rear = (max -1)) then
print “Queue is full”
Step 2: set Rear = Rear +1
Step 3: Queue[Rear] = element
Step 4: Exit

Algorithm to insert at the Front End.

Step 1: if front == 0 then
print “Queue is full”
rerun
Step 2: front = front -1
Step 3: Queue[front] = element
Step 4: Exit

Double Ended Queue Algorithm to Delete from the Rear & Front End

Algorithm to delete at the Rear End.

Step 1: if (front == rear) then
print “Queue is empty”
return
Step 2: Rear = Rear -1
Step 3: element = Queue[Rear]
Step 4: Exit

Algorithm to insert at the Front End.

Step 1: if (front == Rear) then
print “Queue is empty”
rerun
Step 2: front = front +1
Step 3: element = Queue[front]
Step 4: Exit

Priority Queue

In a priority queue (i) each element is assign a priority (ii) The elements are processed according to

- Highest priority element is processed before lower priority element.
- Two elements of same priority are processed according to the order of insertion.

A priority queue contains a collection of items that are waiting to be processed. In queue, items are removed for processing in the same order in which they are added to the queue.
In a priority queue, however, each item, has a priority, and when its time to select an item, the item with the highest priority is the one that is order.

Types of Priority Queue

1. Ascending Priority Queue
2. Descending Priority Queue

Application of Queue

- Queue are used in computer for scheduling of resources to application . These resources are CPU, Printer etc.
- In batch Programming, multiple jobs are combined into a batch and the first program is executed first, the second is executed next and so on in a sequential manners.
- A queue is used in break first search traversal of a graph & level wise traversal of tree.
- Computer simulation, Airport simulation.