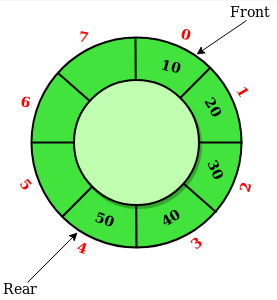
**Circular Queue**

# Circular Queue

A circular queue is a data structure that uses a single, fixed-size buffer as if it were connected end-to-end. This structure lends itself easily to buffering data streams.

**Also known as circular buffer, circular queue, cyclic buffer or ring buffer**



# Time Complexity

Time complexity of enqueue(), dequeue() operation is O(1) as there is no loop in any of the operation

# Operations

## Primary Operations

### enqueue

Adds an item at the front of Circular queue

### circular queueue

Deletes an item from front of Circular queue

## Additional Operations

### peek

Gets the front item from Circular queue

### check empty

Checks whether Circular queue is empty or not

### check full

Checks whether Circular queue is full or not

# Applications

1. **Memory Management**: The unused memory locations in the case of ordinary queues can be utilized in circular queues
2. **Traffic system**: In computer controlled traffic system, circular queues are used to switch on the traffic lights one by one repeatedly as per the time set
3. **CPU Scheduling**: Operating systems often maintain a queue of processes that are ready to execute or that are waiting for a particular event to occur

# Circular Queue Implementations

## Using Array

// C or C++ program for insertion and deletion in Circular Queue

#include<bits/stdc++.h>

using namespace std;

struct Queue {

// Initialize front and rear

int rear, front;

// Circular Queue

int size;

int \*arr;

Queue(int s) {

front = rear = -1;

size = s;

arr = new int[s];

}

void enQueue(int value);

int deQueue();

void displayQueue();

};

/\* Function to create Circular queue \*/

void Queue::enQueue(int value) {

if ((front == 0 && rear == size-1) || (rear == front-1)) {

printf("\nQueue is Full");

return;

}

else if (front == -1) /\* Insert First Element \*/ {

front = rear = 0;

arr[rear] = value;

}

else if (rear == size-1 && front != 0) {

rear = 0;

arr[rear] = value;

}

else {

rear++;

arr[rear] = value;

}

}

// Function to delete element from Circular Queue

int Queue::deQueue() {

if (front == -1) {

printf("\nQueue is Empty");

return INT\_MIN;

}

int data = arr[front];

arr[front] = -1;

if (front == rear) {

front = -1;

rear = -1;

}

else if (front == size-1)

front = 0;

else

front++;

return data;

}

// Function displaying the elements of Circular Queue

void Queue::displayQueue() {

if (front == -1) {

printf("\nQueue is Empty");

return;

}

printf("\nElements in Circular Queue are: ");

if (rear >= front) {

for (int i = front; i <= rear; i++)

printf("%d ",arr[i]);

}

else {

for (int i = front; i < size; i++)

printf("%d ", arr[i]);

for (int i = 0; i <= rear; i++)

printf("%d ", arr[i]);

}

}

/\* Driver of the program \*/

int main() {

Queue q(5);

// Inserting elements in Circular Queue

q.enQueue(14);

q.enQueue(22);

q.enQueue(13);

q.enQueue(-6);

// Display elements present in Circular Queue

q.displayQueue();

// Deleting elements from Circular Queue

printf("\nDeleted value = %d", q.deQueue());

printf("\nDeleted value = %d", q.deQueue());

q.displayQueue();

q.enQueue(9);

q.enQueue(20);

q.enQueue(5);

q.displayQueue();

q.enQueue(20);

return 0;

}

Output:

Elements in Circular Queue are: 14 22 13 -6

Deleted value = 14

Deleted value = 22

Elements in Circular Queue are: 13 -6

Elements in Circular Queue are: 13 -6 9 20 5

Queue is Full

## Using Linked List

// C or C++ program for insertion and /deletion in Circular Queue

#include <bits/stdc++.h>

using namespace std;

// Structure of a Node

struct Node {

int data;

struct Node\* link;

};

struct Queue {

struct Node \*front, \*rear;

};

// Function to create Circular queue

void enQueue(Queue \*q, int value) {

struct Node \*temp = new Node;

temp->data = value;

if (q->front == NULL)

q->front = temp;

else

q->rear->link = temp;

q->rear = temp;

q->rear->link = q->front;

}

// Function to delete element from Circular Queue

int deQueue(Queue \*q) {

if (q->front == NULL) {

printf ("Queue is empty");

return INT\_MIN;

}

// If this is the last node to be deleted

int value; // Value to be dequeued

if (q->front == q->rear) {

value = q->front->data;

free(q->front);

q->front = NULL;

q->rear = NULL;

}

else { // There are more than one nodes

struct Node \*temp = q->front;

value = temp->data;

q->front = q->front->link;

q->rear->link= q->front;

free(temp);

}

return value ;

}

// Function displaying the elements of Circular Queue

void displayQueue(struct Queue \*q) {

struct Node \*temp = q->front;

printf("\nElements in Circular Queue are: ");

while (temp->link != q->front) {

printf("%d ", temp->data);

temp = temp->link;

}

printf("%d", temp->data);

}

/\* Driver of the program \*/

int main() {

// Create a queue and initialize front and rear

Queue \*q = new Queue;

q->front = q->rear = NULL;

// Inserting elements in Circular Queue

enQueue(q, 14);

enQueue(q, 22);

enQueue(q, 6);

// Display elements present in Circular Queue

displayQueue(q);

// Deleting elements from Circular Queue

printf("\nDeleted value = %d", deQueue(q));

printf("\nDeleted value = %d", deQueue(q));

// Remaining elements in Circular Queue

displayQueue(q);

enQueue(q, 9);

enQueue(q, 20);

displayQueue(q);

return 0;

}

Output

Elements in Circular Queue are: 14 22 6

Deleted value = 14

Deleted value = 22

Elements in Circular Queue are: 6

Elements in Circular Queue are: 6 9 20

# References

<https://www.geeksforgeeks.org/introduction-to-circular-queue>