Data Structures and its Applications

UE24CS252A

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DATA STRUCTURES AND ITS APPLICATIONS

Circular Queue - Implementation

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Circular Queues - definition

- Circular Queue is a linear data structure, which follows the principle of FIFO(First In First Out), but instead of ending the queue at the last position, it again starts from the first position after the last, hence making the queue behave like a circular data structure.

- In a simple queue, once the queue is completely full, it's not possible to insert more elements. Even if we perform remove operation on the queue to remove some of the elements, until the queue is reset, no new elements can be inserted

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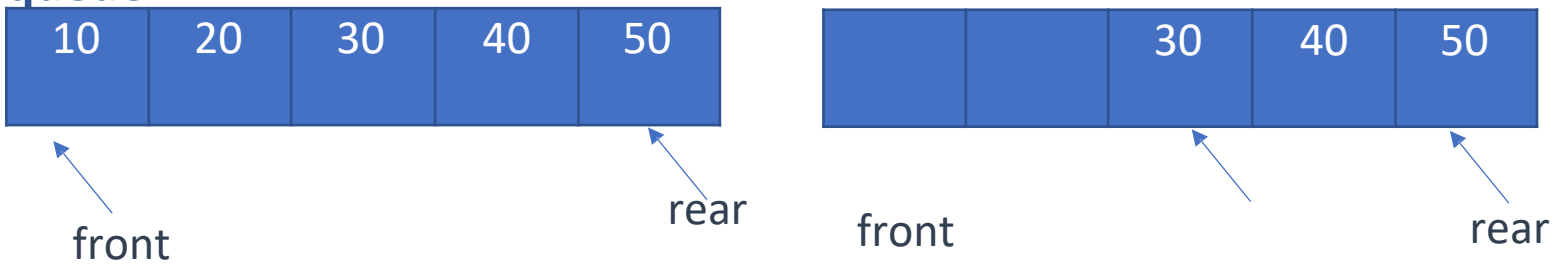
Drawback of a simple Queue

Structure of the simple queue



Cannot insert even after two elements are removed and
Space available in the front.

It is possible to insert in a circular queue by moving the rear To the beginning of the queue

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Implementation of operations

- To insert into the queue : Finding the rear index rear = (rear + 1) % size

  If(rear=front)

  cannot insert

  else

  insert at rear index

- For eg. If size = 5, front = 2 and rear = 4
- rear = (4 + 1) % 5 = 0,
- The new element gets inserted at index 0

- For eg. If size = 5, front = 0 and rear = 4
- rear = (4 + 1) % 5 = 0,
- rear = front , therefore cannot insert

Implementation of operations

- To remove from the queue :
  remove the element pointed by front , move the front front = (front + 1) % size

For eg. If size = 5, front = 2 and rear = 4

- front = (2 + 1) % 5 = 3,
- front moves to index 3 after removal of the element,

- For eg. If size = 5, front = 4 and rear = 2
- front = (4 + 1) % 5 = 0,
- Front moves to 0 after removal of the element

Structure of a circular Queue – Sequential Representation


```
#define MAXQUEUE 100
struct queue
{
  int items [MAXQUEUE]; int front, rear;
} ;

struct queue q; q.rear = q.front = -1;
```

Functions to implement the operations

- insert (&q,x)
- remove (&q)

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Implementation of operations - insert


```
int qinsert(struct queue *q, int x)
{

 //check for queue overflow
     if((q->r+1)%MAXQUEUE==q->f)
     {
          printf("Queue Overflow..\n");
           return -1;}
     else
      {
           q->rear=(q->rear+1)%size;    //get the rear index
           q->item[q->rear]=x;          //insert at rear index if(q->front==-1)  //if first element

            q->front=0;    // make front point to
          return 1;        0
           }
  }
```

Implementation of operations - insert


```
//ANOTHER WAY TO IMPLEMENT INSERT

int qinsert(int *q, int *f, int *r, int size, int x)
{
   // Check for queue overflow
   if ((*r + 1) % size == *f) {
      printf("Queue Overflow..\n");
      return -1;
   }
   else {
      *r = (*r + 1) % size;   // move rear forward
      q[*r] = x;              // insert element

      if (*f == -1)           // if first element, set front to 0
         *f = 0;
      return 0; // success
   }
}
```

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Implementation of operations - remove


```
int remove(struct queue *q)
 {
   int x;
  if(q->front==-1)  //check for empty queue
  {
   printf("Queue empty..\n"); return -1;
  }
else
  {
    x=q->items[q->front];
    if(q->front==q->rear)//only one element q->front=q->rear=-1;
 else
      q->front=(q->front+1)%MAXQUEUE;       //increment the front
    return x;
   }
}
```

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Implementation of operations - remove


```
//ANOTHER WAY TO IMPLEMENT REMOVE
int remove(int *q, int *f, int *r,int size)
 {
   int x;
  if(*f==-1)  //check for empty queue
 {
   printf("Queue empty..\n");
   return -1;
 }
else
  {
    x=q[*f];
    if(*f==*r)//only one element
      *f=*r=-1;
 else
      *f=(*f+1)%size;          //increment the front
    return x;
  } }
```

Implementation of operations - display


```
void display(struct queue q)
 {
  if(q.front==-1) printf("\nQueue empty..\n"); else
  {
    while(q.front!=q.rear) //increment front till it reaches rear
    {
      printf("%d ",q.items[q.front]);
      q.front=(q.front+1)%MAXQUEUE;
    }
   printf("%d ",q->items[q->front]); // display the last element
  }
 }
```

Implementation of operations - display


```
void display(int *q, int f, int r, int size)
 {
  if(f==-1)
    printf("\nQueue empty..\n");
  else
  {
    while(f!=r) //increment front till it reaches rear
    {
      printf("%d ",q[f]); f=(f+1)%size;
    }
   printf("%d ",q[f]); // display the last element
  }
}
```

Multiple Choice Questions (MCQ's)

Question 1: What is the primary advantage of a Circular Queue over a simple queue, as described in the presentation?

a) It allows for elements to be inserted at both ends.

b) It does not follow the FIFO principle.

c) It efficiently utilizes space by allowing new insertions at the beginning after removals, even if the queue was full

d) It has a dynamic size that adjusts automatically.

Multiple Choice Questions (MCQ's)

Question 1: What is the primary advantage of a Circular Queue over a simple queue, as described in the presentation?

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b) It does not follow the FIFO principle.

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Multiple Choice Questions (MCQ's)

Question 2: In a circular queue with a size and current rear index, how is the new rear index calculated for an insertion operation?

a) rear = rear + 1

b) rear = (rear - 1) % size

c) rear = (rear + 1) % size

d) rear = size - 1

Multiple Choice Questions (MCQ's)

Question 2: In a circular queue with a size and current rear index, how is the new rear index calculated for an insertion operation?

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Multiple Choice Questions (MCQ's)

Question 3: What condition indicates an overflow in a circular queue, based on the provided C code examples?

a) q->front == -1

b) q->rear == MAXQUEUE - 1

c) (q->rear + 1) % MAXQUEUE == q->front

d) q->front == q->rear

Multiple Choice Questions (MCQ's)

Question 3: What condition indicates an overflow in a circular queue, based on the provided C code examples?

a) q->front == -1

b) q->rear == MAXQUEUE - 1

c) (q->rear + 1) % MAXQUEUE == q->front

d) q->front == q->rear

Question 4: When removing an element from a circular queue, and it was the only element in the queue, what values are front and rear set to?

a) front = 0, rear = 0

b) front = -1, rear = -1

c) front = (front + 1) % MAXQUEUE, rear = -1

d) front = -1, rear = (rear - 1) % MAXQUEUE

Question 4: When removing an element from a circular queue, and it was the only element in the queue, what values are front and rear set to?

a) front = 0, rear = 0

b) front = -1, rear = -1

c) front = (front + 1) % MAXQUEUE, rear = -1

d) front = -1, rear = (rear - 1) % MAXQUEUE

Multiple Choice Questions (MCQ's)

Question 5: Consider a circular queue with size = 5. If front = 2 and rear = 4, and a new element is inserted, what will be the new rear index?

a) 0

b) 1

c) 4

d) 5

Multiple Choice Questions (MCQ's)

Question 5: Consider a circular queue with size = 5. If front = 2 and rear = 4, and a new element is inserted, what will be the new rear index?

a) 0

b) 1

c) 4

d) 5

THANK YOU

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