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Experiment	1
Aim	To Implement Circular Queue
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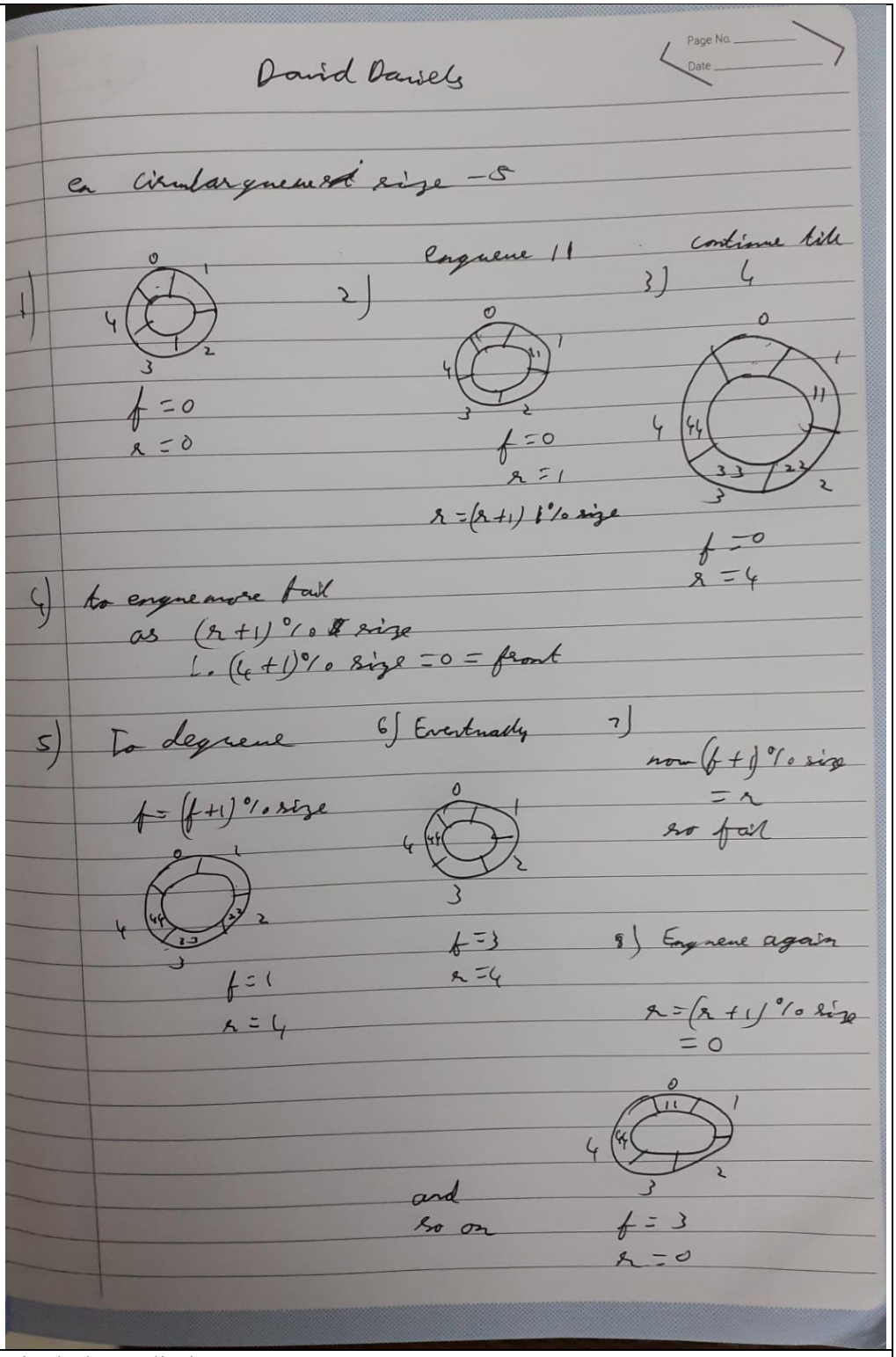
Theory	A Queue Data Structure is used for storing and managing data in a specific order similar to a line at a ticket counter. It follows the principle of First in, First out (FIFO), where the first element added to the queue is the first one to be removed. A Circular Queue is an extended version of a normal queue where the last element of the queue is connected to the first element of the queue forming a circle. In a normal Queue, we can insert elements until queue becomes full. But once queue becomes full, we can not insert the next element even if there is a space in front of queue. Basic Operations of Queue Data Structure • Enqueue (Insert): Adds an element to the rear of the queue. • Dequeue (Delete): Removes and returns the element from the front of the queue. • Empty: Checks if the queue is empty. • Full: Checks if the queue is full. Queues are versatile data structures with many real world applications 1. Scheduling Tasks in CPU: All instructions in CPU first go to buffered queue in CPU to ensure pipelining. 2. Buffering (I/O and Priniting): Queues are used to line up for ex print jobs and user keyboards presses 3. Data Streaming: Queues are used in video streaming to load small chunk of video beforehand and to ensure correct processing of data packets 4. Breadth-First Search (BFS): In graph algorithms, BFS uses a queue to explore nodes level by level. This is useful for finding the shortest path in an unweighted graph. 5. Call Center Systems: Queues are used to manage call systems , making sure that the first person to call is being served 6. Round-Robin Scheduling: Queue is used in multi-threading to make sure that each thread gets fair share of CPU time To implement a queue in C, we must make a structure containing 4 elemenents

	1) int front 2) int rear 3) int size 3) (datatype)* arr **Enqueue Operation**: In enqueue operation, the element is inserted at the rear position, and the rear is updated (circular increment for circular queue and r++ for normal). If the queue is full, a message indicating this is displayed. **Dequeue Operation**: In dequeue operation , the element at the front is removed, and the front is updated (circular increment for circular queue and r++ for normal) If the queue is empty, a message indicating this is displayed.
Algorithm	1) Initialisation of queue 1. Make the struct object using malloc 2. Ask size of queue from user and allocate the array in heap using malloc(size * sizeof(datatype)) 3. Set rear and front to 0 2) Is_full(queue q) 1. If (rear+1)%size == front, then queue must be full 3) Is_empty(queue q) 1. If rear==front , then queue must be empty 4) Enqueue(queue q , int data) 1. Check is_full 2. If element is available then circular increment rear and put data in arr[rear] of array 5) Dequeue(queue q) 1. Check is_empty 2. If element is available then circular increment front and return data of arr[front] and make arr[front]=0 afterwards 6) Display (queue q) 1. Run a for loop from queue front+1 till queue rear; By circular incrementing the number i 2. Print arr[i]

Problem Solving



Program (Code)

```
#include <stdio.h>
#include <stdbool.h>
#include <stdlib.h>

struct circular_queue
{
    int * arr;
    int f,r,size;
```

```
};

bool is_full(struct circular_queue * q)
{
   if ((q->r+1)%q->size==q->f)
   {
      return true;
   }
   return false;
}

bool is_empty(struct circular_queue * q)
{
   if (q->f==q->r)
   {
      return true;
   }
   return false;
}

void enqueue(struct circular_queue * q, int data)
{
   if (is_full(q))
   {
      printf("FAIL\n");
      return;
   }

   q->r=(q->r+1)%q->size;
   q->arr[q->r]=data;
   return;
}

int dequeue(struct circular_queue * q)
{
   int num=0;
   if (is_empty(q))
   {
      printf("EMPTY\n");
      return -1;
   }
   q->f=(q->f+1)%q->size;
   num = q->arr[q->f];
   q->arr[q->f]=0;
   return num;
}


void display(struct circular_queue * q)
{
```

```
    printf("Queue is: \n");
    for (int i = q->f+1; i != q->r; i=(i+1)%q->size)
    {
        printf("%d\n",q->arr[i]);
    }
    printf("%d",q->arr[q->r]);
    printf("\n\n");

}


void take_input(struct circular_queue * q)
{
    int choice=0;
    int d=0;
    printf("Enter 1 to enqueue\n 2 to dequeue\n 3 to print\n 0 to quit\n\n");

    while (true)
    {
        printf("Enter Choice: ");
        scanf("%d",&choice);
        printf("\n\n");
     if (choice==0)
     {
        printf("Goodbye\n");
        return;
     }


    switch (choice)
    {
    case 1:
        {
            printf("Enter number to enqueue: ");
            scanf("%d",&d);
            printf("\n");
            enqueue(q,d);
            break;
        }
    case 2:
        {
            d=dequeue(q);
            printf("Dequeue is: %d",d);
            printf("\n");
            break;
        }
    case 3:
        {
            display(q);
            break;
```

```
        }

    default:
    {
        printf("USER IS AN IDIOT");
        break;
    }

    }
    }
}

int main(int argc, char const *argv[])
{
    int s;
    printf("Enter size of queue: ");
    scanf("%d",&s);
    printf("\n\n ");

    struct circular_queue * q = (struct circular_queue *) malloc(sizeof(struct
circular_queue));
    q->arr=(int *)malloc(sizeof(int) * s);
    q->f=0;
    q->r=0;
    q->size=s;
    int deq =0;
    take_input(q);


    return 0;
}
```

PETROL PROBLEM

```
#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>

struct node
{
   int petrol_at_station;
   int distance_to_next_node;
   struct node* next;
};

struct node* insert_at_end(struct node * head, int pet , int dist)
{
   struct node * new_end = malloc(sizeof(struct node));
   struct node * ptr =head;
   new_end->petrol_at_station=pet;
   new_end->distance_to_next_node=dist;

   while(ptr->next!= head)
   {
      ptr = ptr->next;
   }
   ptr->next=new_end;
   new_end->next=head;
   return head;
}

// all get insered at end anyways
void insert_all_pumps(struct node * head)
{
   int no=0;
   printf("Enter number of pumps: ");
   scanf("%d",&no);
   printf("\n\n");
   int temp_pet=0;
   int temp_dist=0;
   for (int i = 0; i < no; i++)
   {
      printf("Enter fuel you found at pump number %d: ",i+1);
      scanf("%d",&temp_pet);
      printf("\n");
      printf("Enter distance to next pump: ");
      scanf("%d",&temp_dist);
      printf("\n");
      head=insert_at_end(head,temp_pet,temp_dist);
   }
}
```

```
int length_of_cl(struct node *head)
{
   int length=0;
   struct node * ptr = head;
   do
   {
      length++;
      ptr = ptr->next;
   }
   while (ptr!=head);
   printf("\n\n");
   free(ptr);
   return length;
}

void check_for_fuel(struct node * head,struct node * ptr_current,int
pump_no)
{
   int current_fuel=0;
   int distance_to_travel=0;
   struct node * ptr = ptr_current;
   do
   {
      current_fuel+=ptr->petrol_at_station;
      distance_to_travel+=ptr->distance_to_next_node;
      if (current_fuel-distance_to_travel<=0)
      {
         printf("Trip not possible for pump no %d",pump_no);
         free(ptr);
         return;
      }
      ptr=ptr->next;

   } while (ptr->next!=ptr_current);

   if (ptr->next==ptr_current && ptr->petrol_at_station-ptr-
>distance_to_next_node<=0)
   {
      printf("Trip possible: for pump no %d",pump_no);
      free(ptr);
   }
   else
   {
     printf("Trip not possible for pump no %d",pump_no);
      free(ptr);
      return;
   }


}
```

```
void simulate (struct node * head)
{
   int pump_no=0;
   struct node * ptr=head;
   for (int i = 0; i < length_of_cl(head)-1; i++)
   {
      ptr=ptr->next;
      check_for_fuel(head,ptr,pump_no);
      pump_no++;
   }


}

void free_list(struct node* head)
{
   struct node * ptr = head;
   do
   {
      ptr=head;
      head = head->next;
      free(ptr);
   }
   while (ptr!=head);
   free(head);

}

int main(int argc, char const *argv[])
{
   struct node * head = (struct node *)malloc(sizeof(struct node));
   struct node * intial_location = (struct node *)malloc(sizeof(struct node));
   head->next=intial_location;
   //to make circular
   printf("Enter fuel you found at 1st pump: ");
   scanf("%d",&intial_location->petrol_at_station);
   printf("\n");
   printf("Enter distance to next pump: ");
   scanf("%d",&intial_location->distance_to_next_node);
   printf("\n");
   intial_location->next=head;

   insert_all_pumps(head);
   simulate(head);
   free_list(head);
   return 0;
}
```

Output	

```
Enter size of queue:
5


 Enter 1 to enqueue
 2 to dequeue
 3 to print
 0 to quit

Enter Choice: 1


Enter number to enqueue: 1

Enter Choice: 1


Enter number to enqueue: 2

Enter Choice: 1


Enter number to enqueue: 3

Enter Choice: 1


Enter number to enqueue: 4

Enter Choice: 1


Enter number to enqueue: 5

FAIL
```

```
Enter Choice: 3


Queue is:
1
2
3
4

Enter Choice: 2


Dequeue is: 1
Enter Choice: 2


Dequeue is: 2
Enter Choice: 2


Dequeue is: 3
Enter Choice: 2


Dequeue is: 4
Enter Choice: 2


EMPTY
Dequeue is: -1
Enter Choice: 0


Goodbye
```

PETROL PROBLEM

```
Enter fuel you found at 1st pump: 1

Enter distance to next pump: 3

Enter number of pumps: 4


Enter fuel you found at pump number 1: 2

Enter distance to next pump: 4

Enter fuel you found at pump number 2: 3

Enter distance to next pump: 5

Enter fuel you found at pump number 3: 4

Enter distance to next pump: 1

Enter fuel you found at pump number 4:
5

Enter distance to next pump: 2
```

```
Trip not possible for pump no 0

Trip not possible for pump no 1

Trip not possible for pump no 2

Trip possible: for pump no 3

Trip not possible for pump no 4
```

	``` Enter fuel you found at 1st pump: 2 Enter distance to next pump: 3 Enter number of pumps: 2 Enter fuel you found at pump number 1: 3 Enter distance to next pump: 4 Enter fuel you found at pump number 2: 4 Enter distance to next pump: 3 Trip not possible for pump no 0 Trip not possible for pump no 1 Trip not possible for pump no 2 ```
Conclusion	This I have learned to implement a circular queue and its methods using c language I have also implemented the petrol problem using circular linked lists in c