Practical 7: Implementation of circular and doubly linked list

Name: Sutariya Savankumar

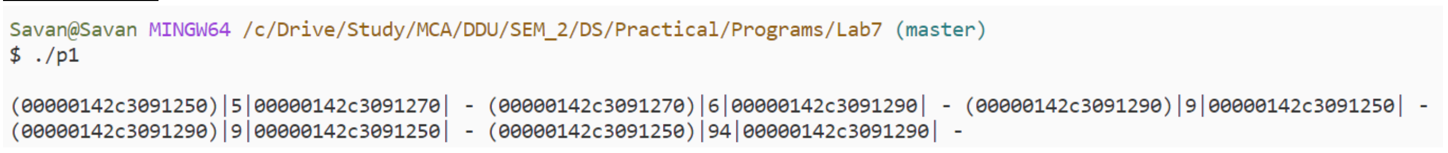
Roll no: MA065

1. **Write a program to implement Enqueue and Dequeue operations of circular queue using circular link list.**

Code

```
#include<stdio.h>
#include<stdlib.h>
struct node{
    int value;
    struct node *next;
};
typedef struct{
    struct node *head;
    struct node *tail;
} queue;

void enqueue(queue *q, int value){
    if(q->tail == NULL && q->head == NULL){
        q->head = (struct node *)malloc(sizeof(struct node));
        q->head->value = value;
        q->head->next = q->head;
        q->tail = q->head;
        return;
    }
    struct node *tmp = q->head;
    while(tmp != q->tail){
        tmp=tmp->next;
    }
    tmp->next = (struct node *)malloc(sizeof(struct node));
    tmp->next->value=value;
    tmp->next->next = q->head;
    q->tail = tmp->next;
}
int dequeue(queue *q){
    if(q->head == NULL || q->tail == NULL){
        printf("empty queue");
        return 0;
    }
    if(q->head == q->tail){
        int val = q->head->value;
        free(q->head);
        q->head = NULL;
        q->tail = NULL;
        return val;
    }
    struct node *tmp = q->head;
    int val = tmp->value;
    q->head = q->head->next;
    q->tail->next = q->head;
    free(tmp);
    return val;
}
void display(queue *q){
    if(q->head == NULL && q->tail == NULL){
        printf("Queue empty!!");
        return;
    }
    struct node *tmp = q->head;
    printf("\n");
    while(tmp != q->tail){
        printf("(%p)|%d|%p| - ",tmp,tmp->value,tmp->next);
        tmp=tmp->next;
    }
    printf("(%p)|%d|%p| - ",tmp,tmp->value,tmp->next);
}

int main(){
    queue q;
    q.head = NULL;
    q.tail = NULL;
    // printf("%d %d",q.head->value,q.head->next->value);
    enqueue(&q,5);
    enqueue(&q,6);
    enqueue(&q,9);
    display(&q);
    dequeue(&q);
    dequeue(&q);
    enqueue(&q,94);
    display(&q);
    return 0;
}
```

Output



```
Savan@Savan MINGW64 /c/Drive/Study/MCA/DDU/SEM_2/DS/Practical/Programs/Lab7 (master)
$ ./p1

(00000142c3091250)|5|00000142c3091270| - (00000142c3091270)|6|00000142c3091290| - (00000142c3091290)|9|00000142c3091250| -
(00000142c3091290)|9|00000142c3091250| - (00000142c3091250)|94|00000142c3091290| -
```

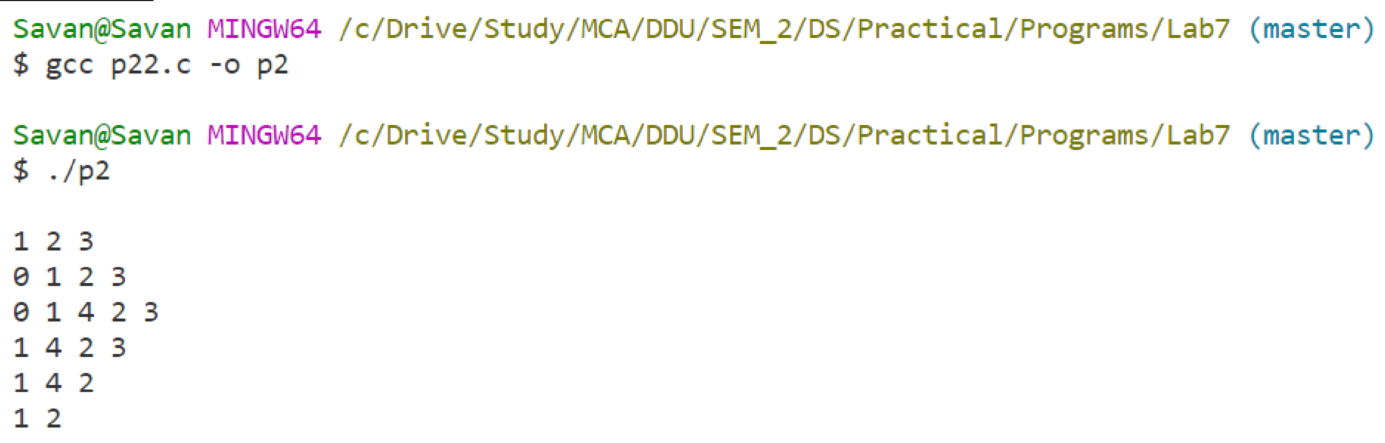
2. **Write a program for all operations of a circular singly linked list.**
   a. **Inserting Node – as First Node, at specific location, as Last Node**
   b. **Deleting Node – at First, at Last, specific node**
   c. **Display List**

Code

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

struct node{
    int value;
    struct node *next;
};

typedef struct{
    struct node *head;
    struct node *tail;
}llist;

void insertAtLast(llist *l, int value){
    if(l->tail == NULL && l->head == NULL){
        l->head = (struct node *)malloc(sizeof(struct node));
        l->head->value = value;
        l->head->next = l->head;
        l->tail = l->head;
        return;
    }
    struct node *tmp = l->head;
    while(tmp != l->tail){
        tmp=tmp->next;
    }
    tmp->next = (struct node *)malloc(sizeof(struct node));
    tmp->next->value=value;
    tmp->next->next = l->head;
    l->tail = tmp->next;
}

void insertAtFirst(llist *l, int value){
```

```c
    if(l->head == NULL && l->tail ==NULL){
        insertAtLast(l,value);
        return;
    }
    struct node *new = (struct node *)malloc(sizeof(struct node));
    new->next=l->head;
    new->value=value;
    l->head = new;
    l->tail->next = l->head;
}

void insertAtSpecific(llist *l, int value, int pos){
    if((l->head == NULL && l->tail)|| pos == 0){
        insertAtFirst(l,value);
        return;
    }
    struct node *tmp = l->head;
    int cnt=0;
    while(tmp != l->tail){
        if(cnt == pos-1){
            break;
        }
        tmp=tmp->next;
        cnt++;
    }
    if(tmp == l->tail){
        insertAtLast(l,value);
        return;
    }
    struct node *new = (struct node *)malloc(sizeof(struct node));
    new->value = value;
    new->next = tmp->next;
    tmp->next = new;
}

void deleteAtFirst(llist *l){
    if(l->head == NULL && l->tail == NULL){
        printf("List is empty");
        return;
    }
    if(l->head == l->tail){
        free(l->head);
        l->head = NULL;
        l->tail = NULL;
        return;
    }
    struct node *tmp = l->head;
    l->head = l->head->next;
    l->tail->next = l->head;
    free(tmp);
}

void deleteAtLast(llist *l){
    if(l->head == NULL && l->tail == NULL){
        printf("List is empty");
        return;
    }
    if(l->head == l->tail){
        free(l->head);
        l->head = NULL;
        l->tail = NULL;
        return;
    }
    struct node *tmp = l->head;
    while(tmp->next != l->tail){
        tmp = tmp->next;
    }
    free(l->tail);
    l->tail = tmp;
    l->tail->next = l->head;
}

void deleteAtSpecific(llist *l, int pos){
    if(l->head == NULL && l->tail == NULL){
        printf("List is empty");
        return;
    }
    if(l->head == l->tail){
        free(l->head);
        l->head = NULL;
        l->tail = NULL;
        return;
    }
    if(pos == 0){
        deleteAtFirst(l);
        return;
    }
    struct node *tmp = l->head;
    int cnt=0;
    while(tmp != l->tail){
        if(cnt == pos-1){
            break;
        }
        tmp=tmp->next;
        cnt++;
    }
    if(tmp == l->tail){
        deleteAtLast(l);
        return;
    }
    struct node *tmp2 = tmp->next;
    tmp->next = tmp->next->next;
    free(tmp2);
}

void display(llist *l){
    printf("\n");
    if(l->head == NULL && l->tail == NULL){
        printf("List is empty");
        return;
    }
    struct node *tmp = l->head;
    while(tmp != l->tail){
        printf("%d ",tmp->value);
        tmp = tmp->next;
    }
    printf("%d ",tmp->value);
}

int main(){
    llist l;
    l.head = NULL;
    l.tail = NULL;
    insertAtLast(&l,1);
    insertAtLast(&l,2);
    insertAtLast(&l,3);
    display(&l);
    insertAtFirst(&l,0);
    display(&l);
    insertAtSpecific(&l,4,2);
    display(&l);
    deleteAtFirst(&l);
    display(&l);
    deleteAtLast(&l);
    display(&l);
    deleteAtSpecific(&l,1);
    display(&l);
    return 0;
}
```

Output



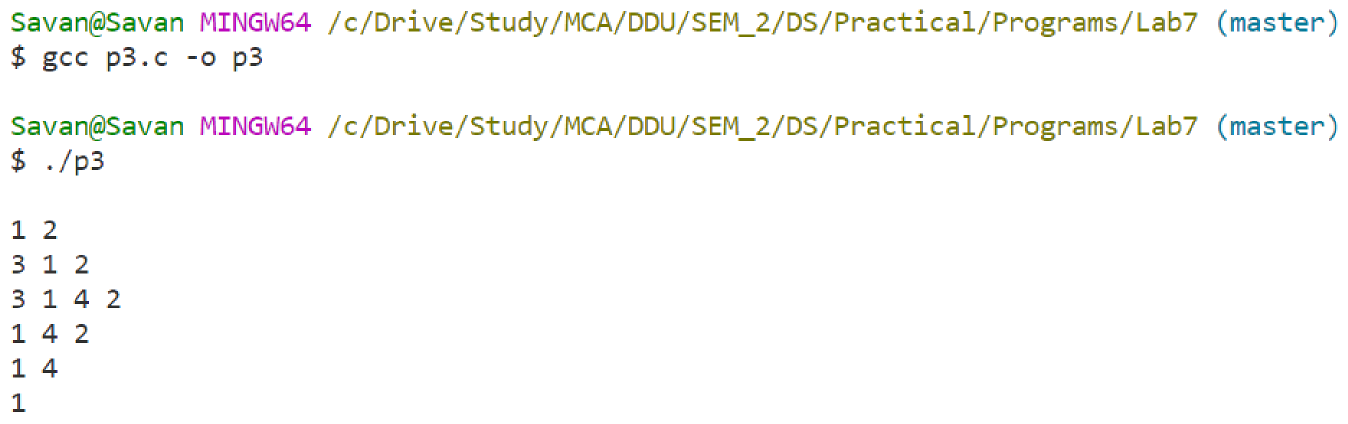
```
Savan@Savan MINGW64 /c/Drive/Study/MCA/DDU/SEM_2/DS/Practical/Programs/Lab7 (master)
$ gcc p22.c -o p2

Savan@Savan MINGW64 /c/Drive/Study/MCA/DDU/SEM_2/DS/Practical/Programs/Lab7 (master)
$ ./p2

1 2 3
0 1 2 3
0 1 4 2 3
1 4 2 3
1 4 2
1 2
```

3. **Write a program for all operations of doubly linked list.**
   a. **Inserting Node – as First Node, at specific location, as Last Node**
   b. **Deleting Node – at First, at Last, specific node**
   c. **Display List**

Code

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

struct node{
    int value;
    struct node *next;
    struct node *prev;
};

typedef struct{
    struct node *head;
    struct node *tail;
}llist;

void insertAtLast(llist *l, int value){
    if(l->tail == NULL && l->head == NULL){
        l->head = (struct node *)malloc(sizeof(struct node));
        l->head->value = value;
        l->head->next = l->head;
        l->head->prev = l->head;
        l->tail = l->head;
        return;
    }
    struct node *tmp = l->head;
    while(tmp != l->tail){
        tmp=tmp->next;
    }
    tmp->next = (struct node *)malloc(sizeof(struct node));
    tmp->next->value=value;
    tmp->next->next = l->head;
    tmp->next->prev = tmp;
    l->tail = tmp->next;
    l->head->prev = l->tail;
}

void insertAtFirst(llist *l, int value){
    if(l->head == NULL && l->tail ==NULL){
        insertAtLast(l,value);
        return;
    }
    struct node *new = (struct node *)malloc(sizeof(struct node));
    new->next=l->head;
    new->value=value;
    new->prev = l->tail;
    l->head->prev = new;
    l->head = new;
    l->tail->next = l->head;
}

void insertAtSpecific(llist *l, int value, int pos){
    if((l->head == NULL && l->tail)|| pos == 0){
        insertAtFirst(l,value);
        return;
    }
    struct node *tmp = l->head;
    int cnt=0;
    while(tmp != l->tail){
        if(cnt == pos-1){
            break;
        }
        tmp=tmp->next;
        cnt++;
    }
    if(tmp == l->tail){
        insertAtLast(l,value);
        return;
    }
    struct node *new = (struct node *)malloc(sizeof(struct node));
    new->value = value;
    new->next = tmp->next;
    new->prev = tmp;
    tmp->next->prev = new;
    tmp->next = new;
}

void deleteAtFirst(llist *l){
    if(l->head == NULL && l->tail == NULL){
        return;
    }
    if(l->head == l->tail){
        free(l->head);
        l->head = NULL;
        l->tail = NULL;
        return;
    }
    struct node *tmp = l->head;
    l->head = l->head->next;
    l->head->prev = l->tail;
    l->tail->next = l->head;
    free(tmp);
}

void deleteAtLast(llist *l){
    if(l->head == NULL && l->tail == NULL){
        return;
    }
    if(l->head == l->tail){
        free(l->head);
        l->head = NULL;
        l->tail = NULL;
        return;
    }
    struct node *tmp = l->head;
    while(tmp != l->tail){
        tmp=tmp->next;
    }
    tmp->prev->next = l->head;
    l->head->prev = tmp->prev;
    l->tail = tmp->prev;
    free(tmp);
}

void deleteAtSpecific(llist *l, int pos){
    if(l->head == NULL && l->tail == NULL){
        return;
    }
    if(pos == 0){
        deleteAtFirst(l);
        return;
    }
    struct node *tmp = l->head;
    int cnt=0;
    while(tmp != l->tail){
        if(cnt == pos-1){
            break;
        }
        tmp=tmp->next;
        cnt++;
    }
    if(tmp == l->tail){
        deleteAtLast(l);
        return;
    }
    tmp->next->next->prev = tmp;
    tmp->next = tmp->next->next;
    free(tmp->next->prev);
}

void display(llist *l){
    printf("\n");
    if(l->head == NULL && l->tail == NULL){
        printf("List is empty");
        return;
    }
    struct node *tmp = l->head;
    while(tmp != l->tail){
        printf("%d ",tmp->value);
        tmp=tmp->next;
    }
    printf("%d ",tmp->value);
}

int main(){
    llist l;
    l.head = NULL;
    l.tail = NULL;
    insertAtLast(&l,1);
    insertAtLast(&l,2);
    display(&l);
    insertAtFirst(&l,3);
    display(&l);
    insertAtSpecific(&l,4,2);
    display(&l);
    deleteAtFirst(&l);
    display(&l);
    deleteAtLast(&l);
    display(&l);
    deleteAtSpecific(&l,2);
    display(&l);
    return 0;
}
```

Output



```
Savan@Savan MINGW64 /c/Drive/Study/MCA/DDU/SEM_2/DS/Practical/Programs/Lab7 (master)
$ gcc p3.c -o p3

Savan@Savan MINGW64 /c/Drive/Study/MCA/DDU/SEM_2/DS/Practical/Programs/Lab7 (master)
$ ./p3

1 2
3 1 2
3 1 4 2
1 4 2
1 4
1
```

4. **Write a program for all operations of circular doubly linked list.**
    a. **Inserting Node – as First Node, at specific location, as Last Node.**
    b. **Deleting Node – at First, at Last, specific node.**
    c. **Display List.**

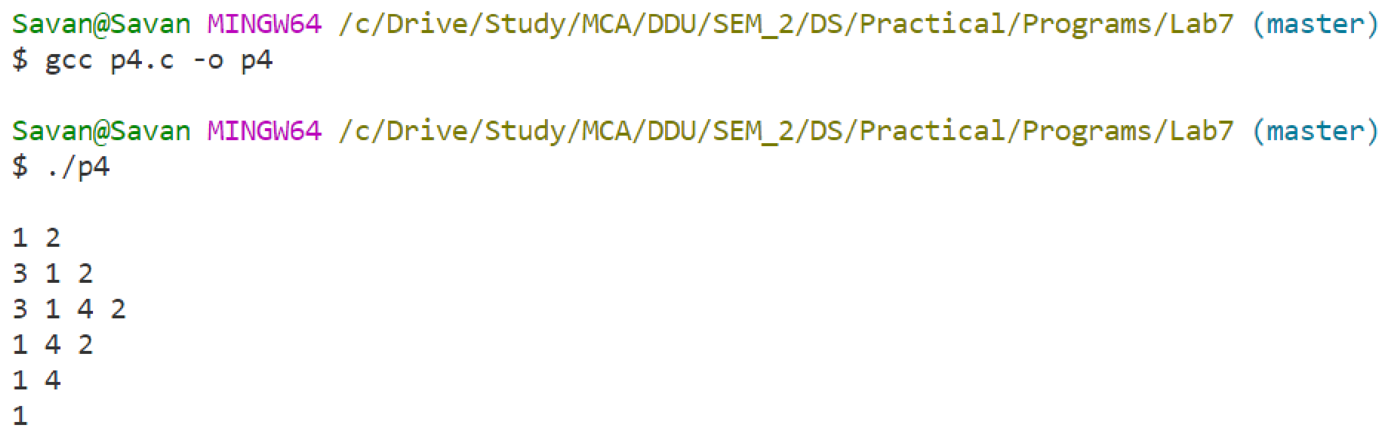
Code

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

struct node{
    int value;
    struct node *next;
    struct node *prev;
};

typedef struct{
    struct node *head;
    struct node *tail;
}llist;
```

```
void insertAtLast(llist *l, int value){
    if(l->tail == NULL && l->head == NULL){
        l->head = (struct node *)malloc(sizeof(struct node));
        l->head->value = value;
        l->head->next = l->head;
        l->head->prev = l->head;
        l->tail = l->head;
        return;
    }
    struct node *tmp = l->head;
    while(tmp != l->tail){
        tmp=tmp->next;
    }
    tmp->next = (struct node *)malloc(sizeof(struct node));
    tmp->next->value=value;
    tmp->next->next = l->head;
    tmp->next->prev = tmp;
    l->tail = tmp->next;
    l->head->prev = l->tail;
}

void insertAtFirst(llist *l, int value){
    if(l->head == NULL && l->tail ==NULL){
        insertAtLast(l,value);
        return;
    }
    struct node *new = (struct node *)malloc(sizeof(struct node));
    new->next=l->head;
    new->value=value;
    new->prev = l->tail;
    l->head->prev = new;
    l->head = new;
    l->tail->next = l->head;
}

void insertAtSpecific(llist *l, int value, int pos){
    if((l->head == NULL && l->tail)|| pos == 0){
        insertAtFirst(l,value);
        return;
    }
    struct node *tmp = l->head;
    int i=0;
    while(i<pos-1){
        tmp=tmp->next;
        i++;
    }
    struct node *new = (struct node *)malloc(sizeof(struct node));
    new->value = value;
    new->next = tmp->next;
    new->prev = tmp;
    tmp->next->prev = new;
    tmp->next = new;
}

void deleteAtFirst(llist *l){
    if(l->head == NULL && l->tail == NULL){
        printf("List is empty");
        return;
    }
    if(l->head == l->tail){
        free(l->head);
        l->head = NULL;
        l->tail = NULL;
        return;
    }
    struct node *tmp = l->head;
    l->head = l->head->next;
    l->head->prev = l->tail;
    l->tail->next = l->head;
    free(tmp);
}

void deleteAtLast(llist *l){
    if(l->head == NULL && l->tail == NULL){
        printf("List is empty");
        return;
    }
    if(l->head == l->tail){
        free(l->head);
        l->head = NULL;
        l->tail = NULL;
        return;
    }
    struct node *tmp = l->tail;
    l->tail = l->tail->prev;
    l->tail->next = l->head;
    l->head->prev = l->tail;
    free(tmp);
}

void deleteAtSpecific(llist *l, int pos){
    if(l->head == NULL && l->tail == NULL){
        return;
    }
    if(pos == 0){
        deleteAtFirst(l);
        return;
    }
    struct node *tmp = l->head;
    int cnt=0;
    while(tmp != l->tail){
        if(cnt == pos-1){
            break;
        }
        tmp=tmp->next;
        cnt++;
    }
    if(tmp == l->tail){
        deleteAtLast(l);
        return;
    }
    tmp->next->next->prev = tmp;
    tmp->next = tmp->next->next;
    free(tmp->next->prev);
}

void display(llist *l){
    printf("\n");
    if(l->head == NULL && l->tail == NULL){
        printf("List is empty");
        return;
    }
    struct node *tmp = l->head;
    while(tmp != l->tail){
        printf("%d ",tmp->value);
        tmp=tmp->next;
    }
    printf("%d ",tmp->value);
}

int main(){
    llist l;
    l.head = NULL;
    l.tail = NULL;
    insertAtLast(&l,1);
    insertAtLast(&l,2);
    display(&l);
```

```c
    insertAtFirst(&l,3);
    display(&l);
    insertAtSpecific(&l,4,2);
    display(&l);
    deleteAtFirst(&l);
    display(&l);
    deleteAtLast(&l);
    display(&l);
    deleteAtSpecific(&l,2);
    display(&l);
    return 0;
}
```

Output



```
Savan@Savan MINGW64 /c/Drive/Study/MCA/DDU/SEM_2/DS/Practical/Programs/Lab7 (master)
$ gcc p4.c -o p4

Savan@Savan MINGW64 /c/Drive/Study/MCA/DDU/SEM_2/DS/Practical/Programs/Lab7 (master)
$ ./p4

1 2
3 1 2
3 1 4 2
1 4 2
1 4
1
```