Experiment No.7
Implement Circular Linked List ADT.
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Experiment No. 7: Circular Linked List Operations

Aim: Implementation of Circular Linked List ADT

Objective:

In circular linked list last node is connected to first node. On other hand circular linked list can be used to implement traversal along web pages.

Theory:

In a circular linked list, the last node contains a pointer to the first node of the list. We can have a circular singly linked list as well as a circular doubly linked list. While traversing a circular linked list, we can begin at any node and traverse the list in any one direction, forward or backward, until we reach the same node where we started. Thus, a circular linked list has no beginning and no ending.

Inserting a New Node in a Circular Linked List

Case 1: The new node is inserted at the beginning.

Case 2: The new node is inserted at the end.

Deleting a Node from a Circular Linked List

Case 1: The first node is deleted.

Case 2: The last node is deleted.

Insertion and Deletion after or before a given node is same as singly linked list.

Algorithm

Algorithm to insert a new node at the beginning

Step 1: IF AVAIL = NULL

Write OVERFLOW

Go to Step 9 [END OF IF]

Step 2: SET NEW_NODE = AVAIL

Step 3: SET AVAIL = AVAIL→NEXT

Step 4: SET NEW_NODE-->DATA = VAL

Step 5: SET PTR=START

Repeat Step 6 while PTR NEXT != START

Step 6: SET PTR = PTR NEXT [END OF LOOP]

Step 7: SET NEW_NODE--> NEXT= START

Step 8: SET PTR-->NEXT = START

Step 9: SET START = NEW_NODE

Step 10: EXIT

Algorithm to insert a new node at the end

Step 1: IF AVAIL = NULL

Write OVERFLOW

Go to Step 11 [END OF IF]

Step 2: SET NEW_NODE = AVAIL

Step 3: SET AVAIL = AVAIL--> NEXT

Step 4: SET NEW_NODE -->DATA = VAL

Step 5: SET NEW_NODE-->NEXT = START

Step 6: SET PTR = START

Step 7: Repeat Step 8 while PTR--> NEXT != START

Step 8: SET PTR = PTR -->NEXT [END OF LOOP]

Step 9: SET PTR -->NEXT = NEW_NODE

Step 10: EXIT

Algorithm to delete the first node

Step 1: IF START = NULL

Write UNDERFLOW

Go to Step 6 [END OF IF]

Step 2: SET PTR = START

Step 3: Repeat Step 4 while PTR--> NEXT != START

Step 4: SET PTR = PTR -->NEXT [END OF LOOP]

Step 4: SET PTR→NEXT = START -->NEXT

Step 5: FREE START

Step 6: EXIT

Algorithm to delete the last node

Step 1: IF START = NULL

Write UNDERFLOW

Go to Step 7 [END OF IF]

Step 2: SET PTR = START [END OF LOOP]

Step 3: Repeat Step 4 and Step 5 while PTR -->NEXT != START

Step 4: SET PREPTR = PTR

Step 5: SET PTR = PTR -->NEXT

Step 6: SET PREPTR-->NEXT = START

Step 7: FREE PTR

Step 8: EXIT

Code:

```
#include <stdio.h>
#include <conio.h>
#include <malloc.h>
struct node
{
 int data;
 struct node *next;
};
struct node *start = NULL;
struct node *create_cll(struct node *);
struct node *display(struct node *);
struct node *insert_beg(struct node *);
struct node *insert_end(struct node *);
struct node *delete_beg(struct node *);
struct node *delete_end(struct node *);
struct node *delete_after(struct node *);
struct node *delete_list(struct node *);
int main()
{
 int option;
 clrscr();
 do
 {
printf("\n\n **MAIN MENU **");
printf("\n 1: Create a list");
```

```
printf("\n 2: Display the list");
printf("\n 3: Add a node at the beginning");
printf("\n 4: Add a node at the end");
printf("\n 5: Delete a node from the beginning");
printf("\n 6: Delete a node from the end");
printf("\n 7: Delete a node after a given node");
printf("\n 8: Delete the entire list");
printf("\n 9: EXIT");
printf("\n\n Enter your option : ");
scanf("%d", &option);
switch(option)
{
 case 1: start = create_cll(start);
 printf("\n CIRCULAR LINKED LIST CREATED");
 break;
 case 2: start = display(start);
 break;
 case 3: start = insert_beg(start);
 break;
 case 4: start = insert_end(start);
 break;
 case 5: start = delete_beg(start);
 break;
 case 6: start = delete_end(start);
 break;
```

```
 case 7: start = delete_after(start);
 break;
 case 8: start = delete_list(start);
 printf("\n CIRCULAR LINKED LIST DELETED");
 break;
}
 }while(option !=9);
 getch();
      return 0;
}
struct node *create_cll(struct node *start)
{
 struct node *new_node, *ptr;
int num;
printf("\n Enter –1 to end");
printf("\n Enter the data : ");
scanf("%d", &num);
while(num!=–1)
{
 new_node = (struct node*)malloc(sizeof(struct node));
 new_node -> data = num;
 if(start == NULL)
 {
 new_node -> next = new_node;
start = new_node;
```

```
 }
 else
 { ptr = start;
 while(ptr -> next != start)
 ptr = ptr -> next;
 ptr -> next = new_node;
 new_node -> next = start;
 }
 printf("\n Enter the data : ");
 scanf("%d", &num);
}
return start;
}
struct node *display(struct node *start)
{
struct node *ptr;
ptr=start;
while(ptr -> next != start)
{
 printf("\t %d", ptr -> data);
 ptr = ptr -> next;
}
printf("\t %d", ptr -> data);
return start;
}
```

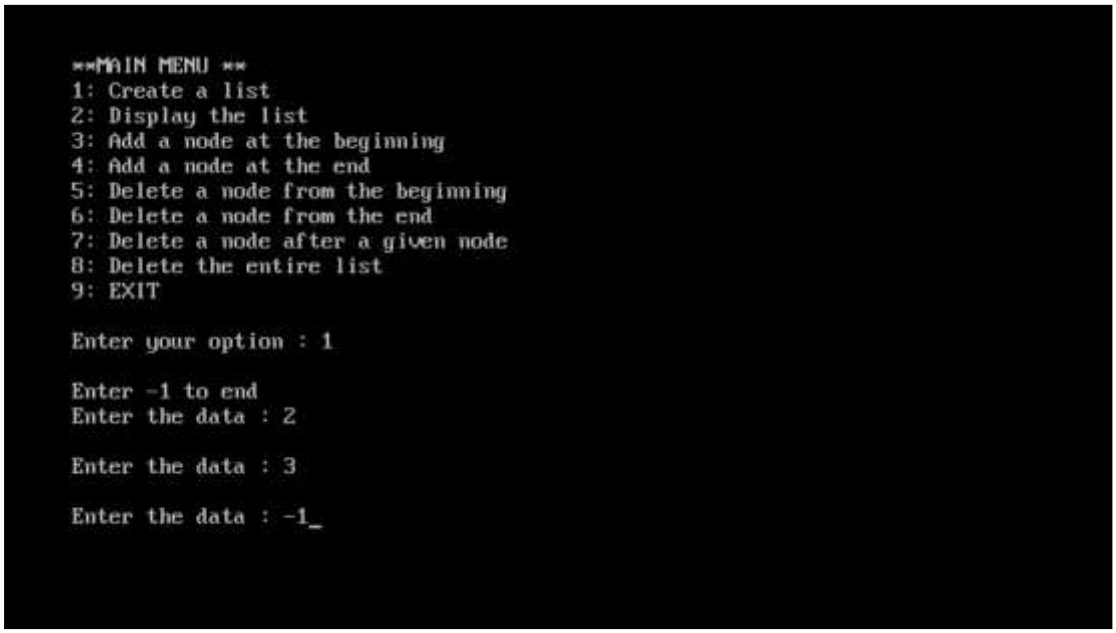
```
struct node *insert_beg(struct node *start)
{
struct node *new_node, *ptr;
int num;
printf("\n Enter the data : ");
scanf("%d", &num);
new_node = (struct node *)malloc(sizeof(struct node));
new_node -> data = num;
ptr = start;
while(ptr -> next != start)
 ptr = ptr -> next;
ptr -> next = new_node;
new_node -> next = start;
start = new_node;
return start;
}
struct node *insert_end(struct node *start)
{
struct node *ptr, *new_node;
int num;
printf("\n Enter the data : ");
scanf("%d", &num);
new_node = (struct node *)malloc(sizeof(struct node));
new_node -> data = num;
ptr = start;
```

```
while(ptr -> next != start)
 ptr = ptr -> next;
ptr -> next = new_node;
new_node -> next = start;
return start;
}
struct node *delete_beg(struct node *start)
{
struct node *ptr;
ptr = start;
while(ptr -> next != start)
 ptr = ptr -> next;
ptr -> next = start -> next;
free(start);
start = ptr -> next;
return start;
}
struct node *delete_end(struct node *start)
{
struct node *ptr, *preptr;
ptr = start;
while(ptr -> next != start)
{
 preptr = ptr;
 ptr = ptr -> next;
```

```
}
preptr -> next = ptr -> next;
free(ptr);
return start;
}
struct node *delete_after(struct node *start)
{
struct node *ptr, *preptr;
int val;
printf("\n Enter the value after which the node has to deleted : ");
scanf("%d", &val);
ptr = start;
preptr = ptr;
while(preptr -> data != val)
{
 preptr = ptr;
 ptr = ptr -> next;
}
preptr -> next = ptr -> next;
if(ptr == start)
 start = preptr -> next;
free(ptr);
return start;
}
struct node *delete_list(struct node *start)
```

```
{
struct node *ptr;
ptr = start;
while(ptr -> next != start)
 start = delete_end(start);
free(start);
return start;
}
```

Output:



```
1: Create a list
2: Display the list
3: Add a node at the beginning
4: Add a node at the end
5: Delete a node from the beginning
6: Delete a node from the end
7: Delete a node after a given node
8: Delete the entire list
9: EXIT

Enter your option : 2
       2      3

**MAIN MENU **
1: Create a list
2: Display the list
3: Add a node at the beginning
4: Add a node at the end
5: Delete a node from the beginning
6: Delete a node from the end
7: Delete a node after a given node
8: Delete the entire list
9: EXIT

Enter your option : _
```

```
1: Create a list
2: Display the list
3: Add a node at the beginning
4: Add a node at the end
5: Delete a node from the beginning
6: Delete a node from the end
7: Delete a node after a given node
8: Delete the entire list
9: EXIT

Enter your option : 2
       1      2      3

**MAIN MENU **
1: Create a list
2: Display the list
3: Add a node at the beginning
4: Add a node at the end
5: Delete a node from the beginning
6: Delete a node from the end
7: Delete a node after a given node
8: Delete the entire list
9: EXIT

Enter your option :
```

Conclusion:

1) Write an example of insertion and deletion in the circular linked list while traversing the web pages?

Circular Linked List for Web Page Traversal:

A circular linked list is a data structure in which each element (node) has a reference (pointer) to the next element, and the last element points back to the first, forming a loop.

1. **Initialization:**
    - Create a class to represent a web page with attributes such as the page's URL and possibly other information.
    - Create a class for the circular linked list to manage web pages.
    - Initially, the list is empty, so there are no nodes in the circular linked list.
2. **Insertion:**

To insert a web page into the circular linked list:

- Create a new node representing the web page with the given URL.
- If the list is empty (no pages exist), set the new node as the only node and make it point to itself.
- If the list is not empty, perform the following steps:
    - Set the new node's next pointer to point to the node following the current page (i.e., **new_node.next = current_page.next**).
    - Update the current page's next pointer to point to the new node (i.e., **current_page.next = new_node**).

3. **Deletion:**

To delete the current web page from the circular linked list:

- Check if the list is empty. If it is, there is no page to delete.
- If there's only one page in the list (i.e., the next pointer of the current page points to itself), clear the list by setting the list to be empty (i.e., **current_page = None**).
- If there are multiple pages, perform the following steps:
    - Traverse the list to find the previous node to the current page (the node whose **next** pointer points to the current page).
    - Update the next pointer of the previous node to point to the page following the current page (i.e., **previous_node.next = current_page.next**).

- Update the current page to the next page (i.e., **current_page = current_page.next**).

4. **Displaying and Navigating:**
   - To display the current page, simply print the URL of the current node.
   - To navigate to the next page, update the current page to the next page in the circular linked list (i.e., **current_page = current_page.next**).