



Vidyavardhini's College of Engineering and Technology
Department of Artificial Intelligence & Data Science

Experiment No.6
Implement Singly Linked List ADT
Name: Aryan Parab
Roll No:36
Date of Performance:
Date of Submission:
Marks:
Sign:

Experiment No. 6: Singly Linked List Operations Aim:

Implementation of Singly Linked List

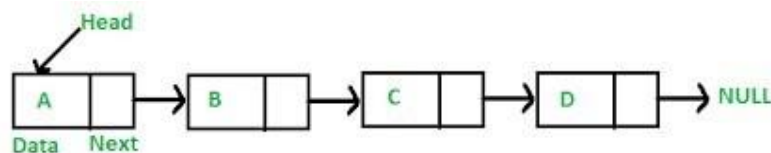
Objective:

It is used to implement stacks and queues which are like fundamental needs throughout computer science. To prevent the collision between the data in the hash map, we use a singly linked list.

Theory:

A linked list is an ordered collection of elements, known as nodes. Each node has two fields: one for data (information) and another to store the address of the next element in the list. The address field of the last node is null, indicating the end of the list. Unlike arrays, linked list elements are not stored in contiguous memory locations; instead, they are connected by explicit links, allowing for dynamic and non-contiguous memory allocation.

The structure of linked list is as shown below



Header is a node containing null in its information field and an next address field contains the address of the first data node in the list. Various operations can be performed



on singly linked lists like insertion at front, end, after a given node, before a given node
deletion at front, at end and after a given node.

Algorithm

Algorithm to insert a new node at the beginning

- Step 1: IF AVAIL = NULL
 - Write OVERFLOW
 - Go to Step 7 [END OF IF]
- Step 2: SET NEW_NODE = AVAIL
- Step 3: SET AVAIL = AVAIL NEXT
- Step 4: SET DATA = VAL
- Step 5: SET NEW_NODE --> NEXT = START
- Step 6: SET START = NEW_NODE
- Step 7: EXIT

Algorithm to insert a new node at the end

- Step 1: IF AVAIL = NULL
 - Write OVERFLOW
 - Go to Step 1 [END OF IF]
- Step 2: SET = AVAIL
- Step 3: SET AVAIL = AVAIL NEXT
- Step 4: SET DATA = VAL
- Step 5: SET NEW_NODE = NULL
- Step 6: SET PTR = START
- Step 7: Repeat Step 8 while PTR NEXT != NULL
- Step 8: SET PTR = PTR NEXT [END OF LOOP]
- Step 9: SET PTR--> NEXT = New_Node
- Step 10: EXIT

Algorithm to insert a new node after a node that has value NUM

- Step 1: IF AVAIL = NULL
 - Write OVERFLOW



Go to Step 12 [END OF IF]

Step 2: SET = AVAIL

Step 3: SET AVAIL = AVAIL-->NEXT

Step 4: SET DATA = VAL

Step 5: SET PTR = START

Step 6: SET PREPTR = PTR

Step 7: Repeat Steps 8 and 9 while != NUM

Step 8: SET PREPTR = PTR

Step 9: SET PTR = PTR -->NEXT

[END OF LOOP]

Step 10 : PREPTR--> NEXT = NEW_NODE

Step 11: SET NEW_NODE NEXT = PTR

Step 12: EXIT

Algorithm to insert a new node before a node that has value NUM

Step 1: IF AVAIL = NULL

Write OVERFLOW

Go to Step 12 [END OF IF]

Step 2: SET = AVAIL

Step 3: SET AVAIL = AVAIL-->NEXT

Step 4: SET DATA = VAL

Step 5: SET PTR = START

Step 6: SET PREPTR = PTR

Step 7: Repeat Steps 8 and 9 while PTR DATA != NUM

Step 8: SET PREPTR = PTR

Step 9: SET PTR = PTR -->NEXT



[END OF LOOP]

Step 10: PREPTR-->NEXT = NEW_NODE

Step 11: SET NEXT = PTR

Step 12: EXIT

Algorithm to delete the first node

Step 1: IF START = NULL

Write UNDERFLOW

Go to Step 5 [END OF IF]

Step 2: SET PTR = START

Step 3: SET START = START -->NEXT

Step 4: FREE PTR

Step 5: EXIT

Algorithm to delete the last node

Step 1: IF START = NULL

Write UNDERFLOW

Go to Step 8 [END OF IF]

Step 2: SET PTR = START

Step 3: Repeat Steps 4 and 5 while PTR NEXT != NULL

Step 4: SET PREPTR = PTR

Step 5: SET PTR = PTR -->NEXT [END OF LOOP]

Step 6: SET PREPTR-->NEXT = NULL

Step 7: FREE PTR

Step 8: EXIT



Algorithm to delete the node after a given node

Step 1: IF START = NULL

 Write UNDERFLOW

 Go to Step 1 [END OF IF]

Step 2: SET PTR = START

Step 3: SET PREPTR = PTR

Step 4: Repeat Steps 5 and 6 while PREPTR DATA != NUM

Step 5: SET PREPTR = PTR

Step 6: SET PTR = PTR--> NEXT

[END OF LOOP]

Step 7: SET TEMP = PTR

Step 8: SET PREPTR --> NEXT = PTR--> NEXT

Step 9: FREE TEMP

Step 10: EXIT

Code:

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

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

```
#include<conio.h>
```

```
#include<malloc.h>
```

```
struct node{ int
```

```
data; struct node
```

```
*next;
```

```
};
```

```
struct node *start = NULL; struct node
```

```
*create_ll(struct node *); struct node
```



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```
*display(struct node *); struct node
*insert_beg(struct node *); struct node
*insert_end(struct node *); struct node
*insert_before(struct node *); struct
node *insert_after(struct node *); struct
node *delete_beg(struct node *); struct
node *delete_end(struct node *); struct
node *delete_node(struct node *); struct
node *delete_after(struct node *); struct
node *delete_list(struct node *); struct
node *sort_list(struct node *); int
main(int argc, char *argv[]) { int option;
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: Add a node before a given
node"); printf("\n 6: Add a node after a given
node"); printf("\n 7: Delete a node from the
beginning"); printf("\n 8: Delete a node from
the end"); printf("\n 9: Delete a given node");
printf("\n 10: Delete a node after a given
node"); printf("\n 11: Delete the entire list");
printf("\n 12: Sort the list"); printf("\n 13:
```



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```
EXIT"); printf("\n\n Enter your option : “);
```

```
scanf(“%d”, &option); switch(option)
```

```
{ case
```

```
1:
```

```
start = create_ll(start);
```

```
printf(“\n 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 =
```

```
insert_before(start);
```

```
break; case 6: start =
```

```
insert_after(start); break;
```

```
case 7: start =
```

```
delete_beg(start); break;
```

```
case 8: start =
```

```
delete_end(start); break;
```

```
case 9: start =
```

```
delete_node(start);
```

```
break; case 10: start =
```

```
delete_after(start); break;
```

```
case 11:
```



```
start = delete_list(start);

printf("\n LINKED LIST DELETED");

break;

case 12:

start = sort_list(start); break;

} } while(option !=13); getch(); return 0; } struct

node *create_ll(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 =

NULL; start = new_node;

} else { ptr=start;

while(ptr->next!=NULL)

ptr=ptr->next; ptr->next =

new_node; new_node-

->next=NULL;

} printf("\n Enter the data : ");

scanf("%d", &num);

} return start;

} struct node *display(struct node *start) {

struct node *ptr; ptr = start;
```




```
while(ptr != NULL) {  
    printf("\t %d", ptr -> data);  
    ptr = ptr -> next;  
}  
return start;  
  
} struct node *insert_beg(struct node *start) { struct  
node *new_node; int num; printf("\n Enter the data :  
"); scanf("%d", &num); new_node = (struct node  
*)malloc(sizeof(struct node)); new_node -> data =  
num;  
  
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; new_node -> next = NULL;  
  
ptr = start; while(ptr ->  
next != NULL) ptr = ptr -  
> next; ptr -> next =  
new_node; return start;  
  
} struct node *insert_before(struct node *start) { struct node *new_node,  
*ptr, *preptr; int num, val; printf("\n Enter the data : "); scanf("%d",  
&num); printf("\n Enter the value before which the data has to be inserted
```



```
: “); scanf(“%d”, &val); new_node = (struct node *)malloc(sizeof(struct
node)); new_node -> data = num;

ptr = start; while(ptr ->
data != val) { preptr =
ptr;

ptr = ptr -> next; } preptr ->
next = new_node;

new_node -> next = ptr;

return start;

} struct node *insert_after(struct node *start) { struct node
*new_node, *ptr, *preptr; int num, val; printf(“\n Enter the data :
“); scanf(“%d”, &num); printf(“\n Enter the value after which the
data has to be inserted : “); scanf(“%d”, &val); new_node =
(struct node *)malloc(sizeof(struct node)); new_node -> data =
num;

ptr = start; preptr = ptr;

while(preptr -> data != val) {

preptr = ptr; ptr = ptr -> next;

} preptr ->
next=new_node;

new_node -> next = ptr;

return start;

} struct node *delete_beg(struct node *start)
```



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

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

} struct node *delete_node(struct node *start) { struct node
*ptr, *preptr; int val; printf("\n Enter the value of the node
which has to be deleted : "); scanf("%d", &val);
ptr = start; if(ptr -> data
== val) { start =
delete_beg(start); return
start; } else { while(ptr -
> data != val) { 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 =
```



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```
start; preptr = ptr; while(preptr -> data != val) { preptr = ptr;

ptr = ptr -> next;

} preptr -> next=ptr ->

next; free(ptr); return

start;

} struct node *delete_list(struct node *start)

{ struct node *ptr; if(start!=NULL){

ptr=start; while(ptr != NULL) { printf("\n

%d is to be deleted next", ptr -> data); start =

delete_beg(ptr); ptr = start;

} } return start; } struct node

*sort_list(struct node *start) { struct

node *ptr1, *ptr2; int temp;

ptr1 = start; while(ptr1 -> next

!= NULL) { ptr2 = ptr1 ->

next; while(ptr2 != NULL) {

if(ptr1 -> data > ptr2 -> data) {

temp = ptr1 -> data; ptr1 ->

data = ptr2 -> data; ptr2 ->

data = temp; } ptr2 = ptr2 ->

next; } ptr1 = ptr1 -> next; }

return start;

}
```

Output:



```
*****MAIN MENU *****
1: Create a list
2: Display the list
3: Add a node at the beginning
4: Add the node at the end
5: Add the node before a given node
6: Add the node after a given node
7: Delete a node from the beginning
8: Delete a node from the end
9: Delete a given node
10: Delete a node after a given node
11: Delete the entire list
12: Sort the list
13: Exit
Enter your option : 3
Enter your option : 73
```

Conclusion:

Write an example of stack and queue implementation using singly linked list?

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

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

```
// Node structure for the singly linked list
```

```
struct Node {
```

```
    int data;    struct
```

```
Node* next;
```

```
};
```

```
struct Node* front = NULL;
```

```
struct Node* rear = NULL;
```



```
void enqueue(int value) {    struct Node* newNode = (struct
Node*)malloc(sizeof(struct Node));    newNode->data = value;

newNode->next = NULL;

    if (rear == NULL) {

front = rear = newNode;

        return;

    }

    rear->next = newNode;

rear = newNode;

}
```

```
void dequeue() {    if (front ==
NULL) {        printf("Queue is
empty.\n");        return;    }
```

```
    struct Node* temp = front;

front = front->next;
```

```
    if (front == NULL) {

rear = NULL;
```



```
}
```

```
free(temp);
```

```
}
```

```
int peek() { if (front ==
```

```
NULL) { printf("Queue is
```

```
empty.\n"); return -1; }
```

```
return front->data;
```

```
}
```

```
int isEmpty() { return
```

```
front == NULL;
```

```
}
```

```
int main() {
```

```
enqueue(10);
```

```
enqueue(20);
```

```
enqueue(30);
```



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```
printf("Front element: %d\n", peek());  
  
dequeue();    printf("Front element after dequeue:  
  
%d\n", peek());  
  
return 0;  
  
}
```