Experiment No.6
Implement Singly Linked List ADT
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Experiment No. 6: Singly Linked List Operations

Aim: Implementation of Singly

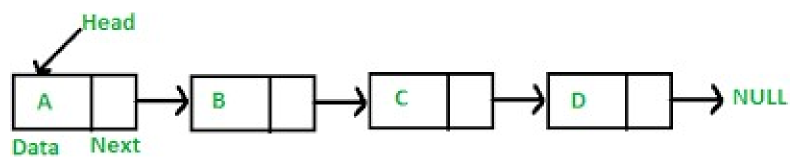
Linked List Objective:

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
*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 ** IMPLEMENRTATION OF SINGLY LINDED LIST **");

 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: 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);
```

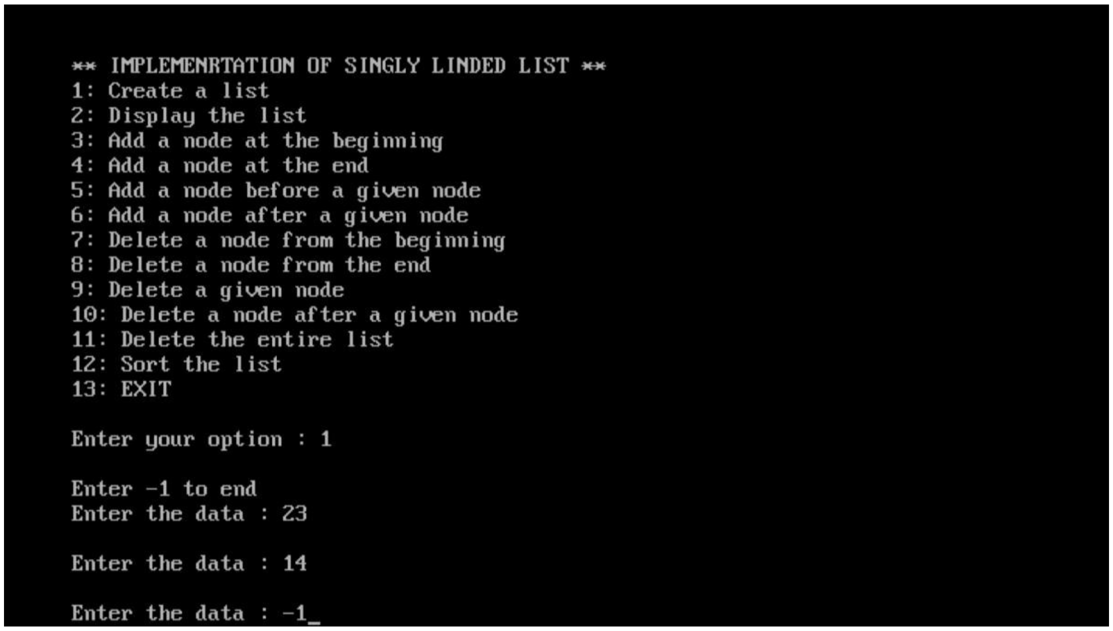
```
break;

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;
```

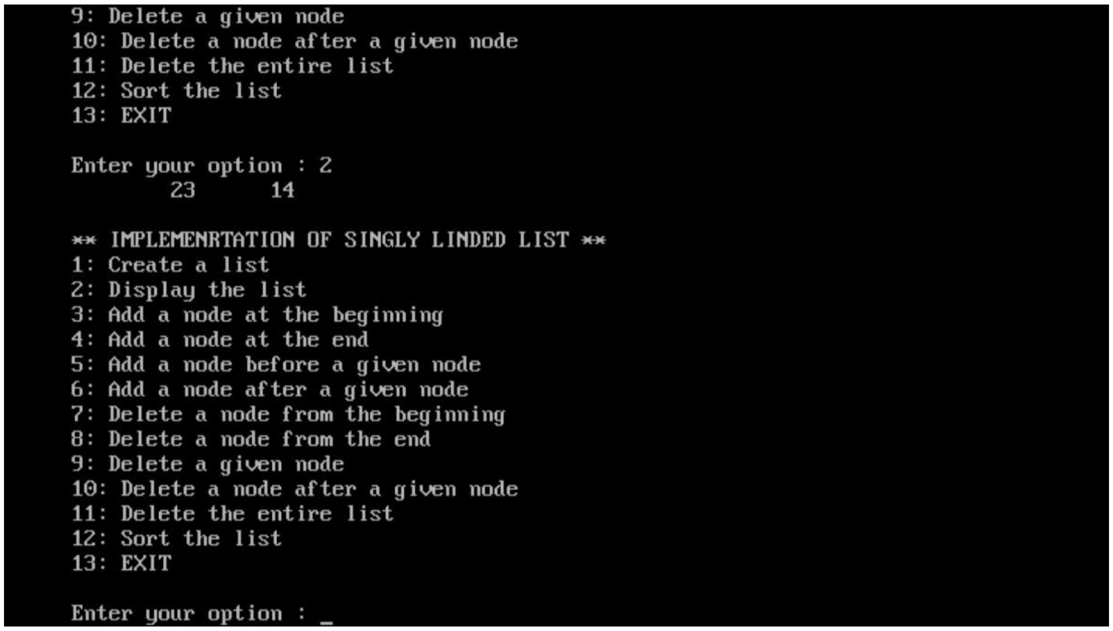
```
}

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 =

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; // Lines 252-254 were modified from original
code to fix unresposiveness in output window


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:



```
** IMPLEMENRTATION OF SINGLY LINDED LIST **
1: Create a list
2: Display the list
3: Add a node at the beginning
4: Add a node at the end
5: Add a node before a given node
6: Add a 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 : 1

Enter -1 to end
Enter the data : 23

Enter the data : 14

Enter the data : -1_
```



```
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 : 2
        23      14

** IMPLEMENRTATION OF SINGLY LINDED LIST **
1: Create a list
2: Display the list
3: Add a node at the beginning
4: Add a node at the end
5: Add a node before a given node
6: Add a 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 : _
```

Conclusion:

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

- The provided code is for implementing a singly linked list and various operations on it, such as creating a list, displaying it, adding nodes at the beginning or end, inserting nodes before or after a given node, deleting nodes, sorting the list, and deleting the entire list. The code appears to be written in C and includes a menu- driven approach for interacting with the linked list.

However, the code includes header files like `<conio.h>` and `<malloc.h>`, which are not part of the standard C library and are platform-dependent. It also uses the `getch()` function, which is typically found in older DOS-based compilers. These dependencies might limit the portability of the code to modern systems.

Regarding your question about stack and queue implementations using a singly linked list, here's a brief explanation:

Stack Implementation using Singly Linked List:

A stack can be implemented using a singly linked list by restricting operations to one end of the list, typically the head. The most recent element pushed onto the stack becomes the new head. Stack operations are as follows:

- Push: Add an element to the head of the list.
- Pop: Remove and return the element at the head of the list.
- Peek: Return the element at the head without removing it.
- IsEmpty: Check if the list is empty.

Queue Implementation using Singly Linked List:

A queue can also be implemented using a singly linked list. In a queue, elements are added at one end (rear) and removed from the other end (front) of the list. Queue operations are as follows:

- Enqueue: Add an element to the rear of the list.
- Dequeue: Remove and return the element at the front of the list.
- Front: Return the element at the front without removing it.
- IsEmpty: Check if the list is empty.

To implement these data structures using a singly linked list, you can adapt the provided code by defining appropriate functions for stack and queue operations. The fundamental idea is to manipulate the linked list in a way that preserves the desired behavior of stacks and queues.