Experiment No.8
Implement stack ADT using Linked list
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Experiment No. 8: Stack using Linked list

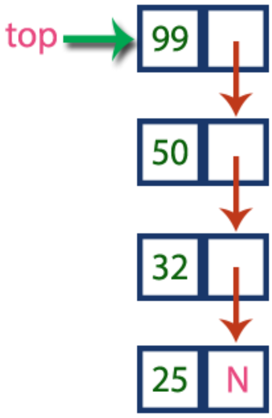
Aim: Implement Stack ADT using Linked list

Objective:

Stack can be implemented using linked list for dynamic allocation. Linked list implementation gives flexibility and better performance to the stack.

Theory:

A stack implemented using an array has a limitation in that it can only handle a fixed number of data values, and this size must be defined at the outset. This limitation makes it unsuitable for cases where the data size is unknown. On the other hand, a stack implemented using a linked list is more flexible and can accommodate an unlimited number of data values, making it suitable for variable-sized data. In a linked list-based stack, each new element becomes the 'top' element, and removal is achieved by updating 'top' to point to the previous node, effectively popping the element. The first element's "next" field should always be NULL to indicate the end of the list.



Stack Operations using Linked List

To implement a stack using a linked list, we need to set the following things before implementing actual operations.

Step 1 - Include all the header files which are used in the program. And declare all the user defined functions.

Step 2 - Define a 'Node' structure with two members data and next.

Step 3 - Define a Node pointer 'top' and set it to NULL.

Step 4 - Implement the main method by displaying Menu with list of operations and make suitable function calls in the main method.

push(value) - Inserting an element into the Stack

Step 1 - Create a newNode with given value.

Step 2 - Check whether stack is Empty (top == NULL)

Step 3 - If it is Empty, then set newNode → next = NULL.

Step 4 - If it is Not Empty, then set newNode → next = top.

Step 5 - Finally, set top = newNode.

pop() - Deleting an Element from a Stack

Step 1 - Check whether the stack is Empty (top == NULL).

Step 2 - If it is Empty, then display "Stack is Empty!!!

Step 3 - If it is Not Empty, then define a Node pointer 'temp' and set it to 'top'.

Step 4 - Then set 'top = top → next'.

Step 5 - Finally, delete 'temp'. (free(temp)).

display() - Displaying stack of elements

Step 1 - Check whether stack is Empty (top == NULL).

Step 2 - If it is Empty, then display 'Stack is Empty!!!' and terminate the function.

Step 3 - If it is Not Empty, then define a Node pointer 'temp' and initialize with top.

Step 4 - Display 'temp → data --->' and move it to the next node. Repeat the same until temp reaches to the first node in the stack. (temp → next != NULL).

Step 5 - Finally! Display 'temp → data ---> NULL'.

Code:

```
#include
#include
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#include
struct stack{
int data;
struct stack *next;
};
struct stack *top = NULL;
struct stack *push(struct stack *, int);
struct stack *display(struct stack *);
```

```
struct stack *pop(struct stack *);
int peek(struct stack *);
int main(int argc, char *argv[]) {
int val, option;
do {
printf("\n *****MAIN MENU*****");
printf("\n 1. PUSH");
printf("\n 2. POP");
printf("\n 3. PEEK");
printf("\n 4. DISPLAY");
printf("\n 5. EXIT");
printf("\n Enter your option: ");
scanf("%d", &option);
switch(option) {
case 1:
printf("\n Enter the number to be pushed on stack: ");
scanf("%d", &val);
top = push(top, val);
break;
case 2:
top = pop(top);
break;
case 3:
val = peek(top);
if (val != -1)
printf("\n The value at the top of stack is: %d", val);
else
printf("\n STACK IS EMPTY");
break;
case 4:
top = display(top);
break; }
}while(option != 5);
return 0;
```

```
}
 struct stack *push(struct stack *top, int val) {
 struct stack *ptr;
ptr = (struct stack*)malloc(sizeof(struct stack));
 ptr -> data = val;
 if(top == NULL) {
 ptr -> next = NULL;
top = ptr;
} else {
ptr -> next = top;
 top = ptr;
 } return top;
} struct stack *display(struct stack *top) {
struct stack *ptr;
 ptr = top;
 if(top == NULL)
printf("\n STACK IS EMPTY");
else {
 while(ptr != NULL) {
printf("\n %d", ptr -> data);
ptr = ptr -> next;
 }
 }
 return top;
} struct stack *pop(struct stack *top) {
struct stack *ptr;
 ptr = top;
if(top == NULL)
printf("\n STACK UNDERFLOW");
 else {
top = top -> next;
 printf("\n The value being deleted is: %d", ptr -> data);
 free(ptr);
 } return top;
```

```
} int peek(struct stack *top) {
 if(top==NULL)
return -1;
 else
return top ->data;
 }
```

Output:

```
*****MAIN MENU*****
1. PUSH
2. POP
3. Peek
4. DISPLAY
5. EXIT
Enter your option : 1
Enter the number to be pushed on stack : 100
```

Conclusion:

Write in detail about an application where stack is implemented as linked list?

1.Write in detail about an application where stack is implemented as linked list?

In a programming language's runtime environment, a stack implemented as a linked list is used to manage function calls and local variables. This allows for nested function calls, proper variable scoping, and the orderly execution of functions in programs.

2. What are some real-world applications of Huffman coding, and why is it preferred in those applications?

Huffman coding is used in data compression for applications like file compression, image compression, and data transmission. It's preferred for its ability to achieve optimal compression by assigning shorter codes to more frequent data, making it efficient and saving storage and transmission costs.

3.What are the limitations and potential drawbacks of using Huffman coding in practical data compression scenarios?

Huffman coding is an efficient data compression method, but it does have limitations and potential drawbacks in practical scenarios:

1. Variable-Length Codes: While variable-length codes are efficient for compressing frequently occurring symbols, they can lead to slower decoding, as the code's length must be determined while decoding.

2. No Compression for Rare Symbols: Huffman coding doesn't compress rare symbols efficiently, potentially resulting in minimal compression gains for datasets with a wide range of symbols.

3. Memory Overhead: Storing the Huffman tree or table adds memory overhead to the compressed data, which can be significant for large datasets.
4. Compression Efficiency: Huffman coding may not always achieve the highest compression efficiency compared to more advanced compression methods like Lempel-Ziv-Welch (LZW) used in formats like ZIP or GIF.

5. Complexity: Building the Huffman tree can be computationally expensive, making it less suitable for real-time compression or scenarios with limited processing power.

6. Lossless Only: Huffman coding is suitable for lossless compression, which preserves data integrity but may not be the best choice for lossy compression, where some data loss is acceptable.

7. Lack of Adaptability:Once the Huffman tree is constructed, it remains fixed, which can be less adaptive to changes in the data distribution over time.

Despite these limitations, Huffman coding is still widely used in scenarios where lossless compression and simplicity are essential, especially when dealing with text or similar data types