VISVESVARAYATECHNOLOGICALUNIVERSITY

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LAB REPORT

On

DATA STRUCTURES (23CS3PCDST)

Submitted by

SUJAY PRASAD P V (2023BMS02634)

in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
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B. M. S. College of Engineering,
Bull Temple Road, Bangalore 560019
(Affiliated To Visvesvaraya Technological University, Belgaum) Department of Computer Science and Engineering

This is to certify that the Lab work entitled **"DATA STRUCTURES"** carried out by **SUJAY PRASAD P V (2023BMS02634)**, who is a bonafide student of **B. M. S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2023-24. The Lab report has been approved as it satisfies the academic requirements in respect of Data structures Lab - **(23CS3PCDST)**work prescribed for the said degree.

Prof. Lakshmi Neelima
Assistant Professor
Department of CSE
BMSCE, Bengaluru

Dr. Jyothi S Nayak
Professor and Head Department of CSE
BMSCE, Bengaluru

Index Sheet

Course outcomes:

CO1	Apply the concept of linear and nonlinear data structures.
CO2	Analyze data structure operations for a given problem
CO3	Design and develop solutions using the operations of linear and nonlinear data structure for a given specification.
CO4	Conduct practical experiments for demonstrating the operations of different data structures.

Lab program 1:

Write a program to simulate the working of stack using an array with the following:

a) **Push**
b) **Pop**
c) **Display**

The program should print appropriate messages for stack overflow, stack underflow.

```
#include <stdio.h>
#include <stdlib.h>
int size = 5;
int top = -1, stack[5];
void push(int a)
{ if (top == size)
      printf("stack overflow\n");
   else
   {
      top = top + 1;
      stack[top] = a;
      printf("insertion operation is complete\n");
   }
}
void pop()
{
   if (top == -1)
   {
      printf("stack is empty\n");
   }
   else
   {
      top--;
   }
}
void display()
{
   if (top == -1)
```

```
        printf("stack is empty\n");
    else
    {
        for (int i = top; i >= 0; i--)
        {
            printf("%d\n", stack[i]);
        }
    }
}
int main()
{
    int value, choice, t = 0;
    while (1)
    {
        printf("----------MENU----------\n");
        printf("1.push\n 2.pop\n 3.display\n 4.exit\n");
        scanf("%d", &choice);
        switch (choice)
        {
        case 1:
            printf("enter a value:\n");
            scanf("%d", &value);
            push(value);
            break;
        case 2:
            pop();
            break;
        case 3:
            display();
            break;
        case 4:
```

```
            exit(0);
            break;
        default:
            printf("wrong input!\n");
            break;
        }
    }
}
```

OUTPUT:

```
---------------MENU----------------
1.push
 2.pop
 3.display
 4.exit
1
enter a value:
50
insertion operation is complete
---------------MENU----------------
1.push
 2.pop
 3.display
 4.exit
2
---------------MENU----------------
1.push
 2.pop
 3.display
 4.exit
3
stack is empty
---------------MENU----------------
1.push
 2.pop
 3.display
 4.exit
4
```

LAB PROGRAM 2:

Write a program to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), (minus), * (multiply) and / (divide).

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
int top = -1, pos = 0;
char temp, stack[25], infix[25], postfix[25];
void push(char s)
{
   stack[++top] = s;
}
int precedence(char s)
{
   switch (s)
   {
   case '^':
      return 3;
   case '+':
   case '-':
      return 1;
   case '*':
   case '/':
      return 2;
   case '(':
      return 0;
   }
}
char pop()
{  char symb = stack[top];
   top--;
   return symb;
}
void infixtopostfix()
```

```
{
   int len = strlen(infix);
   int i = 0;
   char symbol;
   while (i < len)
   {
      symbol = infix[i];
      switch (symbol)
      {
      case '(':
         push(symbol);
         break;
      case ')':
         temp = pop();
         while (temp != '(')
         {
            postfix[pos++] = temp;
            temp = pop();
         }
         break;
      case '+':
      case '-':
      case '*':
      case '/':
      case '^':
         while (precedence(stack[top]) >= precedence(symbol))
         {
            postfix[pos++] = pop();
         }
         push(symbol);
         break;
      default:
         postfix[pos++] = symbol;
```

```
        }
        i++;
    }
    while (top != -1)
    {
        postfix[pos++] = stack[top];
        top--;
    }
    return;
}
int main()
{
    printf("enter a infix problem:\n");
    scanf("%s", infix);
    infixtopostfix();
    printf("infix :%s\n", infix);
    printf("postfix :%s\n", postfix);
}
```

OUTPUT:

```
enter a infix problem:
a+b*(c^d-e)^(f+g-h)-i
infix :a+b*(c^d-e)^(f+g-h)-i
postfix :abcd^e-fg+h-^*+i-
```

LAB PROGRAM 3:

Write a program to simulate the working of a queue of integers using an array.Provide the following operations: Insert, Delete, Display.The program should print appropriate messages for queue empty and queue overflow conditions.

```
#include<stdio.h>
#include<stdlib.h>
# define size 5
int front=-1,rear=-1,queue[size];
void enqueue()
{
   int a;
   if (rear==size-1)
   {
      printf("overflow\n");
   }
   else
   {
      if(front==-1)
         front=0;
      printf("enter a element:");
      scanf("%d",&a);
      queue[++rear]=a;
   }
}

int dequeue()
{
   if(front==-1||front>rear)
   {
      printf("underflow\n");
      return;
   }
   else
   {
      if (front==rear)
      {
         front=-1;
         rear=-1;
         return;
      }
      int s = queue[front++];
      return s;
   }
}
```

```
void display()
{
   if(front==-1)
   {
      printf("overflow\n");
   }
   else
   {
      for (int i=front;i<=rear;i++)
      {
         printf("%d\n",queue[i]);
      }
   }
}

int main()
{
   int choice;

   while(1)
   {
      printf("-----------MENU----------\n");
      printf("1.enqueue\n 2.dequeue\n 3.display\n 4.exit\n");
      scanf("%d",&choice);

      switch(choice)
      {
         case 1:enqueue();
                break;
         case 2:dequeue();
                break;
         case 3:display();
                break;
         case 4: exit(0);
                break;
         default:printf("wrong input");
      }
   }
}
```

OUTPUT:

```
----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
1
enter a element:32
----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
1
enter a element:45
----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
3
32
45
----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
2
----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
3
45
----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
4
```

LAB PROGRAM 4:

Write a program to simulate the working of a circular queue of integers using an array. Provide the following operations: Insert, Delete & Display .The program should print appropriate messages for queue empty and queue overflow conditions.

```
#include <stdio.h>
#include <stdlib.h>
#define size 5
int front = -1, rear = -1, queue[size];

void enqueue()
{
   int a;
   if (front == rear + 1 || front == 0 && rear == size - 1)
   {
      printf("overflow\n");
   }
   else
   {
      if (front == -1)
         front = 0;
      printf("enter a element:");
      scanf("%d", &a);
      rear = (rear + 1) % size;
      queue[rear] = a;
   }
}

int dequeue()
{
   if (front == -1)
   {
      printf("underflow\n");
   }
   else
   {

      int s = queue[front];
      if (front == rear)
      {
         front = -1;
         rear = -1;
      }
      else
      {
         front = (front + 1) % size;
      }
```

```
        printf("deleted element:%d", s);
        return s;
    }
}
void display()
{
    int i;
    if (front == -1)
    {
        printf("overflow\n");
    }
    else
    {
        for (i = front; i != rear; i = (i + 1) % size)
        {
            printf("\n%d\n", queue[i]);
        }
        printf("\n%d\n", queue[i]);
    }
}

int main()
{
    int choice;

    while (1)
    {
        printf("\n-----------MENU----------\n");
        printf("1.enqueue\n 2.dequeue\n 3.display\n
4.exit\n");
        scanf("%d", &choice);

        switch (choice)
        {
        case 1:
            enqueue();
            break;
        case 2:
            dequeue();
            break;
        case 3:
            display();
            break;
        case 4:
            exit(0);
            break;
        default:
```

```
        printf("wrong input");
      }
   }
}
```

OUTPUT:

```
-----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
1
enter a element:35

-----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
1
enter a element:46

-----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
2
deleted element:35
-----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
3

46

-----------MENU----------
1.enqueue
 2.dequeue
 3.display
 4.exit
4
```

LAB PROGRAM 5 & 6:

Write a program to Implement Singly Linked List with following operations

a) **Create a linked list.**

b) **Insertion of a node at first position, at any position and at end of list.**

c) **Deletion of first element, specified element and last element in the list.**

Display the contents of the linked list.

```
#includ<stdio.h>
#include<stdlib.>
struct node
{
int data;
structnode*next;
};
struct node *head= NULL;

struct node *create_ll(struct node *head)
{
struct node *new_node, *ptr;
int num;
printf("Enter -1 to exit.. \n");
printf("Enter the num: ");
scanf("%d", &num);

while (num != -1)
{
new_node = (struct node *)malloc(sizeof(struct node));
new_node->data = num;
if (head == NULL)
{
```

```
head = new_node;
new_node->next = NULL;
}
else
{
ptr = head;
while (ptr->next != NULL)
{
ptr = ptr->next;
}
ptr->next = new_node;
new_node->next = NULL;
}
printf("Enter the num: ");
scanf("%d", &num);
}
return head;
}

struct node *insert_beg(struct node *head)
{
struct node *new_node;
int num;
printf("Enter the num: ");
scanf("%d", &num);
new_node = (struct node *)malloc(sizeof(struct node));
new_node->data = num;
if (head == NULL)
{
```

```
head = new_node;
new_node->next = NULL;
}
else
{
new_node->next = head;
head = new_node;
}
return head;
}

struct node *insert_end(struct node *head)
{
struct node *ptr, *new_node;
int num;
printf("Enter the num: ");
scanf("%d", &num);
new_node = (struct node *)malloc(sizeof(struct node));
new_node->data = num;
new_node->next = NULL;
if (head == NULL)
{
head = new_node;
}
else
{
ptr = head;
while (ptr->next != NULL)
{
```

```
ptr = ptr->next;
}
ptr->next = new_node;
}
return head;
}

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

```
struct node *new_node, *ptr, *prevptr;
int num, val;
printf("Enter the num: ");
scanf("%d", &num);
printf("Enter the value before which number has to be inserted: ");
scanf("%d", &val);
new_node = (struct node *)malloc(sizeof(struct node));
new_node->data = num;
ptr = head;
while (ptr->next != NULL)
{
prevptr = ptr;
ptr = ptr->next;
}
prevptr = ptr;
ptr = ptr->next;
prevptr->next = new_node;
new_node->next = ptr;
return head;
}
struct node *display(struct node *head)
{
struct node *ptr;
if (head == NULL)
{
printf("Linked List is empty...\n");
}
else
{
```

```
ptr = head;
while (ptr != NULL)
{
printf("%d ", ptr->data);
ptr = ptr->next;
}
printf("\n");
}
return head;
}

struct node *delete_beg(struct node *head)
{
struct node *ptr;
if (head == NULL)
{
printf("Nothing to delete.. \n");
}
else
{
ptr = head;
head = ptr->next;
free(ptr);
}
return head;
}

struct node *delete_end(struct node *head)
{
```

```
struct node *ptr, *prevptr;
ptr = head;
while (ptr->next != NULL)
{
prevptr = ptr;
ptr = ptr->next;
}
prevptr->next = NULL;
free(ptr);
return head;
}

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

```
ptr = ptr->next;
}
prevptr->next = ptr->next;
free(ptr);
return head;
}
}

int main()
{
int choice;
printf("\n---------menu-------\n");
printf("\n1.create lined list\n 2.display\n 3.insert_beg\n 4.insert_end\n 5.insert_before\n 6.insert_after\n
7.del_beg\n 8.del_end\n 9.del_node\n 10.exit");
do
{
printf("\nenter the choice:\n");
scanf("%d", &choice);
switch (choice)
{
case 1:
head = create_ll(head);
printf("linked list created");
break;
case 2:
head = display(head);
break;
case 3:
head = insert_beg(head);
```

```
break;
case 4:
head = insert_end(head);
break;
case 5:
head = insert_before(head);
break;
case 6:
head = insert_after(head);
break;
case 7:
head = delete_beg(head);
break;
case 8:
head = delete_end(head);
break;
case 9:
head = delete_node(head);
break;
}
} while (choice != 10);
}
```

OUTPUT:

```
---------menu-------

1.create lined list
 2.display
 3.insert_beg
 4.insert_end
 5.insert_before
 6.insert_after
 7.del_beg
 8.del_end
 9.del_node
 10.exit
enter the choice:
1
Enter -1 to exit..
Enter the num: 40
Enter the num: 20
Enter the num: -1
linked list created
enter the choice:
2
40 20

enter the choice:
3
Enter the num: 10

enter the choice:
2
10 40 20

enter the choice:
4
Enter the num: 30

enter the choice:
2
10 40 20 30
```

```
enter the choice:
7

enter the choice:
2
40 20 30

enter the choice:
8

enter the choice:
2
40 20

enter the choice:
9
Enter the value that has to be deleted: 40

enter the choice:
2
20

enter the choice:
10
```

LAB PROGRAM 7:

a) WAP to Implement Single Link List with following operations: Sort the linked list, Reverse the linked list and Concatenation of two linked lists.

```
#include <stdio.h>
#include <stdlib.h>
struct node
{
   int data;
   struct node *next;
};
struct node *head1;
struct node *head2;
struct node *insert(struct node *head)
{
   struct node *new_node, *ptr;
   int num;
   printf("Enter the number: ");
   scanf("%d", &num);
   new_node = (struct node *)malloc(sizeof(struct node));
   new_node->next = NULL;
   new_node->data = num;
   if (head == NULL)
   {
      head = new_node;
   }
   else
   {
      ptr = head;
      while (ptr->next != NULL)
      {
         ptr = ptr->next;
      }
      ptr->next = new_node;
   }
   return head;
}
void display(struct node *head)
{
   struct node *ptr;

   ptr = head;
   printf("Element are: \n");
   while (ptr != NULL)
   {
      printf("%d->", ptr->data);
      ptr = ptr->next;
```

```
    }
    printf("\n");
}
void concat(struct node *head1, struct node *head2)
{
    struct node *ptr;

    if (head1 != NULL && head2 != NULL)
    {
        ptr = head1;
        while (ptr->next != NULL)
        {
            ptr = ptr->next;
        }
        ptr->next = head2;
        head2=head1;
    }
    else
    {
        printf("either of the Linked List is Empty");
    }
    display(head1);
}
void reverse(struct node *head1)
{
    struct node *ptr = NULL, *prev = NULL;
    while (head1 != NULL)
    {
        ptr = head1->next;
        head1->next = prev;
        prev = head1;
        head1 = ptr;
    }
    head1 = prev;
    display(head1);
}

void sort(struct node *head1)
{ struct node *current, *nextNode;
    int temp;
    current = head1;
      while (current != NULL)
        {
            nextNode = current->next;
            while (nextNode != NULL)
            {
                if (current->data > nextNode->data)
```

```
            {
               temp = current->data;
               current->data = nextNode->data;
               nextNode->data = temp;
            }
         nextNode = nextNode->next;
         }
      current = current->next;
      }
      display(head1);
}
int main()
{
   int choice;
   while (1)
   {
      printf("1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse\n");
         printf("Enter the Choice: ");
      scanf("%d", &choice);

      switch (choice)
      {
      case 1:
         head1 = insert(head1);
         break;
      case 2:
         head2 = insert(head2);
         break;
      case 3:
         display(head1);
         break;
      case 4:
         display(head2);
         break;
      case 5:
         concat(head1, head2);
         break;
      case 6:
         sort(head1);
         break;
      case 7:
         reverse(head1);
         break;
      }
   }
}
```

OUTPUT:

```
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 1
Enter the number: 32
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 1
Enter the number: 32
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 2
Enter the number: 65
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 1
Enter the number: 65
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 1
Enter the number: 94
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 2
Enter the number: 85
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 2
Enter the number: 87
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 2
Enter the number: 69
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 3
Element are:
32->32->65->94->
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 4
Element are:
65->85->87->69->
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 5
Element are:
32->32->65->94->65->85->87->69->
1.insert1 2.insert2 3.display1 4.display2 5.concat 6.sort 7.reverse
Enter the Choice: 7
Element are:
69->87->85->65->94->65->32->32->
```

LAB PROGRAM 8 :

Write a program to Implement Single Link List to simulate Stack & Queue Operations.

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

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

struct node *head = NULL;
void push()
{
   struct node *new_node;
   int num;
   printf("Enter the number:\n");
   scanf("%d", &num);
   new_node = (struct node *)malloc(sizeof(struct node));
   new_node->data = num;
   if (head == NULL)
   {
      head = new_node;
      new_node->next = NULL;
   }
   else
   {
      new_node->next = head;
      head = new_node;
   }
}

void pop()
{
   struct node *ptr;
   if (head == NULL)
   {
      printf("underflow\n");
   }
   else
   {
      ptr = head;
      head = ptr->next;
      printf("popped element:%d", ptr->data);
      free(ptr);
   }
```

```
}

void display()
{
   struct node *ptr;
   ptr = head;
   if (head == NULL)
   {
      printf("stack is empty\n");
   }
   else
   {
      while (ptr != NULL)
      {
         printf("%d\n", ptr->data);
         ptr = ptr->next;
      }
   }
}

int main()
{
   int ch;
   while (1)
   {
      printf("-------menu------\n1.push\n2.pop\n3.display\n4.exit\n");
      printf("Enter the choice\n");
      scanf("%d", &ch);
      switch (ch)
      {
      case 1:
         push();
         break;
      case 2:
         pop();
         break;
      case 3:
         display();
         break;
      case 4:
         exit(0);
         break;
      default:
         printf("invalid number!");
      }
   }
}
```

OUTPUT:

```
-------menu------
1.push
2.pop
3.display
4.exit
Enter the choice
1
Enter the number:
32
-------menu------
1.push
2.pop
3.display
4.exit
Enter the choice
1
Enter the number:
35
-------menu------
1.push
2.pop
3.display
4.exit
Enter the choice
1
Enter the number:
65
-------menu------
1.push
2.pop
3.display
4.exit
Enter the choice
3
65
35
32
-------menu------
1.push
2.pop
3.display
4.exit
Enter the choice
2
popped element:65-------menu------
```

Queue Implementation:

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

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

struct node *head = NULL;
void enqueue()
{
   struct node *new_node;
   int num;
   printf("Enter the number:\n");
   scanf("%d", &num);
   new_node = (struct node *)malloc(sizeof(struct node));
   new_node->data = num;
   if (head == NULL)
   {
      head = new_node;
      new_node->next = NULL;
   }
   else
   {
      struct node *ptr=head;
      while(ptr->next!=NULL)
      {
         ptr=ptr->next;

      }
      ptr->next=new_node;
      new_node->next = NULL;
   }
}
void dequeue()
{
   struct node *ptr;
   if (head == NULL)
   {
      printf("underflow\n");
   }
   else
   {
      ptr = head;
      head = ptr->next;
```

```
        printf("popped element:%d", ptr->data);
        free(ptr);
    }
}
void display()
{
    struct node *ptr;
    ptr = head;
    if (head == NULL)
    {
        printf("stack is empty\n");
    }
    else
    {
        while (ptr != NULL)
        {
            printf("%d\n", ptr->data);
            ptr = ptr->next;
        }
    }
}
int main()
{  int ch;
    while (1)
    {
        printf("-------menu------\n1.enqueue\n2.dequeue\n3.display\n4.exit\n");
        printf("Enter the choice\n");
        scanf("%d", &ch);
        switch (ch)
        {
        case 1:
            enqueue();
            break;
        case 2:
            dequeue();
            break;
        case 3:
            display();
            break;
        case 4:
            exit(0);
            break;
        default:
            printf("invalid number!");
        }
}
}
```

OUTPUT:

```
-------menu------
1.enqueue
2.dequeue
3.display
4.exit
Enter the choice
1
Enter the number:
32
-------menu------
1.enqueue
2.dequeue
3.display
4.exit
Enter the choice
1
Enter the number:
35
-------menu------
1.enqueue
2.dequeue
3.display
4.exit
Enter the choice
1
Enter the number:
65
-------menu------
1.enqueue
2.dequeue
3.display
4.exit
Enter the choice
3
32
35
65
-------menu------
1.enqueue
2.dequeue
3.display
4.exit
Enter the choice
2
popped element:32-------menu------
```

LAB PROGRAM 9:

Write a program to Implement doubly link list with primitive operations.

a) **Create a doubly linked list.**

b) **Insert a new node to the left of the node.**

c) **Delete the node based on a specific value**

d) **Display the contents of the list**

```
#include <stdio.h>
#include <stdlib.h>
struct node
{  int data;
   struct node *next;
   struct node *prev;
};
struct node *head;
void create_ll()
{  struct node *new_node, *ptr;
   int num;
   printf("Enter -1 to exit.. \n");
   while (num != -1)
   {  printf("Enter the num: ");
      scanf("%d", &num);
      new_node = (struct node *)malloc(sizeof(struct node));
      new_node->data = num;
      if (head == NULL)
      {  head = new_node;
         new_node->next = NULL;
         new_node->prev = NULL;
      }
      else
      {  ptr = head;
         while (ptr->next != NULL)
         {ptr = ptr->next;}
         ptr->next = new_node;
         new_node->prev = ptr;
         new_node->next = NULL;
      }
   }
}
void insert_left()
{  struct node *new_node, *ptr;
   int val, num;
   new_node = (struct node *)malloc(sizeof(struct node));
   printf("enter a value to insert at left:");
```

```
    scanf("%d", &val);
    printf("Enter the value of node:");
    scanf("%d", &num);
    new_node->data = val;
    ptr = head;
    if (head == NULL)
    {printf("list is empty!");}
    else
    {while (ptr->data != num)
        { ptr = ptr->next;}
        ptr->prev->next = new_node;
        new_node->prev = ptr->prev;
        new_node->next = ptr;
        ptr->prev = new_node;
    }
}
void display()
{  struct node *ptr;
    if (head == NULL)
    {
        printf("Linked list is empty!");
    }
    else
    {
        ptr = head;
        while (ptr != NULL)
        {
            printf("%d->", ptr->data);
            ptr = ptr->next;
        }
    }
}

void del()
{  struct node *ptr;
    int val;
    printf("enter the value to be deleted:");
    scanf("%d", &val);
    ptr = head;
    if (head->data == val)
    {
        ptr = ptr->next;
        head = ptr;
    }
    else
    {
        while (ptr->data != val)
```

```
        {
            ptr = ptr->next;
        }
        ptr->prev->next = ptr->next;
        ptr->next->prev = ptr->prev;
        free(ptr);
    }
}

int main()
{
    int value, choice;
    while (1)
    {
        printf("----------------MENU----------------\n");
        printf("1.create_ll\n 2.insert_left\n 3.delete\n 4.display\n 5.exit\n");
        scanf("%d", &choice);
        switch (choice)
        {
        case 1:
            create_ll();
            break;

        case 2:
            insert_left();
            break;

        case 3:
            del();
            break;

        case 4:
            display();
            break;

        case 5:
            exit(0);
            break;

        default:
            printf("wrong input!\n");
            break;
        }
    }
}
```

OUTPUT:

```
---------------MENU----------------
1.create_ll
 2.insert_left
 3.delete
 4.display
 5.exit
1
Enter -1 to exit..
Enter the num: 32
Enter the num: 46
Enter the num: 65
Enter the num: -1
---------------MENU----------------
1.create_ll
 2.insert_left
 3.delete
 4.display
 5.exit
4
32->46->65->-1->---------------MENU----------------
1.create_ll
 2.insert_left
 3.delete
 4.display
 5.exit
2
enter a value to insert at left:99
Enter the value of node:46
---------------MENU----------------
1.create_ll
 2.insert_left
 3.delete
 4.display
 5.exit
4
32->99->46->65->-1->---------------MENU----------------
1.create_ll
 2.insert_left
 3.delete
 4.display
 5.exit
3
enter the value to be deleted:46
---------------MENU----------------
1.create_ll
 2.insert_left
 3.delete
 4.display
 5.exit
4
32->99->65->-1->---------------MENU----------------
1.create_ll
 2.insert_left
 3.delete
 4.display
 5.exit
```

LAB PROGRAM 10:

Write a program

a) **To construct a binary Search tree.**

b) **To traverse the tree using all the methods i.e., in-order, preorder and post order**

c) **To display the elements in the tree.**

```
#include <stdio.h>
#include <stdlib.h>
struct node{
   int data;
   struct node* left;
   struct node* right;
};
struct node* create_tree(int data)
{struct node * new_node;
   new_node=(struct node*)malloc(sizeof(struct node));
   new_node->data=data;
   new_node->left=new_node->right=NULL;
   return new_node;
}

struct node* insert(struct node* root,int data)
{if(root==NULL)
       return create_tree(data);
   if(data<root->data)
       root->left=insert(root->left,data);
   else if(data>root->data)
       root->right=insert(root->right,data);
   return root;
}
void inorder(struct node *root)
{if(root!=NULL)
   {inorder(root->left);
       printf("%d->",root->data);
       inorder(root->right);

   }
}
void preorder(struct node *root)
{if(root!=NULL)
   {printf("%d->",root->data);
       preorder(root->left);
       preorder(root->right);
   }
}
```

```
void postorder(struct node *root)
{if(root!=NULL)
   {postorder(root->left);
      postorder(root->right);
      printf("%d->",root->data);
   }
}
void display(struct node *root)
{if (root!=NULL)
   {printf("inorder:");
      inorder(root);
      printf("\npreorder:");
      preorder(root);
      printf("\npostorder");
      postorder(root);

   }
}
int main()
{struct node *root=NULL;
   root=insert(root,500);
   root=insert(root,300);
   root=insert(root,900);
   root=insert(root,550);
   root=insert(root,50);
   display(root);
}
```

OUTPUT:

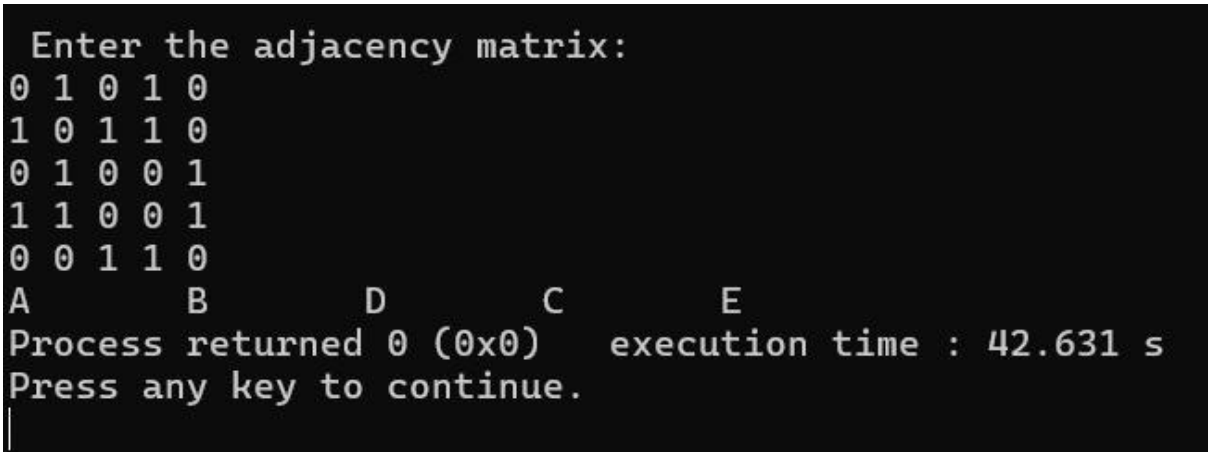
```
inorder:50->300->500->550->900->
preorder:500->300->50->900->550->
postorder50->300->550->900->500->
```

LAB PROGRAM 11:

a) Write a program to traverse a graph using BFS method.

```
#include <stdio.h>
#define MAX 5
void breadth_first_search(int adj[][MAX],int visited[],int start){
int queue[MAX],rear = -1,front = -1, i;
queue[++rear] = start;
visited[start] = 1;
while(rear != front)
{ start = queue[++front];
if(start == 4)
printf("%c\t",start+65);
else {printf("%c \t",start + 65);
for(i = 0; i < MAX; i++) {
    if(adj[start][i] == 1 && visited[i] ==0)
    { queue[++rear] = i;
    visited[i] = 1;
    } }}
}
int main()
{ int visited[MAX] = {0};
 int adj[MAX][MAX], i, j;
 printf("\n Enter the adjacency matrix:");
for(i = 0; i < MAX; i++)
for(j=0;j<MAX; j++)
scanf("%d", &adj[i][j]);
breadth_first_search(adj,visited,0);
return 0;
}
```

OUTPUT:



b) Write a program to check whether a given graph is connected or not using the DFS method.

```
#include <stdbool.h>
#include <stdio.h>
#include <string.h>
#define N 50 int gr[N][N];
 bool vis[N];
void Add_edge(int u, int v)
{ gr[u][v] = 1;}
 void dfs(int x)
{ vis[x] = true;
for (int i = 1; i <= N; i++)
{ if (gr[x][i] && !vis[i])
                    dfs(i);
}
bool Is_Connected(int n)
{ memset(vis, false, sizeof vis);
dfs(1);
for (int i = 1; i <= n; i++){
if (!vis[i])
return false; }
```

```
return true;}
int main()
{ int n, u, v;
printf("Enter the number of vertices: ");
scanf("%d", &n);
printf("Enter the number of edges: ");
int m; scanf("%d", &m);
printf("Enter the edges (u v):\n");
for (int i = 0; i < m; ++i)
{ scanf("%d %d", &u, &v);
Add_edge(u, v);
}
if (Is_Connected(n))
printf("Connected\n");
else
printf("Not Connected\n");
return 0;
}
```

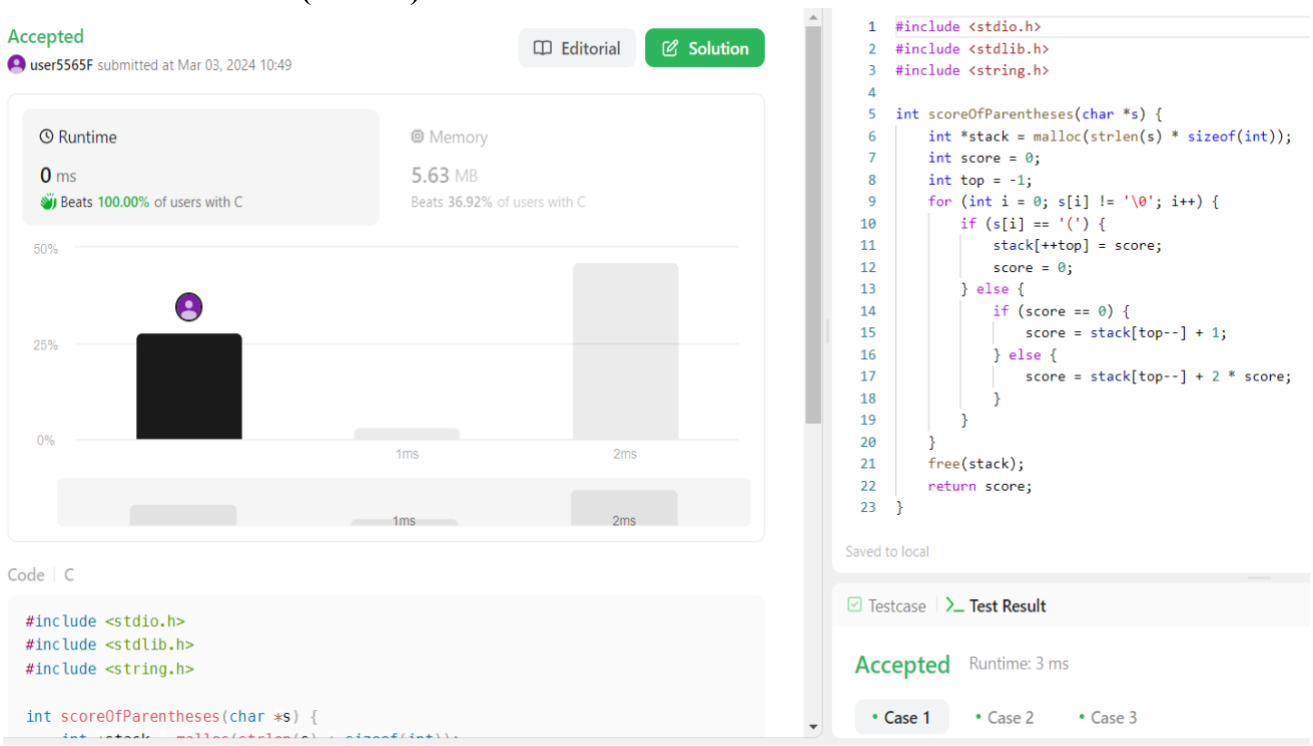
OUTPUT:

```
Enter the number of vertices: 4
Enter the number of edges: 4
Enter the edges (u v):
1 2
1 3
2 3
3 4
Connected
```

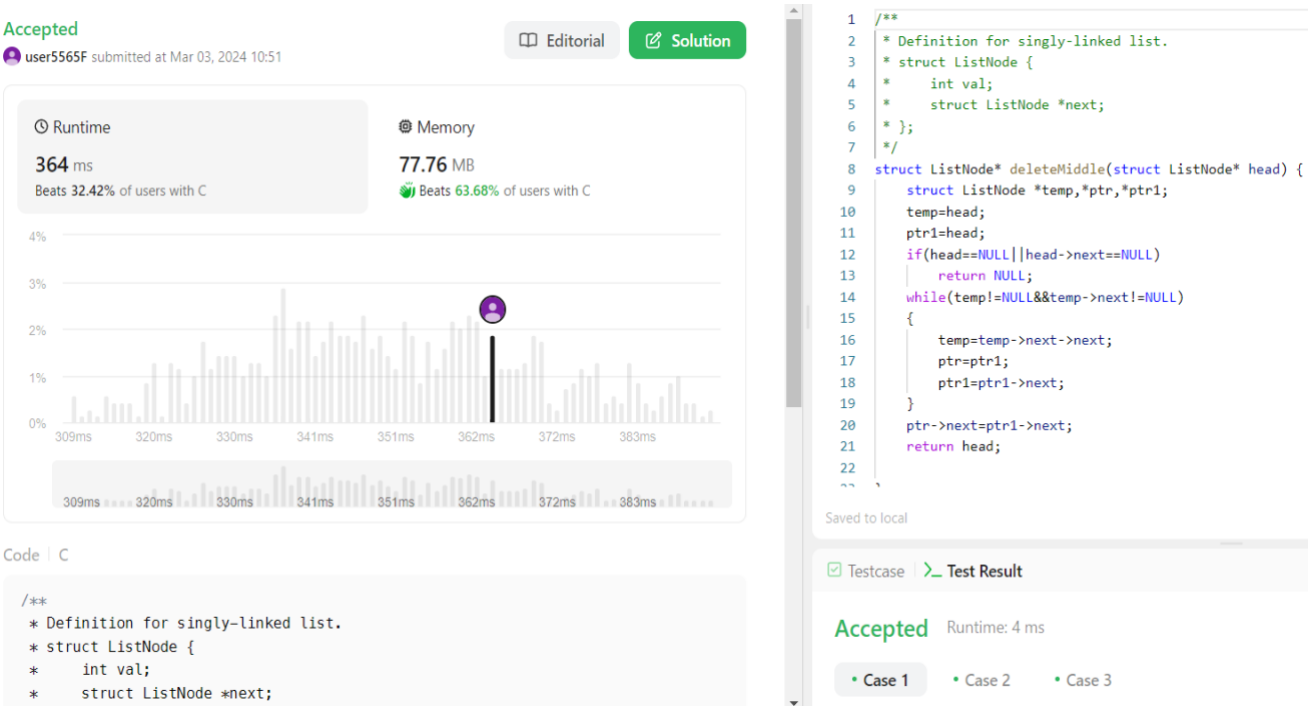
```
Enter the number of vertices: 5
Enter the number of edges: 4
Enter the edges (u v):
1 2
4 3
4 5
2 3
Not Connected
```

LeetCode Programs:

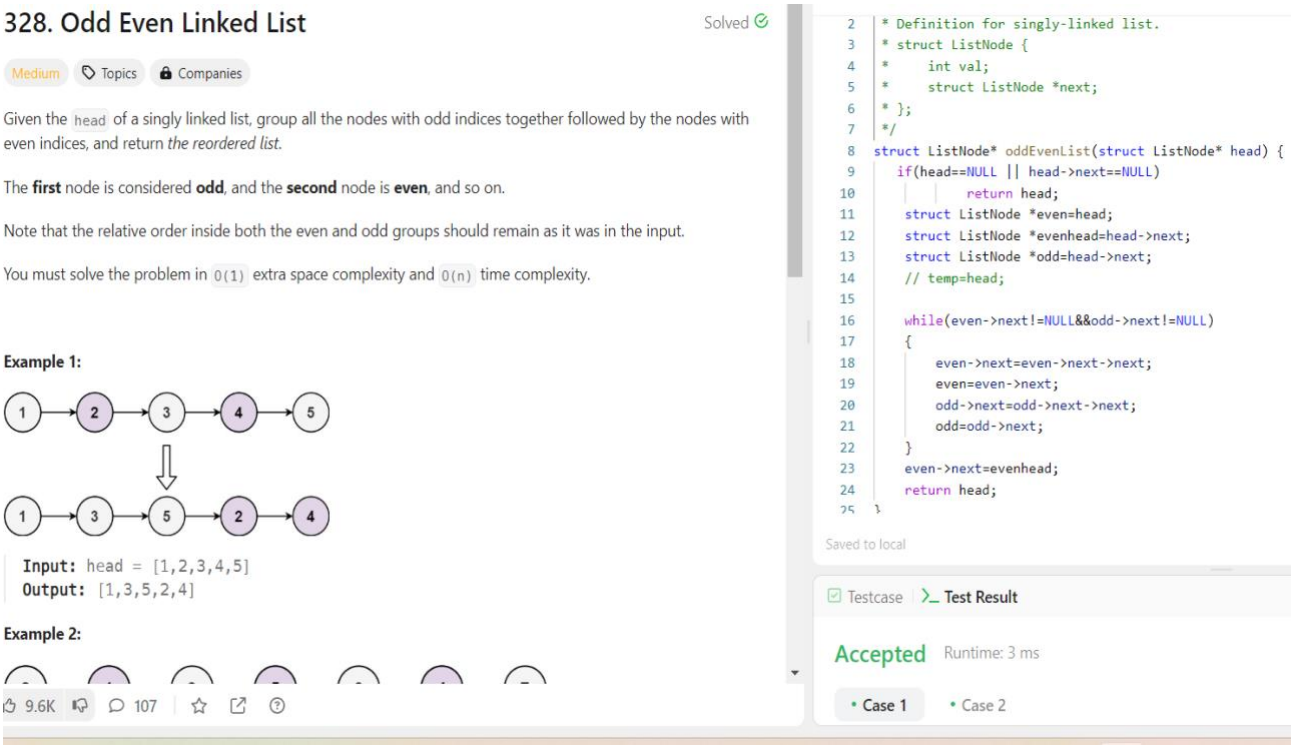
1.Score of Parentheses(LP:856)



2.Delete middle node of linked list.(LP:2095)



3.Odd Even Linked List(LP:328)



328. Odd Even Linked List

Solved

Medium | Topics | Companies

Given the `head` of a singly linked list, group all the nodes with odd indices together followed by the nodes with even indices, and return *the reordered list.*

The **first** node is considered **odd**, and the **second** node is **even**, and so on.

Note that the relative order inside both the even and odd groups should remain as it was in the input.

You must solve the problem in `O(1)` extra space complexity and `O(n)` time complexity.

Example 1:


```
Input: head = [1,2,3,4,5]
Output: [1,3,5,2,4]
```

Example 2:

9.6K 107

```
/*
 * Definition for singly-linked list.
 * struct ListNode {
 *     int val;
 *     struct ListNode *next;
 * };
 */
struct ListNode* oddEvenList(struct ListNode* head) {
    if(head==NULL || head->next==NULL)
            return head;
     struct ListNode *even=head;
     struct ListNode *evenhead=head->next;
     struct ListNode *odd=head->next;
     // temp=head;

     while(even->next!=NULL&&odd->next!=NULL)
     {
         even->next=even->next->next;
         even=even->next;
         odd->next=odd->next->next;
         odd=odd->next;
     }
     even->next=evenhead;
     return head;
}
```

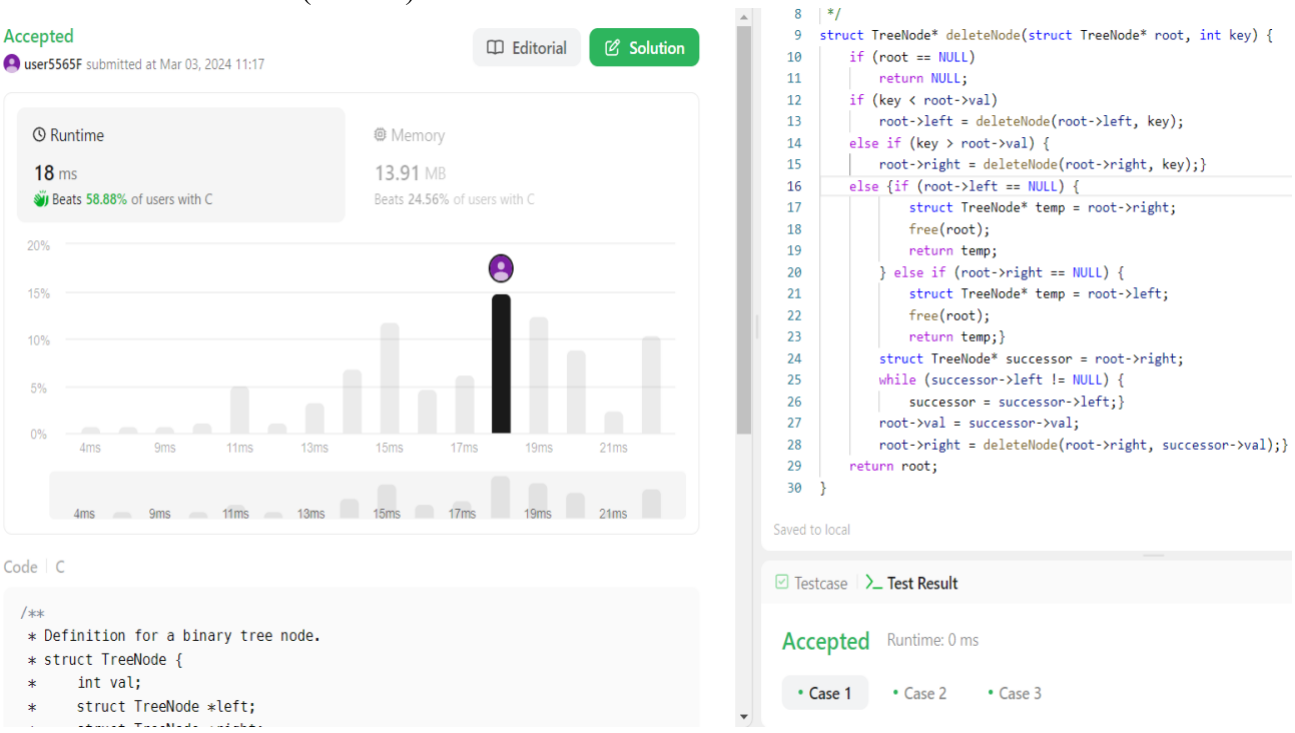
Saved to local

Testcase | Test Result

Accepted Runtime: 3 ms

Case 1 | Case 2

4.Delete a node in BST.(LP:450)



Accepted

user5565F submitted at Mar 03, 2024 11:17

Editorial | Solution

Runtime

18 ms

Beats 58.88% of users with C

Memory

13.91 MB

Beats 24.56% of users with C

Code | C

```
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     struct TreeNode *left;
```

```
*/
struct TreeNode* deleteNode(struct TreeNode* root, int key) {
    if (root == NULL)
        return NULL;
    if (key < root->val)
        root->left = deleteNode(root->left, key);
    else if (key > root->val) {
        root->right = deleteNode(root->right, key);}
    else {if (root->left == NULL) {
            struct TreeNode* temp = root->right;
            free(root);
            return temp;
        } else if (root->right == NULL) {
            struct TreeNode* temp = root->left;
            free(root);
            return temp;}
        struct TreeNode* successor = root->right;
        while (successor->left != NULL) {
            successor = successor->left;}
        root->val = successor->val;
        root->right = deleteNode(root->right, successor->val);}
    return root;
}
```

Saved to local

Testcase | Test Result

Accepted Runtime: 0 ms

Case 1 | Case 2 | Case 3

5.Bottom Left Tree Value.(LP:513)