VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

DATA STRUCTURES

Submitted by

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in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

B.M.S. COLLEGE OF ENGINEERING
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(Affiliated To Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "**DATA STRUCTURES**" carried out by **MANAV Y TAKE (1BM21CS102),** 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 2022-23. The Lab report has been approved as it satisfies the academic requirements in respect of Data structures Lab **- (22CS3PCDST)** work prescribed for the said degree.

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Course Outcome :

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 Data Structure concepts.
CO4	Conduct practical experiments for demonstrating the operations of different data structures.

LAB PROGRAM 1:

Program to simulate the working of stack using an array.

Program code-C:

```
#include <stdio.h>
#define Stack_size 5
int top, item, st[10],i;
top=-1;

void push()
{
   if (top==Stack_size-1)
   printf("STACK OVERFLOW\n\n\n");
   else
   {
      top++;
      st[top]=item;
   }
}

int pop()
{
   int del_item;
   if(top==-1)
   printf("STACK UNDERFLOW\n");
   else
   {
```

```
        del_item = st[top];
        top--;
        return del_item;
    }
}

void display()
{
    if(top==-1)
    printf("Stack empty. There is nothing to display\n");

    for(i=0;i<=top;i++)
        printf(" %d ", st[i]);
}

int main()
{
    int op;
    while(1)
    {
        printf("\nEnter the operation\n 1.PUSH  2. POP  3. DISPLAY\n");
        scanf("%d", &op);

        switch(op)
        {
            case 1: printf("Enter the number : ");
                    scanf("%d", &item);
```

```
                push();
                break;

            case 2: pop();
                break;

            case 3: display();
                break;

            default: printf("Invalid input\n\n");
                 break;
        }
    }
    return 0;
}
```

Outputs:

```
Enter the operation
 1.PUSH  2. POP  3. DISPLAY
1
Enter the number : 2

Enter the operation
 1.PUSH  2. POP  3. DISPLAY
1
Enter the number : 3

Enter the operation
 1.PUSH  2. POP  3. DISPLAY
1
Enter the number : 5

Enter the operation
 1.PUSH  2. POP  3. DISPLAY
1
Enter the number : 4

Enter the operation
 1.PUSH  2. POP  3. DISPLAY
1
Enter the number : 8
STACK OVERFLOW



Enter the operation
 1.PUSH  2. POP  3. DISPLAY
2

Enter the operation
 1.PUSH  2. POP  3. DISPLAY
3
 1  2  3  5
```

LAB PROGRAM 2:

Program to convert a given infix arithmetic expression to postfix expression.

Program code-C:

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

int top = -1;
char s[20];
char infix[20];
char postfix[20];

void inf_to_post();
int sp(char);
int ip(char);
void push(char);
char pop();

void main() {
  printf("enter a valid infix expression\n");
  scanf("%s", infix);
  inf_to_post();
  printf("The postfix expression is %s", postfix);
}
void push(char item) {
  s[++top] = item;
```

```
}
char pop() {
  return s[top--];
}
int sp(char item) {
  switch (item) {
  case '+':
  case '-': return 2;
  case '*':
  case '/': return 4;
  case '^':
  case '$': return 5;
  case '(': return 0;
  case '#': return -1;
  default: return 8;
  }
}
int ip(char item) {
  switch (item) {
  case '+':
  case '-': return 1;
  case '*':
  case '/': return 3;
  case '^':
  case '$': return 6;
  case '(': return 9;
  case ')': return 0;
```

```
   default: return 7;
  }
}
void inf_to_post() {
  int i, j = 0;
  char symbol;
  push('#');
  for (i = 0; i < strlen(infix); i++) {
    symbol = infix[i];
    while (sp(s[top]) > ip(symbol)) {
      postfix[j] = pop();
      j++;
    }
    if (sp(s[top] < ip(symbol))) {
      push(symbol);
    }
    if (sp(s[top]) == ip(symbol)) {
      pop();
    }
  }
  while (s[top] != '#') {
    postfix[j] = pop();
    j++;
  }
  postfix[j] = '\0';
}
```

Outputs:

```
enter a valid infix expression
k+m-c*(y/q/t)^x-a
The postfix expression is km+cyq/t/)x^a-(*-
```

LAB PROGRAM 3:

Program to simulate the working of a queue of integers using an array.

Program code-C:

```
#include <stdio.h>
#define QSIZE 5

void insert_rear(int q[], int item, int *r)
{
   if(*r==QSIZE-1)
   printf("Queue Overflow\n");
   else
   {
      (*r)++;
      q[*r]=item;
   }
}

int delete_front(int q[], int *f, int *r)
{
   if(*f>*r)z
   printf("Queue Underflow\n");
   else{
   return q[(*f)++];   //return(q[(*f)++]);
   }
}
```

```
void display(int q[], int *f, int *r)
{
   int i;
   if(*f>*r)
   printf("Queue is empty\n");
   else
   {
      for(i=*f;i<=*r;i++)
      printf("%d",q[i]);
   }
}

int main()
{
  int op,item,st[10],val;
  int rear=-1;
  int front=0;
   while(1)
   {
      printf("\nEnter the operation\n 1.Insert  2.Delete  3. Display\n");
      scanf("%d", &op);

      switch(op)
      {
         case 1: printf("Enter the number : ");
                 scanf("%d", &item);
                 insert_rear(st, item , &rear);
```

```
            break;

        case 2: val=delete_front(st,&front,&rear);
            printf("The value deleted is :%d",val);
            break;

        case 3: display(st,&front,&rear);
            break;

        default: printf("Invalid input\n\n");
             break;
      }
   }

   return 0;
}
```

Outputs:

```
Enter the operation
 1.Insert  2.Delete  3. Display
3
Queue is empty

Enter the operation
 1.Insert  2.Delete  3. Display
2
Queue Underflow
The value deleted is :16
Enter the operation
 1.Insert  2.Delete  3. Display
1
Enter the number : 1

Enter the operation
 1.Insert  2.Delete  3. Display
1
Enter the number : 5

Enter the operation
 1.Insert  2.Delete  3. Display

1
Enter the number : 6

Enter the operation
 1.Insert  2.Delete  3. Display
1
Enter the number : 7

Enter the operation
 1.Insert  2.Delete  3. Display
3
1567
Enter the operation
 1.Insert  2.Delete  3. Display
2
The value deleted is :1
```

LAB PROGRAM 4:

Program to simulate the working of a circular queue of integers using an array.

Program code-C:

```
#include<stdio.h>
#include<stdlib.h>
#define QSIZE 3
int count=0;
void insert_rear(int q[3],int item,int *r)
{
   if(count==QSIZE)
     printf("Queue overflow\n");
   else
     {
        *r=*r+1;
        *r=(*r)% QSIZE;
        q[*r]=item;
        count++;
     }
}

int delete_front(int q[3],int *f,int *r)
{
   int del_item;
   if (count==0)
    printf("Queue underflow\n");
```

```
    else
    {
        del_item=q[*f];
        *f=*f+1;
        *f=((*f)% QSIZE);
        count--;
        return del_item;
    }
}


void display(int q[3],int *f)
{
    int temp,i;
    temp=*f;
    for(i=0;i<count;i++)
     {
         printf("%d\t",q[temp]);
         temp=(temp+1)% QSIZE;
     }
}


 void main()
 {
    int q[QSIZE],item,r=-1,f=0,choice,val_del;
    while(1)
```

```
  {
     printf("\n Enter your choice\n");
     printf("\n1.insert 2.delete 3.display\n");
     scanf("%d",&choice);
     switch(choice)
     {
        case 1:printf("enter the value to be inserted\n");
               scanf("%d",&item);
               insert_rear(q,item,&r);
               break;

        case 2:val_del=delete_front(q,&f,&r);
               printf("Item deleted=%d",val_del);
               break;

        case 3:display(q,&f);
               break;

         default:exit(0);
     }
  }
}
```

Outputs:

```
1.insert 2.delete 3.display
1
enter the value to be inserted
5

 Enter your choice

1.insert 2.delete 3.display
1
enter the value to be inserted
10

 Enter your choice

1.insert 2.delete 3.display
1
enter the value to be inserted
15

 Enter your choice

1.insert 2.delete 3.display
1
enter the value to be inserted
20
Queue overflow

 Enter your choice

1.insert 2.delete 3.display
3
5       10      15
 Enter your choice

1.insert 2.delete 3.display
2
Item deleted=5
```

LAB PROGRAM 5:

Program to implement Singly Linked List (Create, Insert and Display functions)

Program code-C:

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
struct node
{
        int value;
        struct node *next;
};

typedef struct node *NODE;

NODE getnode()
{
        NODE temp;
        temp=(NODE)malloc(sizeof(struct node));
        if (temp==NULL)
        {
                printf("Memory not allocated\n");
                return NULL;
        }

        return temp;
```

```
}

NODE insert_beg(int item,NODE first)
{
        NODE new;
        new=getnode();
        new->value=item;
        new->next=NULL;
        if(first==NULL)
        {
                return new;
        }
        else
        {
                new->next=first;
                first=new;
                return first;
        }
}

NODE insert_end(int item,NODE first)
{
        NODE new,last;
   new=getnode();
        new->value=item;
        new->next=NULL;
        if (first==NULL)
```

```
        {
                return new;
        }
        if(first->next==NULL)
        {
                first->next=new;
                return first;
        }
        last=first;
        while(last->next!=NULL)
                last=last->next;
        last->next=new;
        return first;
}

NODE insert_pos(NODE first,int item,int pos)
{
        int count=1;
        int val=item;
        NODE new,curr,prev;
        new=getnode();
        new->value=item;
        new->next=NULL;

        if(first==NULL && pos==1)
        return new;
        prev=NULL;
```

```
        curr=first;
        while(count!=pos && curr!=NULL)
        {
                prev=curr;
                curr=curr->next;
                count++;
        }

        if(count==pos)
        {
                prev->next=new;
                new->next=curr;
                return first;
        }

        if(curr==NULL)
        {
                printf("position not fount\n");
                return first;
        }

        if(first!=NULL && pos==1)
        first=insert_beg(val,first);
        return first;
}

void display(NODE first)
```

```
{
        NODE temp;
        temp=first;
        while(temp!=NULL)
        {
                printf("value stored in node=%d\n",temp->value);
                temp=temp->next;
        }
}

void main()
{
        NODE first=NULL;
        int choice,pos,item;
        while(1)
        {
                printf("\n1.Insert_beg  2.Insert_end  3.Insert_pos  4.Display\n");
                printf("\n enter your choice\n");
                scanf("%d",&choice);
                switch(choice)
                {
                        case 1:printf("\nEnter the value to be inserted at the beginning\n");
                             scanf("%d",&item);
                             first=insert_beg(item,first);
                             break;

                        case 2:printf("\nEnter the value to be inserted at the end\n");
```

```
                    scanf("%d",&item);
                    first=insert_end(item,first);
                    break;

                case 3: printf("\nEnter the value to be inserted\n");
                    scanf("%d",&item);
                    printf("\nEnter the position at which item should be inserted \n");
                    scanf("%d",&pos);
                    first=insert_pos(first,item,pos);
                    break;

                case 4:display(first);
                    break;

                default:exit(0);

            }

        }
}
```

Outputs:

```
1.Insert_beg  2.Insert_end  3.Insert_pos  4.Display

 enter your choice
1

Enter the value to be inserted at the begining
3

1.Insert_beg  2.Insert_end  3.Insert_pos  4.Display

 enter your choice
1

Enter the value to be inserted at the begining
4

1.Insert_beg  2.Insert_end  3.Insert_pos  4.Display

 enter your choice
1

Enter the value to be inserted at the begining
5

1.Insert_beg  2.Insert_end  3.Insert_pos  4.Display

 enter your choice
4
value stored in node=5
value stored in node=4
value stored in node=3
value stored in node=2
value stored in node=1
```

LAB PROGRAM 6:

Program to Implement Singly Linked List (Create, Delete and Display functions).

Program code-C:

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
struct node {
   int value;
   struct node * next;
};
typedef struct node * NODE;
NODE getnode() {
   NODE temp;
   temp = (NODE) malloc(sizeof(struct node));
   if (temp == NULL) {
      printf("Memory not allocated\n");
      return NULL;
   }
   return temp;
}

NODE insert_beg(int item, NODE first) {
   NODE new;
   new = getnode();
   new -> value = item;
```

```
    new -> next = NULL;
    if (first == NULL) {
        return new;
    } else {
        new -> next = first;
        first = new;
        return first;
    }
}

NODE insert_end(int item, NODE first) {
    NODE new, last;
    new = getnode();
    new -> value = item;
    new -> next = NULL;
    if (first == NULL) {
        return new;
    }
    if (first -> next == NULL) {
        first -> next = new;
        return first;
    }
    last = first;
    while (last -> next != NULL)
        last = last -> next;
    last -> next = new;
    return first;
```

```
}

NODE insert_pos(NODE first, int item, int pos) {
   int count = 1;
   int val = item;
   NODE new, curr, prev;
   new = getnode();
   new -> value = item;
   new -> next = NULL;

   if (first == NULL && pos == 1)
      return new;
   prev = NULL;
   curr = first;
   while (count != pos && curr != NULL) {
      prev = curr;
      curr = curr -> next;
      count++;
   }

   if (count == pos) {
      prev -> next = new;
      new -> next = curr;
      return first;
   }
   if (curr == NULL) {
      printf("position not fount\n");
```

```
        return first;
    }
    if (first != NULL && pos == 1)
        first = insert_beg(val, first);
    return first;
}

NODE delete_beg(NODE first) {
    NODE temp;
    if (first == NULL) {
        printf("Cannot delete\n");
        return NULL;
    }
    temp = first;
    temp = temp -> next;
    printf("Item deleted=%d", first -> value);
    free(first);
    return temp;
}

NODE delete_end(NODE first) {
    NODE prev, curr;
    if (first == NULL) {
        printf("Cannot delete\n");
        return NULL;
    }
    prev = NULL;
```

```
    curr = first;
    while (curr -> next != NULL) {
        prev = curr;
        curr = curr -> next;
    }
    prev -> next = NULL;
    printf("Item deleted=%d", curr -> value);
    return first;
}

NODE delete_specific_value(NODE first, int key) {
    NODE prev, curr;
    if (first == NULL) {
        printf("Cannot delete\n");
        return NULL;
    }
    curr = first;
    if (curr -> value == key) {
        printf("Item deleted=%d", curr -> value);
        first = first -> next;
        free(curr);
        return first;
    }
    prev = NULL;
    curr = first;
    while (curr -> value != key && curr != NULL) {
        prev = curr;
```

```
        curr = curr -> next;
    }
    if (curr -> value == key) {
        prev -> next = curr -> next;
        printf("%d=Item deleted", curr -> value);
        free(curr);
        return first;
    }
    if (curr == NULL) {
        printf("End of list reached and item not fount\n");
        return first;
    }
}

void display(NODE first) {
    NODE temp;
    temp = first;
    while (temp != NULL) {
        printf("value stored in node=%d\n", temp -> value);
        temp = temp -> next;
    }
}

void main() {
    NODE first = NULL;
    int choice, pos, item;
    while (1) {
```

```
printf("\n1.Insert_beg \n2.Insert_end \n3.Insert_pos \n4.delete_beg \n5.delete_end \n6.delete_specific_value \n7.Display\n");
printf("\n enter your choice\n");
scanf("%d", & choice);
switch (choice) {
case 1:
   printf("\nEnter the value to be inserted at the begining\n");
   scanf("%d", & item);
   first = insert_beg(item, first);
   break;

case 2:
   printf("\nEnter the value to be inserted at the end\n");
   scanf("%d", & item);
   first = insert_end(item, first);
   break;

case 3:
   printf("\nEnter the value to be inserted\n");
   scanf("%d", & item);
   printf("\nEnter the position at which item should be inserted \n");
   scanf("%d", & pos);
   first = insert_pos(first, item, pos);
   break;

case 4:
   first = delete_beg(first);
   break;
```

```
        case 5:
            first = delete_end(first);
            break;

        case 6:
            printf("\nEnter the value to be deleted\n");
            scanf("%d", & item);
            first = delete_specific_value(first, item);
            break;

        case 7:
            display(first);
            break;

        default:
            exit(0);

        }
    }
}
```

Outputs:

```
value stored in node=5
value stored in node=4
value stored in node=3
value stored in node=2
value stored in node=1

1.Insert_beg
2.Insert_end
3.Insert_pos
4.delete_beg
5.delete_end
6.delete_specific_value
7.Display

 enter your choice
4
Item deleted=5
1.Insert_beg
2.Insert_end
3.Insert_pos
4.delete_beg
5.delete_end
6.delete_specific_value
7.Display

 enter your choice
5
Item deleted=1
1.Insert_beg
2.Insert_end
3.Insert_pos
4.delete_beg
5.delete_end
6.delete_specific_value
7.Display

 enter your choice
7
value stored in node=4
value stored in node=3
value stored in node=2
```

LAB PROGRAM 7:

Program to Implement Single Link List (Sort, Reverse and Concatenate list functions).

Program code-C:

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

struct node
{
        int value;
        struct node *next;
};
typedef struct node *NODE;
NODE getnode()
{
        NODE temp;
        temp=(NODE)malloc(sizeof(struct node));
        if(temp==NULL)
        {
                printf("Memory not allocated");
                return NULL;
        }
        return temp;
}
int countfun(NODE first)
{
```

```
   NODE temp=first;int c=0;
   while(temp!=NULL)
   {
      c++;
      temp=temp->next;
   }
   return c;
}
NODE insert_beg(NODE first,int item)
{
        NODE new;
        new=getnode();
        new->value=item;
        new->next=NULL;
        if(first==NULL)
        {
                return new;
        }
        else
        {
                new->next=first;
                first=new;
                return first;
        }
}
void display(NODE first)
{
```

```
        NODE temp;
        temp=first;
        if(first==NULL)
        {
                printf("List is empty\n");
        }
        while(temp!=NULL)
        {
                printf("Value stored in the node=%d\n",temp->value);
                temp=temp->next;
        }

}
NODE sort(NODE first)
{
   NODE curr=first;
   int count=countfun(first);
   int temp,i,j;
   if(first->next==NULL)
      return first;
   for(i=0;i<count-1;i++)
   {
      curr=first;
      for(j=0;j<count-i-1;j++)
      {
         if(curr->value>curr->next->value)
         {
```

```
            temp=curr->value;
            curr->value=curr->next->value;
            curr->next->value=temp;
          }
          curr=curr->next;
       }
    }
    return first;

}
NODE concatenate(NODE first1, NODE first2)
{
          NODE temp;
          temp=first1;
          if(first1==NULL && first2==NULL)
          {
                    return NULL;
          }
          if(first1==NULL)
          {
                    return first2;
          }
          while(temp->next!=NULL)
          {
                    temp=temp->next;
          }
          temp->next=first2;
```

```
        return first1;
}
NODE reverse(NODE first)
{
   NODE prev=NULL;
   NODE curr=first;
   NODE next=NULL;
   while(curr!=NULL)
   {
      next=curr->next;
      curr->next=prev;
      prev=curr;
      curr=next;

   }
   first=prev;
   return prev;
}


int main()
{
        int item,c;
        int count1=0,count2=0;
        NODE first1=NULL,first2=NULL;
        while(1)
        {
```

```
printf("\n1.Insert at beginning for list1\n2.Insert at beginning for list2\n3.Sort list1\n3.Sort list2\n5.Concatenate(output is stored in list1)\n6.Reverse list1\n7.Reverse list2\n8.Display list1\n9.Display list2\n\n");
printf("Enter your choice :");
scanf("%d",&c);
switch(c)
{
case 1:printf("Enter the item to be inserted :");
scanf("%d",&item);
first1=insert_beg(first1,item);
break;
case 2:printf("Enter the item to be inserted :");
scanf("%d",&item);
first2=insert_beg(first2,item);
break;
case 3:first1=sort(first1);
break;
case 4:first2=sort(first2);
break;
case 5:first1=concatenate(first1,first2);
break;
case 6:first1=reverse(first1);
break;
case 7:first2=reverse(first2);
break;
case 8:display(first1);
break;
case 9:display(first2);
```

```
                    break;
                    default:printf("Invalid choice!!!");
                                exit(0);
                }
            }
        }
```

Outputs:

```
Value stored in the node=1
Value stored in the node=10
Value stored in the node=5

1.Insert at beginning for list1
2.Insert at beginning for list2
3.Sort list1
3.Sort list2
5.Concatenate(output is stored in list1)
6.Reverse list1
7.Reverse list2
8.Display list1
9.Display list2

Enter your choice :5

1.Insert at beginning for list1
2.Insert at beginning for list2
3.Sort list1
3.Sort list2
5.Concatenate(output is stored in list1)
6.Reverse list1
7.Reverse list2
8.Display list1
9.Display list2

Enter your choice :8
Value stored in the node=1
Value stored in the node=10
Value stored in the node=5
Value stored in the node=6
Value stored in the node=4
Value stored in the node=2
```

```
Enter your choice :3

1.Insert at beginning for list1
2.Insert at beginning for list2
3.Sort list1
3.Sort list2
5.Concatenate(output is stored in list1)
6.Reverse list1
7.Reverse list2
8.Display list1
9.Display list2

Enter your choice :8
Value stored in the node=1
Value stored in the node=2
Value stored in the node=4
Value stored in the node=5
Value stored in the node=6
Value stored in the node=10
```

```
1.Insert at beginning for list1
2.Insert at beginning for list2
3.Sort list1
3.Sort list2
5.Concatenate(output is stored in list1)
6.Reverse list1
7.Reverse list2
8.Display list1
9.Display list2

Enter your choice :8
Value stored in the node=10
Value stored in the node=6
Value stored in the node=5
Value stored in the node=4
Value stored in the node=2
Value stored in the node=1
```

LAB PROGRAM 8:

Program to implement Stack & Queues using Linked Representation.

Program code-C:

Stacks:

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
struct node
{
        int value;
        struct node *next;
};

typedef struct node *NODE;

NODE getnode()
{
        NODE temp;
        temp=(NODE)malloc(sizeof(struct node));
        if (temp==NULL)
        {
                printf("Memory not allocated\n");
                return NULL;
        }

        return temp;
```

```
}

NODE insert_beg(int item,NODE first)
{
        NODE new;
        new=getnode();
        new->value=item;
        new->next=NULL;
        if(first==NULL)
        {
                return new;
        }
        else
        {
                new->next=first;
                first=new;
                return first;
        }
}

NODE delete_beg(NODE first)
{
   NODE temp;
   if(first==NULL)
   {
      printf("Cannot delete\n");
      return NULL;
```

```
    }
    temp=first;
    temp=temp->next;
    printf("Item deleted=%d",first->value);
    free(first);
    return temp;
}


void display(NODE first)
{
        NODE temp;
        temp=first;
        while(temp!=NULL)
        {
                printf("value stored in node=%d\n",temp->value);
                temp=temp->next;
        }
}

void main()
{
        NODE first=NULL;
        int choice,pos,item;
        while(1)
        {
      printf("\n1.Push \n2.Pop \n3.Display\n");
```

```
                printf("\n enter your choice\n");
                scanf("%d",&choice);
                switch(choice)
    {
      case 1:printf("\nEnter the value to be inserted\n");
                              scanf("%d",&item);
                              first=insert_beg(item,first);
           break;

      case 2:first=delete_beg(first);
           break;

      case 3:display(first);
                              break;

      default:exit(0);

                }

       }
}
```

Queues:

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
struct node
{
```

```
        int value;
        struct node *next;
};

typedef struct node *NODE;

NODE getnode()
{
        NODE temp;
        temp=(NODE)malloc(sizeof(struct node));
        if (temp==NULL)
        {
                printf("Memory not allocated\n");
                return NULL;
        }

        return temp;
}

NODE insert_beg(int item,NODE first)
{
        NODE new;
        new=getnode();
        new->value=item;
        new->next=NULL;
        if(first==NULL)
        {
```

```
                return new;
        }
        else
        {
                new->next=first;
                first=new;
                return first;
        }
}

NODE delete_end(NODE first)
{
   NODE prev,curr;
   if(first==NULL)
    {
      printf("Cannot delete\n");
      return NULL;
   }
   prev=NULL;
   curr=first;
   while(curr->next!=NULL)
   {
      prev=curr;
      curr=curr->next;
   }
   prev->next=NULL;
   printf("Item deleted=%d",curr->value);
```

```
   return first;
}

void display(NODE first)
{
        NODE temp;
        temp=first;
        while(temp!=NULL)
        {
                printf("value stored in node=%d\n",temp->value);
                temp=temp->next;
        }
}

void main()
{
        NODE first=NULL;
        int choice,pos,item;
        while(1)
        {
      printf("\n1.Insert \n2.delete \n3.Display\n");
                printf("\n enter your choice\n");
                scanf("%d",&choice);
                switch(choice)
      {
         case 1:printf("\nEnter the value to be inserted\n");
                                scanf("%d",&item);
```

```
                        first=insert_beg(item,first);
            break;

        case 2:first=delete_end(first);
            break;

        case 3:display(first);
                        break;

        default:exit(0);

                }

         }
}
```

```
Enter the value to be inserted
3

1.Push
2.Pop
3.Display

 enter your choice
3
value stored in node=3
value stored in node=7
value stored in node=6
value stored in node=5

1.Push
2.Pop
3.Display

 enter your choice
2
Item deleted=3
1.Push
2.Pop
3.Display
```

```
 enter your choice
2
Cannot delete

1.Insert
2.delete
3.Display

 enter your choice
1

Enter the value to be inserted
7

1.Insert
2.delete
3.Display

 enter your choice
1

Enter the value to be inserted
98

1.Insert
2.delete
3.Display

 enter your choice
1

Enter the value to be inserted
756

1.Insert
2.delete
3.Display

 enter your choice
3
value stored in node=756
value stored in node=98
value stored in node=7
```

LAB PROGRAM 9:

Program to Implement doubly link list.

Program code-C:

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
struct node
{
        int value;
        struct node *next;
        struct node *prev;
};

typedef struct node *NODE;

NODE getnode()
{
        NODE temp;
        temp=(NODE)malloc(sizeof(struct node));
        if(temp==NULL)
        {
                printf("Memory not allocated\n");
        }
        return temp;
}
```

```
NODE insert_beg(NODE first,int item)
{
        NODE new;
        new=getnode();
        new->value=item;
        new->prev=NULL;
        new->next=NULL;
        if(first==NULL)
        {
                return new;
        }
        new->next=first;
        first->prev=new;
        return new;
}

NODE insert_left(NODE first,int key,int item)
{
        NODE temp,new;
        new=getnode();
        new->value=item;
        new->prev=NULL;
        new->next=NULL;
        if(first==NULL)
        {
                printf("List is empty");
                return NULL;
```

```
}
if(first->next==NULL && first->value!=key)
{
        printf("key not found.....cant insert!!!");
        return first;
}
if(first->next==NULL && first->value==key)
{
   first=insert_beg(first,new->value);
}
temp=first;
while(temp->value!=key && temp->next!=NULL)
{
        temp=temp->next;
}
if(temp->value==key)
{
        new->next=temp;
        new->prev=temp->prev;
        (temp->prev)->next=new;
        temp->prev=new;
        return first;
}
if(temp->value!=key)
{
        printf("value not found\n");
        return first;
```

```
        }
}


NODE delete_specific(NODE first,int key)
{
        NODE curr,temp;
        if(first==NULL)
        {
                printf("Linkedlist is empty\n");
                return NULL;
        }
        if(first->next==NULL && first->value==key)
        {
                free(first);
                return NULL;
        }
        if(first->next==NULL && first->value!=key)
        {
                printf("element not found\n");
                return first;
        }
        if(first->value==key)
        {
                (first->next)->prev=NULL;
                temp=first->next;
                free(first);
```

```
                return temp;
        }
        while(curr!=NULL)
        {
                if(curr->value==key)
                break;
                curr=curr->next;
        }
        if(curr==NULL)
        {
                printf("Element not found\n");
        }
        (curr->prev)->next=curr->next;
        if(curr->next!=NULL)
        {
                (curr->next)->prev=curr->prev;
        }
}

void display(NODE first)
{
        NODE temp;
        if(first==NULL)
        {
                printf("List is empty\n");
        }
        temp=first;
```

```
        while(temp!=NULL)
        {
                printf("%d\n",temp->value);
                temp=temp->next;
        }
}

void main()
{
        NODE first=NULL;
        int choice,key,item;
        while(1)
        {
                printf("\n1.Insert_beg  2.Insert_left  3.Delete_specific  4.Display\n");
                printf("\n enter your choice");
                scanf("%d",&choice);
                switch(choice)
                {
                        case 1:printf("\nEnter the value to be inserted at the begining\n");
                             scanf("%d",&item);
                             first=insert_beg(first,item);
                             break;

                        case 2:printf("\nEnter the value to be inserted at the left\n");
                             scanf("%d",&item);
                             printf("\nEnter the key\n");
                             scanf("%d",&key);
```

```
                        first=insert_left(first,key,item);
            break;

          case 3:printf("\nEnter the value to be deleted\n");
                        scanf("%d",&key);
                        first=delete_specific(first,key);
                        break;

                    case 4:display(first);
                        break;

                default:exit(0);

              }

        }
}
```

Outputs:

```
1.Insert_beg  2.Insert_left  3.Delete_specific  4.Display

 enter your choice1

Enter the value to be inserted at the begining
45

1.Insert_beg  2.Insert_left  3.Delete_specific  4.Display

 enter your choice4
45
34
5

1.Insert_beg  2.Insert_left  3.Delete_specific  4.Display

 enter your choice2

Enter the value to be inserted at the left
34

Enter the key
5

1.Insert_beg  2.Insert_left  3.Delete_specific  4.Display

 enter your choice4
45
34
34
5
```

LAB PROGRAM 10:

Program to Implement a Binary Search Tree (Create, Traversal and Display functions).

Program code-C:

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

struct node {
  int key;
  struct node *left, *right;
};

// Create a node
struct node *newNode(int item) {
  struct node *temp = (struct node *)malloc(sizeof(struct node));
  temp->key = item;
  temp->left = temp->right = NULL;
  return temp;
}

// Preorder Traversal
void preorder(struct node *root) {
  if (root != NULL) {

    // Traverse root
    printf("%d -> ", root->key);
```

```
    // Traverse left
    preorder(root->left);

    // Traverse right
    preorder(root->right);

  }
}


// Postorder Traversal
void postorder(struct node *root) {
  if (root != NULL) {

    // Traverse left
    postorder(root->left);

    // Traverse right
    postorder(root->right);

    // Traverse root
    printf("%d -> ", root->key);
  }
}

// Inorder Traversal
```

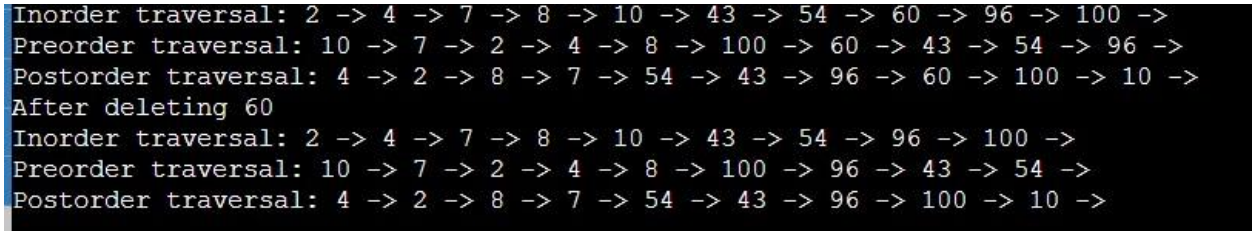
```
void inorder(struct node *root) {
  if (root != NULL) {
    // Traverse left
    inorder(root->left);

    // Traverse root
    printf("%d -> ", root->key);

    // Traverse right
    inorder(root->right);
  }
}

// Insert a node
struct node *insert(struct node *node, int key) {
  // Return a new node if the tree is empty
  if (node == NULL) return newNode(key);

  // Traverse to the right place and insert the node
  if (key < node->key)
    node->left = insert(node->left, key);
  else
    node->right = insert(node->right, key);

  return node;
}
```

```
// Find the inorder successor
struct node *minValueNode(struct node *node) {
  struct node *current = node;

  // Find the leftmost leaf
  while (current->left != NULL)
    current = current->left;

  return current;
}

// Deleting a node
struct node *deleteNode(struct node *root, int key) {
  // Return if the tree is empty
  if (root == NULL) return root;

  // Find the node to be deleted
  if (key < root->key)
    root->left = deleteNode(root->left, key);
  else if (key > root->key)
    root->right = deleteNode(root->right, key);

  else {
    // If the node is with only one child or no child
    if (root->left == NULL) {
      struct node *temp = root->right;
      free(root);
```

```
      return temp;
    } else if (root->right == NULL) {
      struct node *temp = root->left;
      free(root);
      return temp;
    }

    // If the node has two children
    struct node *temp = minValueNode(root->right);

    // Place the inorder successor in position of the node to be deleted
    root->key = temp->key;

    // Delete the inorder successor
    root->right = deleteNode(root->right, temp->key);
  }
  return root;
}

// Driver code
int main() {
  struct node *root = NULL;
  root = insert(root, 10);
  root = insert(root, 100);
  root = insert(root, 60);
  root = insert(root, 7);
  root = insert(root, 96);
```

```
  root = insert(root, 43);
  root = insert(root, 2);
  root = insert(root, 4);
  root = insert(root, 8);
  root = insert(root, 54);

  printf("Inorder traversal: ");
  inorder(root);

  printf("\nPreorder traversal: ");
  preorder(root);

  printf("\nPostorder traversal: ");
  postorder(root);

  printf("\nAfter deleting 60\n");
  root = deleteNode(root, 60);

  printf("Inorder traversal: ");
  inorder(root);

  printf("\nPreorder traversal: ");
  preorder(root);

  printf("\nPostorder traversal: ");
  postorder(root);
}
```

Output:



Thank you!