VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

DATA STRUCTURE LAB RECORD

Submitted by

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Under the Guidance of

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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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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 RECORD carried out by **SAIPRAVEEN MARNI(1BM19CS138)** who is the bonafide students 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 Visveswaraiah Technological University, Belgaum during the year 2020-2021. The lab report has been approved as it satisfies the academic requirements in respect of **DATA STRUCTURE LAB RECORD (19CS3PCDST)** work prescribed for the said degree.

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1. **Write a program to stimulate the working of stack using an array with the following:**

a) Push b) Pop c) Display

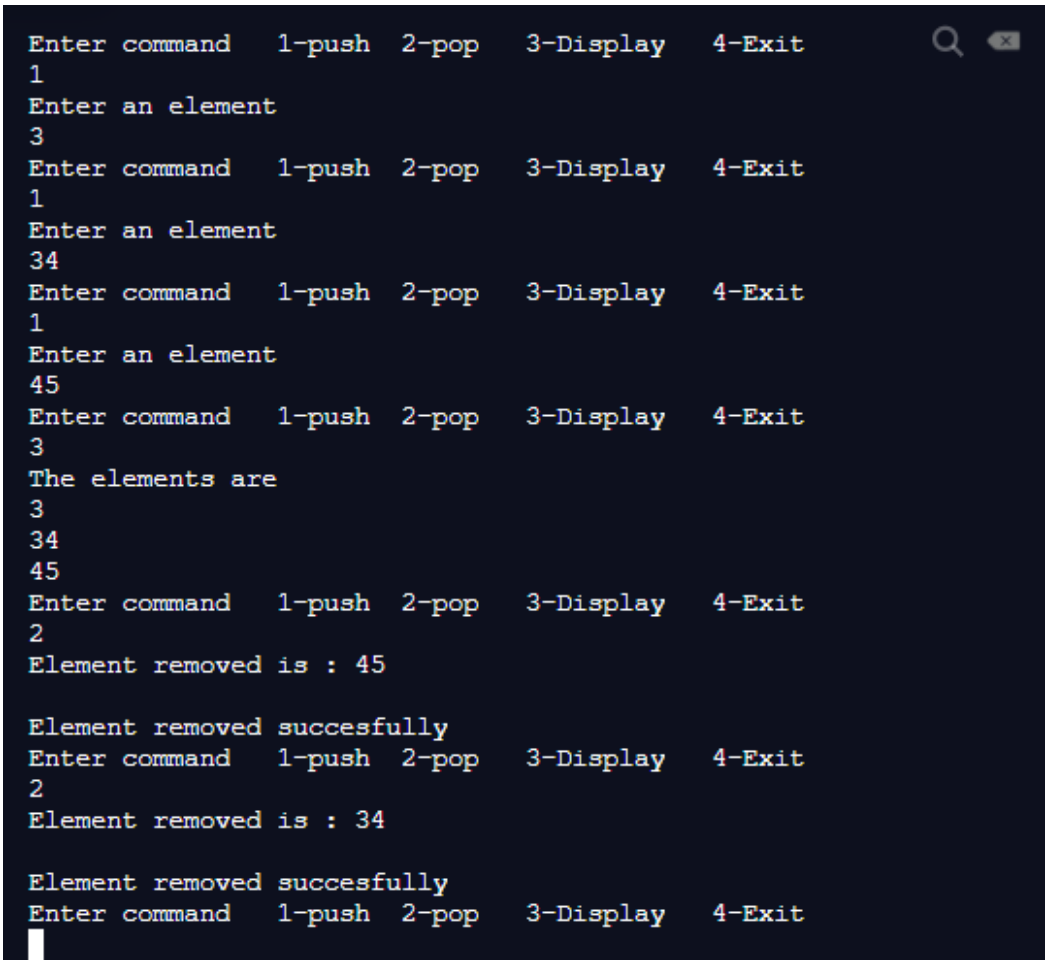
The program should print appropriate for stack overflow, stack underflow.

```
#include
<stdio.h>
            #include <stdlib.h>
            #define SIZE 5
            int top=-1;
            int stack[SIZE];
            void push(int ele)
             {
                if(top==SIZE-1)
                {
                    printf("The stack is full\n");
                }
                else
                {
                    top++;
                    stack[top]=ele;
                }
             }
             int pop()
             {
                 if(top==-1)
                 {
                     return 0;
                 }
                 else
                 {   printf("Element removed is : %d\n",stack[top--]);
                     return 1;
```

```
    }
}

void display()
{
    if(top==-1)
        printf("The stack is empty\n");
    else
    {
        printf("The elements are\n");
        for(int i=0;i<=top;i++)
        {
            printf("%d\n",stack[i]);
        }
    }
}

int main()
{
  int c,d,p;
  while(c!=4)
  {
  printf("Enter command\t1-push\t2-pop\t3-Display\t4-Exit\n");
  scanf("%d",&c);
  switch(c)
  {
    case 1:printf("Enter an element\n");
           scanf("%d",&d);
           push(d);
           break;
    case 2:p=pop();
           if(p==0)
            printf("Stack is empty\n");
            else
            printf("\nElement removed succesfully\n");
            break;
    case 3:display();
           break;
    case 4:break;
    default: printf("Invalid input\n");
  }
  }
return 0;
```

```
}
```

OUTPUT:


Enter command 1-push 2-pop 3-Display 4-Exit
1
Enter an element
3
Enter command 1-push 2-pop 3-Display 4-Exit
1
Enter an element
34
Enter command 1-push 2-pop 3-Display 4-Exit
1
Enter an element
45
Enter command 1-push 2-pop 3-Display 4-Exit
3
The elements are
3
34
45
Enter command 1-push 2-pop 3-Display 4-Exit
2
Element removed is : 45
Element removed succesfully
Enter command 1-push 2-pop 3-Display 4-Exit
2
Element removed is : 34
Element removed succesfully
Enter command 1-push 2-pop 3-Display 4-Exit

2) WAP 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).

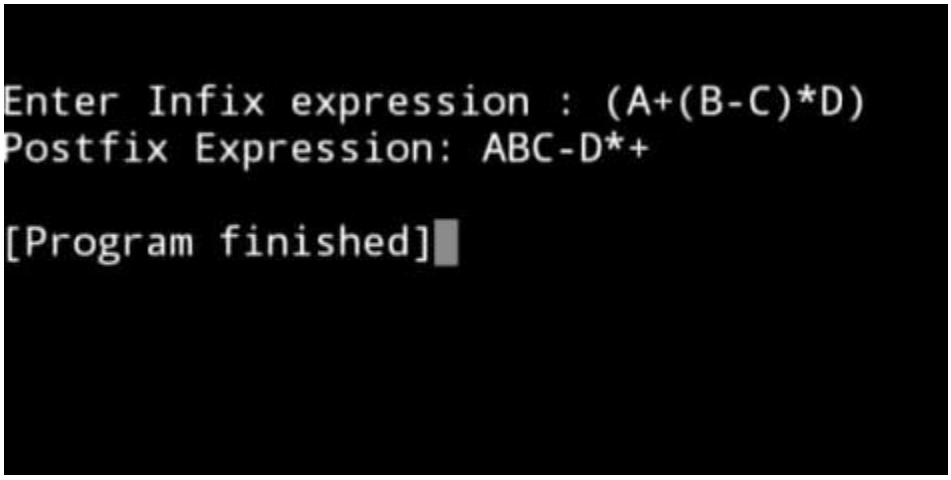
```
#include<stdio.h>
                    #include<stdlib.h>
                    #include<ctype.h>
                    #include<string.h>
                    #define SIZE 100
                    char stack[SIZE];
                    int top = -1;
                    void push(char item)
                    {
                           if(top >= SIZE-1)
                           {
                                  printf("\nStack Overflow.");
                           }
                           else
                           {
                                  top = top+1;
                                  stack[top] = item;
                           }
                    }
                    char pop()
                    {
                           char item ;

                           if(top <0)
                           {
                                  printf(" invalid infix expression");
                                  getchar();
                                  exit(1);
                           }
                           else
                           {
                                  item = stack[top];
                                  top = top-1;
                                  return(item);
                           }
                    }
                    int is_operator(char symbol)
```

```
{
	if(symbol == '^' || symbol == '*' || symbol == '/' || symbol ==
'+' || symbol =='-')
	{
		return 1;
	}
	else
	{
	return 0;
	}
}
int precedence(char symbol)
{
	if(symbol == '^')
	{
		return(3);
	}
	else if(symbol == '*' || symbol == '/')
	{
		return(2);
	}
	else if(symbol == '+' || symbol == '-')
	{
		return(1);
	}
	else
	{
		return(0);
	}
}

void InfixToPostfix(char infix_exp[], char postfix_exp[])
{
	int i, j;
	char item;
	char x;
	push('(');
	strcat(infix_exp,")");

	i=0;
	j=0;
	item=infix_exp[i];
```

```
        while(item != '\0')
        {
                if(item == '(')
                {
                        push(item);
                }
                else if( isdigit(item) || isalpha(item))
                {
                        postfix_exp[j] = item;
                        j++;
                }
                else if(is_operator(item) == 1)
                {
                        x=pop();
                        while(is_operator(x) == 1 && precedence(x)>=
precedence(item))
                        {
                                postfix_exp[j] = x;
                                j++;
                                x = pop();
                        }
                        push(x);
        push(item);
                }
                else if(item == ')')
                {
                        x = pop();
                        while(x != '(')
                        {
                                postfix_exp[j] = x;
                                j++;
                                x = pop();
                        }
                }
                else
                {
                        printf("\nInvalid infix Expression.\n");
                        getchar();
                        exit(1);
                }
                i++;
      item = infix_exp[i];
        }
```

```
        if(top>0)
        {
                printf("\nInvalid infix Expression.\n");
                getchar();
                exit(1);
        }
        if(top>0)
        {
                printf("\nInvalid infix Expression.\n");
                getchar();
                exit(1);
        }
        postfix_exp[j] = '\0';
}
int main()
{
        char infix[SIZE], postfix[SIZE];
        printf("\nEnter Infix expression : ");
        gets(infix);
        InfixToPostfix(infix,postfix);
        printf("Postfix Expression: ");
        puts(postfix);
        return 0;
}
```

OUTPUT:



3) WAP to simulate the working of a queue of integers using an array. Provide the following operations.

a) Insert

b) Delete

c) Display

The program should print appropriate messages for queue empty and queue overflow conditions.

```
#include<stdio.h>
                    #include<stdlib.h>
                    #define QUE_SIZE 3
                    int item,front=0,rear=-1,q[10];
                    void insertrear()
                    {if(rear==QUE_SIZE-1)
                    {
                           printf("queue overflow\n");
                           return;
                    }
                    rear=rear+1;
                    q[rear]=item;
                    }int deletefront()
                    {if (front>rear)
                    {front=0;
                    rear=-1;
                    return -1;
                    }return q[front++];
                    }void displayQ()
                    {int i;
                    if (front>rear)
                    {
                           printf("queue is empty\n");
                           return;
                    }
                    printf("contents of queue\n");
                    for(i=front;i<=rear;i++)
                    {
                           printf("%d\n",q[i]);
                    }}
                    int main()
                    {
                           int choice;
```

```
for(;;)
{
        printf("1:insertrear 2:deletefront 3:display 4:exit\n");
        printf("enter the choice\n");
        scanf("%d",&choice);
        switch(choice)
        {
                case 1:printf("enter the item to be inserted\n");
                scanf("%d",&item);
                insertrear ();
                break;
                case 2:item=deletefront();
                if(item==-1)
                printf("queue is empty\n");
                else
                printf("item deleted=%d\n",item);
                break;
                case 3:displayQ();
                break;
                default:exit (0);

        }

}
}
```

OUTPUT:

```
1:insertrear 2:deletefront 3:display 4:exit
enter the choice
1
enter the item to be inserted
12
1:insertrear 2:deletefront 3:display 4:exit
enter the choice
1
enter the item to be inserted
23
1:insertrear 2:deletefront 3:display 4:exit
enter the choice
1
enter the item to be inserted
34
1:insertrear 2:deletefront 3:display 4:exit
enter the choice
3
contents of queue
12
23
34
1:insertrear 2:deletefront 3:display 4:exit
enter the choice
2
item deleted=12
1:insertrear 2:deletefront 3:display 4:exit
enter the choice
2
item deleted=23
1:insertrear 2:deletefront 3:display 4:exit
enter the choice
2
item deleted=34
1:insertrear 2:deletefront 3:display 4:exit
enter the choice
2
queue is empty
1:insertrear 2:deletefront 3:display 4:exit
enter the choice
```

4) WAP to simulate the working of a circular queue of integers using an array. Provide the following operations.

a) Insert

b) Delete

c) Display

The program should print appropriate messages for queue empty and queue overflow conditions.

```
#include<stdio.h>
                    #include<stdlib.h>
                    #include<process.h>
                    #define que_size 3
                    int item,front=0,rear=-1,q[que_size],count=0;
                    void insertrear()
                    {
                           if(count==que_size)
                           {
                                  printf("queue overflow");
                                  return;
                           }
                           rear=(rear+1)%que_size;
                           q[rear]=item;
                           count++;
                    }
                    int deletefront()
                    {
                           if(count==0) return -1;
                           item = q[front];
                           front=(front+1)%que_size;
                           count=count-1;
                           return item;
                    }
                    void displayq()
                    {
                           int i,f;
                           if(count==0)
                           {
                                  printf("queue is empty");
                                  return;
                           }
                           f=front;
```

```
        printf("contents of queue \n");
        for(i=0;i<=count;i++)
        {
                printf("%d\n",q[f]);
                f=(f+1)%que_size;
        }
}
void main()
{
        int choice;
        for(;;)
        {
                printf("\n1.Insert rear \n2.Delete front \n3.Display
\n4.exit \n ");
                printf("Enter the choice : ");
                scanf("%d",&choice);
                switch(choice)
                {
                        case 1:printf("Enter the item to be inserted :");
                               scanf("%d",&item);
                               insertrear();
                               break;
                        case 2:item=deletefront();
                                  if(item==-1)
                                  printf("queue is empty\n");
                                  else
                                  printf("item deleted is %d \n",item);
                                  break;
                    case 3:displayq();
                                  break;
                    default:exit(0);
                }
        }
        getch();
}
```

OUTPUT:

```
1.Insert rear   2.Delete front  3.Display       4.exit
 Enter the choice : 1
Enter the item to be inserted :56

1.Insert rear   2.Delete front  3.Display       4.exit
 Enter the choice : 1
Enter the item to be inserted :45

1.Insert rear   2.Delete front  3.Display       4.exit
 Enter the choice : 1
Enter the item to be inserted :67

1.Insert rear   2.Delete front  3.Display       4.exit
 Enter the choice : 3
contents of queue
56
45
67
56

1.Insert rear   2.Delete front  3.Display       4.exit
 Enter the choice : 2
item deleted is 56

1.Insert rear   2.Delete front  3.Display       4.exit
 Enter the choice : 2
item deleted is 45

1.Insert rear   2.Delete front  3.Display       4.exit
 Enter the choice : 2
item deleted is 67

1.Insert rear   2.Delete front  3.Display       4.exit
 Enter the choice : 2
queue is empty

1.Insert rear   2.Delete front  3.Display       4.exit
 Enter the choice : 3
queue is empty
1.Insert rear   2.Delete front  3.Display       4.exit
 Enter the choice : 4

[Program finished]
```

5 & 6) WAP 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.

d)Display the contents of the linked list.

```
#include<stdio.h>
                    #include<stdlib.h>
                    struct node{
                    int info;
                    struct node *link;
                    };
                    typedef struct node *NODE;
                    NODE getnode(){
                    NODE x;
                    x=(NODE)malloc(sizeof(struct node));
                    if(x==NULL){
                    printf("Memory full\n");
                    exit(0);
                    }
                    return x;
                    }
                    void freenode(NODE x){
                    free(x);
                    }
                    NODE insert_front(NODE first,int item){
                    NODE temp;
                    temp=getnode();
                    temp->info=item;
                    temp->link=NULL;
                    if(first==NULL)
                    return temp;
                    temp->link=first;
                    first=temp;
                    return first;
                    }
                    NODE delete_front(NODE first){
                    NODE temp;
```

```
if(first==NULL){
printf("List is empty cannot delete\n");
return first;
}
temp=first;
temp=temp->link;
printf("Item deleted at front end is %d\n",first->info);
free(first);
return temp;
}
NODE insert_rear(NODE first,int item){
NODE temp,cur;
temp=getnode();
temp->info=item;
temp->link=NULL;
if(first==NULL)
return temp;
cur=first;
while(cur->link!=NULL)
cur=cur->link;
cur->link=temp;
return first;
}
NODE delete_rear(NODE first){
NODE cur,prev;
if(first==NULL){
printf("List is empty cannot delete\n");
return first;
}
if(first->link==NULL){
printf("Item deleted is %d\n",first->info);
free(first);
return NULL;
}
prev=NULL;
cur=first;
while(cur->link!=NULL){
prev=cur;
cur=cur->link;
}
printf("Item deleted at rear end is %d",cur->info);
free(cur);
prev->link=NULL;
```

```
return first;
}
NODE insert_pos(int item,int pos,NODE first){
NODE temp,cur,prev;
int count;
temp=getnode();
temp->info=item;
temp->link=NULL;
if(first==NULL&&pos==1){
return temp;
}
if(first==NULL){
printf("Invalid position\n");
return first;
}
if(pos==1){
temp->link=first;
first=temp;
return temp;
}
count=1;
prev=NULL;
cur=first;
while(cur!=NULL&&count!=pos){
prev=cur;
cur=cur->link;
count++;
}
if(
count==pos){
prev->link=temp;
temp->link=cur;
return first;
}
printf("Invalid position\n");
return first;
}
NODE delete_pos(int pos,NODE first){
NODE cur;
NODE prev;
int count,flag=0;
if(first==NULL || pos<0){
printf("Invalid position\n");
```

```
return NULL;
}
if(pos==1){
cur=first;
first=first->link;
freenode(cur);
return first;
}
prev=NULL;
cur=first;
count=1;
while(cur!=NULL){
if(count==pos){
flag=1;
break;
}
count++;
prev=cur;
cur=cur->link;
}
if(flag==0){
printf("Invalid position\n");
return first;
}
printf("Item deleted at given position is %d\n",cur->info);
prev->link=cur->link;
freenode(cur);
return first;
}
void display(NODE first){
NODE temp;
if(first==NULL)
printf("List empty cannot display items\n");
for(temp=first;temp!=NULL;temp=temp->link){
printf("%d\n",temp->info);
}
}
void main()
{
int item,choice,key,pos;
int count=0;
NODE first=NULL;
for(;;){
```

```
printf("\n1:Insert rear\n2:Delete rear\n3:Insert front\n4:Delete
front\n5:Insert info position\n6:Delete info position\n7:Display
list\n8:Exit\n");
printf("Enter the choice: ");
scanf("%d",&choice);
switch(choice){
case 1:printf("Enter the item at rear end\n");
scanf("%d",&item);
first=insert_rear(first,item);
break;
case 2:first=delete_rear(first);
break;
case 3:printf("\nEnter the item at front end\n");
scanf("%d",&item);
first=insert_front(first,item);
break;
case 4:first=delete_front(first);
break;
case 5:printf("Enter the item to be inserted at given position\n");
scanf("%d",&item);
printf("Enter the position\n");
scanf("%d",&pos);
first=insert_pos(item,pos,first);
break;
case 6:printf("Enter the position\n");
scanf("%d",&pos);
first=delete_pos(pos,first);
break;
case 7:display(first);
break;
default:exit(0);
break;
}
}
}
```

OUTPUT:

```
:Insert rear
:Delete rear
:Insert front
:Delete front
:Insert info position
:Delete info position
:Display list
:Exit
nter the choice: 1
nter the item at rear end
0

:Insert rear
:Delete rear
:Insert front
:Delete front
:Insert info position
:Delete info position
:Display list
:Exit
nter the choice: 3

nter the item at front end
1

:Insert rear
:Delete rear
:Insert front
:Delete front
:Insert info position
:Delete info position
:Display list
:Exit
nter the choice: 5
nter the item to be inserted at given position
2
nter the position


:Insert rear
:Delete rear
:Insert front
:Delete front
:Insert info position
:Delete info position
:Display list
:Exit
nter the choice: 7
1
2
0

:Insert rear
:Delete rear
:Insert front
:Delete front
:Insert info position
:Delete info position
:Display list
:Exit
nter the choice: 2
tem deleted at rear end is 10
```

```
1:Insert rear
2:Delete rear
3:Insert front
4:Delete front
5:Insert info position
6:Delete info position
7:Display list
8:Exit
Enter the choice: 4
Item deleted at front end is 11

1:Insert rear
2:Delete rear
3:Insert front
4:Delete front
5:Insert info position
6:Delete info position
7:Display list
8:Exit
Enter the choice: 6
Enter the position
1

1:Insert rear
2:Delete rear
3:Insert front
4:Delete front
5:Insert info position
6:Delete info position
7:Display list
8:Exit
Enter the choice: 7
List empty cannot display items

1:Insert rear
2:Delete rear
3:Insert front
4:Delete front
5:Insert info position
6:Delete info position
7:Display list
8:Exit
Enter the choice: 8

[Program finished]
```

7) WAP Implement Single Link List with following operations

a) Sort the linked list.

b) Reverse the linked list.

c) Concatenation of two linked lists

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

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

                    typedef struct node *NODE;

                    NODE getNode(){
                           NODE temp = (NODE)malloc(sizeof(struct node));
                           if(temp == NULL){
                                  return NULL;
                           }
                           return temp;
                    }

                    void freeNode(NODE temp){
                           free(temp);
                    }

                    NODE insertFront(NODE first){
                           NODE temp;
                           temp = getNode();
                           int num;
                           scanf("%d",&num);
                           temp->num = num;
                           temp->next = NULL;
                           if(first==NULL){
                                  return temp;
                           }
                           temp->next = first;
                           first = temp;
                           return first;
                    }
```

```
NODE deleteFront(NODE first){
	NODE temp;
	if(first==NULL){
		printf("List is empty\n");
		return NULL;
	}
	if(first->next == NULL){
		printf("Deleted element = %d\n",first->num);
		freeNode(first);
		return NULL;
	}
	temp = first;
	temp = temp->next;
	printf("Deleted elements = %d\n",first->num);
	freeNode(first);
	return temp;
}

NODE sort(NODE first){
	NODE curr,temp;
	if(first==NULL){
		return NULL;
	}
	curr = first;
	while(curr!=NULL){
		temp = curr->next;
		while(temp!=NULL){
			if(temp->num<curr->num){
				int num = curr->num;
				curr->num=temp->num;
				temp->num = num;
			}
			temp = temp->next;
		}
		curr = curr->next;
	}
	return first;
}

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

```
                return;
        }
        curr = first;
        while(curr!=NULL){
                printf("%d ",curr->num);
                curr=curr->next;
        }
        printf("\n");
}

NODE reverse(NODE first){
        NODE curr=NULL;
        NODE temp = getNode();
        while(first!=NULL){
                temp = first;
                first = first->next;
                temp->next = curr;
                curr = temp;
                //printf("%d ",first->num);
        }
        return temp;
}

NODE concat(NODE first){
        NODE sec = NULL;
        int chq;
        while(1){
                printf("Enter the choice:\n1-insertFront\t2-
deleteFront\t3-display\t4-concat\n");
                scanf("%d",&chq);
                if(chq==4){
                        break;
                }
                switch(chq){
                        case 1:
                                sec = insertFront(sec);
                                break;
                        case 2:
                                sec = deleteFront(sec);
                                break;
                        case 3:
                                display(sec);
                                break;
```

```
                }
        }
        NODE curr;
        if(first==NULL){
                return sec;
        }
        if(sec==NULL){
                return first;
        }
        curr = first;
        while(curr->next!=NULL){
                curr = curr->next;
        }
        curr->next = sec;
        return first;
}

int main(){
        int chq;
        NODE first = NULL;
        while(1){
                printf("Enter the choice:\n1-insertFront\t2-
deleteFront\t3-display\t4-sort\t5-reverse\t6-concat\t7-exit\n");
                scanf("%d",&chq);
                switch(chq){
                        case 1:
                                first = insertFront(first);
                                break;
                        case 2:
                                first = deleteFront(first);
                                break;
                        case 3:
                                display(first);
                                break;
                        case 4:
                                first = sort(first);
                                break;
                        case 5:
                                first = reverse(first);
                                break;
                        case 6:
                                printf("Creating the second list for
concat\n");
```

```
                                        concat(first);
                                        break;
                                case 7:
                                        return 0;

                        }
                }
        }
```

OUTPUT:

```
Enter the choice:
1-insertFront   2-deleteFront   3-display       4-sort  5-reverse
-concat 7-exit
1
12
Enter the choice:
1-insertFront   2-deleteFront   3-display       4-sort  5-reverse
-concat 7-exit
1
23
Enter the choice:
1-insertFront   2-deleteFront   3-display       4-sort  5-reverse
-concat 7-exit
4
Enter the choice:
1-insertFront   2-deleteFront   3-display       4-sort  5-reverse
-concat 7-exit
3
12 23
Enter the choice:
1-insertFront   2-deleteFront   3-display       4-sort  5-reverse
-concat 7-exit
6
Creating the second list for concat
Enter the choice:
1-insertFront   2-deleteFront   3-display       4-concat
1
34
Enter the choice:
1-insertFront   2-deleteFront   3-display       4-concat
1
45
Enter the choice:
1-insertFront   2-deleteFront   3-display       4-concat
4
Enter the choice:
1-insertFront   2-deleteFront   3-display       4-sort  5-reverse
-concat 7-exit
3
12 23 45 34
Enter the choice:
1-insertFront   2-deleteFront   3-display       4-sort  5-reverse
-concat 7-exit
7

[Program finished]
```

8) WAP to implement Stack & Queues using Linked Representation.

->STACK IMPLEMENTATION

```
#include<stdio.h>
#include<conio.h>
#include<alloc.h>
#include<process.h>
struct node
{
  int info;
  struct node *link;
};
typedef struct node *NODE;
NODE getnode()
{
NODE x;
x=(NODE)malloc(sizeof(struct node));
if(x==NULL)
 {
  printf("mem full\n");
  exit(0);
 }
 return x;
}
void freenode(NODE x)
{
free(x);
}
NODE insert_front(NODE first,int item)
{
NODE temp;
temp=getnode();
temp->info=item;
temp->link=NULL;
if(first==NULL)
return temp;
temp->link=first;
first=temp;
return first;
}
NODE delete_front(NODE first)
{
NODE temp;
if(first==NULL)
{
printf("stack is empty cannot delete\n");
return first;
}
temp=first;
temp=temp->link;
printf("item deleted at front-end is=%d\n",first->info);
free(first);
return temp;
}
void display(NODE first)
{
 NODE temp;
```

```
 if(first==NULL)
 printf("stack empty cannot display items\n");
 for(temp=first;temp!=NULL;temp=temp->link)
  {
  printf("%d\n",temp->info);
  }
}
void main()
{
int item,choice,pos;
NODE first=NULL;
clrscr();
for(;;)
{
printf("\n 1:Insert_front\n 2:Delete_front\n 3:Display_list\n 4:Exit\n");
printf("enter the choice\n");
scanf("%d",&choice);
switch(choice)
 {
  case 1:printf("enter the item at front-end\n");
         scanf("%d",&item);
         first=insert_front(first,item);
         break;
  case 2:first=delete_front(first);
         break;
  case 3:display(first);
         break;
 default:exit(0);
         break;
 }
}
```

OUTPUT:

```
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
1
enter the item at front-end
12
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
1
enter the item at front-end
23
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
1
enter the item at front-end
34
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
1
enter the item at front-end
45
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
3
45
34
23
12
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
2
item deleted at front-end is=45
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
2
item deleted at front-end is=34
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
2
item deleted at front-end is=23
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
2
item deleted at front-end is=12
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
2
stack is empty cannot delete
        1:Insert_front  2:Delete_front   3:Display_list 4:Exit
enter the choice
```

->QUEUE IMPLEMENTATION

```
#include<stdio.h>
#include<conio.h>
#include<alloc.h>
#include<process.h>
struct node
{
  int info;
  struct node *link;
};
typedef struct node *NODE;
NODE getnode()
{
NODE x;
x=(NODE)malloc(sizeof(struct node));
if(x==NULL)
 {
  printf("mem full\n");
  exit(0);
 }
 return x;
}
void freenode(NODE x)
{
free(x);
}
NODE insert_rear(NODE first,int item)
{
NODE temp,cur;
temp=getnode();
temp->info=item;
temp->link=NULL;
if(first==NULL)
 return temp;
cur=first;
while(cur->link!=NULL)
 cur=cur->link;
cur->link=temp;
return first;
}

NODE delete_front(NODE first)
{
NODE temp;
if(first==NULL)
{
printf("list is empty cannot delete\n");
return first;
}
temp=first;
temp=temp->link;
printf("item deleted at front-end is=%d\n",first->info);
free(first);
return temp;
}
void display(NODE first)
{
```

```
 NODE temp;
 if(first==NULL)
 printf("list empty cannot display items\n");
 for(temp=first;temp!=NULL;temp=temp->link)
  {
  printf("%d\n",temp->info);
  }
}
void main()
{
int item,choice,pos;
NODE first=NULL;
for(;;)
{
printf("\n 1:Insert_rear\t 2:Delete_front\t 3:Display_list\t 4:Exit\n");
printf("enter the choice\n");
scanf("%d",&choice);
switch(choice)
 {
  case 1:printf("enter the item at rear-end\n");
         scanf("%d",&item);
         first=insert_rear(first,item);
         break;
  case 2:first=delete_front(first);
         break;
  case 3:display(first);
         break;
 default:exit(0);
         break;
 }
}
}
```

OUTPUT:

```
 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
1
enter the item at rear-end
12

 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
1
enter the item at rear-end
23

 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
1
enter the item at rear-end
45

 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
1
enter the item at rear-end
56

 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
3
12
23
45
56

 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
2
item deleted at front-end is=12

 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
2
item deleted at front-end is=23

 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
2
item deleted at front-end is=45

 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
2
item deleted at front-end is=56

 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
2
list is empty cannot delete

 1:Insert_rear   2:Delete_front  3:Display_list  4:Exit
enter the choice
4

[Program finished]
```

9) WAP 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 info;
                      struct node *rlink;
                      struct node *llink;
                     };
                    typedef struct node *NODE;
                    NODE getnode()
                    {
                    NODE x;
                    x=(NODE)malloc(sizeof(struct node));
                    if(x==NULL)
                     {
                      printf("mem full\n");
                      exit(0);
                     }
                     return x;
                    }
                    void freenode(NODE x)
                    {
                    free(x);
                    }
                    NODE insert_rear(NODE head,int item)
                    {
                    NODE temp,cur;
                    temp=getnode();
                    temp->rlink=NULL;
                    temp->llink=NULL;
                    temp->info=item;
                    cur=head->llink;
                    temp->llink=cur;
                    cur->rlink=temp;
                    head->llink=temp;
                    temp->rlink=head;
```

```
head->info=head->info+1;
return head;
}
NODE insert_leftpos(int item,NODE head)
{
NODE temp,cur,prev;
if(head->rlink==head)
{
printf("list empty\n");
return head;
}
cur=head->rlink;
while(cur!=head)
{
if(item==cur->info)break;
cur=cur->rlink;
}
if(cur==head)
{
 printf("key not found\n");
 return head;
 }
 prev=cur->llink;
 printf("enter towards left of %d=",item);
 temp=getnode();
 scanf("%d",&temp->info);
 prev->rlink=temp;
 temp->llink=prev;
 cur->llink=temp;
 temp->rlink=cur;
 return head;
}
NODE delete_all_key(int item,NODE head)
{
NODE prev,cur,next;
int count;
   if(head->rlink==head)
    {
     printf("LE");
     return head;
     }
count=0;
cur=head->rlink;
```

```
while(cur!=head)
{
  if(item!=cur->info)
  cur=cur->rlink;
  else
 {
  count++;
  prev=cur->llink;
  next=cur->rlink;
  prev->rlink=next;
  next->llink=prev;
  freenode(cur);
  cur=next;
 }
}
if(count==0)
  printf("key not found");
  else
 printf("key found at %d positions and are deleted\n", count);

return head;
}
NODE ddelete_rear(NODE head)
{
NODE cur,prev;
if(head->rlink==head)
{
printf("list is empty\n");
return head;
}
cur=head->llink;
prev=cur->llink;
head->llink=prev;
prev->rlink=head;
printf("the node deleted is %d \n",cur->info);
freenode(cur);
return head;
}
void display(NODE head)
{
NODE temp;
if(head->rlink==head)
{
```

```
printf("list empty\n");
return;
}
for(temp=head->rlink;temp!=head;temp=temp->rlink)
printf("%d\n",temp->info);
}
void main()
{
int item,choice,key;
NODE head,tem;
head=getnode();
head->rlink=head;
head->llink=head;
for(;;)
{
printf("\n1.insert_rear  2.insert_key  3.display  4.delete key
5.delete_rear 6.exit\n");
printf("enter the choice : ");
scanf("%d",&choice);
switch(choice)
 {
  case 1:printf("enter the item : ");
                scanf("%d",&item);
                head=insert_rear(head,item);
                break;
  case 2:printf("enter the key item : ");
                scanf("%d",&item);
                head=insert_leftpos(item,head);
                break;
  case 3:display(head);
                break;
  case 4:printf("enter the key item : ");
                scanf("%d",&item);
                head=delete_all_key(item,head);
                break;
  case 5:head=ddelete_rear(head);
                      break;
  default:exit(0);
                 break;
  }
 }
}
```

OUTPUT:

```
1.insert_rear  2.insert_key  3.display  4.delete key  5.delete_rear
 6.exit
enter the choice : 1
enter the item : 12

1.insert_rear  2.insert_key  3.display  4.delete key  5.delete_rear
 6.exit
enter the choice : 1
enter the item : 23

1.insert_rear  2.insert_key  3.display  4.delete key  5.delete_rear
 6.exit
enter the choice : 2
enter the key item : 12
enter towards left of 12=11

1.insert_rear  2.insert_key  3.display  4.delete key  5.delete_rear
 6.exit
enter the choice : 3
11
12
23

1.insert_rear  2.insert_key  3.display  4.delete key  5.delete_rear
 6.exit
enter the choice : 2
enter the key item : 11
enter towards left of 11=10

1.insert_rear  2.insert_key  3.display  4.delete key  5.delete_rear
 6.exit
enter the choice : 3
10
11
12
23

1.insert_rear  2.insert_key  3.display  4.delete key  5.delete_rear
 6.exit
enter the choice : 4
enter the key item : 23
key found at 1 positions and are deleted

1.insert_rear  2.insert_key  3.display  4.delete key  5.delete_rear
 6.exit
enter the choice : 3
10
11
12

1.insert_rear  2.insert_key  3.display  4.delete key  5.delete_rear
 6.exit
enter the choice : 6

[Program finished]
```

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.

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

                    struct node{
                            struct node *left;
                            int value;
                            struct node *right;
                    };

                    typedef struct node *NODE;

                    NODE getNode(){
                            NODE temp;
                            temp = (NODE)malloc(sizeof(struct node));
                            return temp;
                    }

                    NODE insert(NODE root){
                            int value;
                            NODE temp,curr,prev;
                            temp = getNode();
                            printf("Enter the value:\n");
                            scanf("%d",&value);
                            temp->value = value;
                            temp->left = NULL;
                            temp->right = NULL;
                            if(root==NULL){
                                    return temp;
                            }
                            curr = root;
                            prev = NULL;
                            while(curr!=NULL){
                                    prev = curr;
                                    if(value<curr->value){
                                            curr = curr->left;
                                    }else{
                                            curr = curr->right;
```

```
                }
        }
        if(value<prev->value){
                prev->left = temp;
        }else{
                prev->right = temp;
        }
        return root;
}

void display(NODE root,int i){
        int j;
        if(root!=NULL){
                display(root->right,i+1);
                for(j=0;j<i;j++){
                        printf(" ");
                }
                printf("%d\n",root->value);
                display(root->left,i+1);
        }
}

void preOrder(NODE root){
        if(root==NULL){
                return;
        }
        printf("%d ",root->value);
        preOrder(root->left);
        preOrder(root->right);
}

void inOrder(NODE root){
        if(root == NULL){
                return;
        }
        inOrder(root->left);
        printf("%d ",root->value);
        inOrder(root->right);
}

void postOrder(NODE root){
        if(root == NULL){
                return;
```

```
        }
        postOrder(root->left);
        postOrder(root->right);
        printf("%d ",root->value);
}

int main(){
        int chq;NODE root = NULL;
        while(1){
                printf("Enter the choice:\t1-Insert\t2-Display\t3-
Preorder\t 4-Inorder\t5-Postorder\t6-Exit\n");
                scanf("%d",&chq);
                switch(chq){
                        case 1:
                                root = insert(root);
                                break;
                        case 2:
                                if(root==NULL){
                                        printf("Tree is empty\n");
                                }else{
                                        display(root,0);
                                }
                                break;
                        case 3:
                                if(root==NULL){
                                        printf("Tree is empty\n");
                                }else{
                                        preOrder(root);
                                        printf("\n");
                                }
                                break;
                        case 4:
                                if(root==NULL){
                                        printf("Tree is empty\n");
                                }else{
                                        inOrder(root);
                                        printf("\n");
                                }
                                break;
                        case 5:
                                if(root==NULL){
                                        printf("Tree is empty\n");
                                }else{
```

```
                                        postOrder(root);
                                        printf("\n");
                                    }
                                    break;
                                case 6:
                                    return 0;
                            }
                        }
                    }
```

OUTPUT:

```
Enter the choice:       1-Insert        2-Display       3-Preorder
4-Inorder       5-Postorder     6-Exit
1
Enter the value:
45
Enter the choice:       1-Insert        2-Display       3-Preorder
4-Inorder       5-Postorder     6-Exit
1
Enter the value:
34
Enter the choice:       1-Insert        2-Display       3-Preorder
4-Inorder       5-Postorder     6-Exit
1
Enter the value:
23
Enter the choice:       1-Insert        2-Display       3-Preorder
4-Inorder       5-Postorder     6-Exit
1
Enter the value:
12
Enter the choice:       1-Insert        2-Display       3-Preorder
4-Inorder       5-Postorder     6-Exit
2
45
 34
  23
   12
Enter the choice:       1-Insert        2-Display       3-Preorder
4-Inorder       5-Postorder     6-Exit
3
45 34 23 12
Enter the choice:       1-Insert        2-Display       3-Preorder
4-Inorder       5-Postorder     6-Exit
4
12 23 34 45
Enter the choice:       1-Insert        2-Display       3-Preorder
4-Inorder       5-Postorder     6-Exit
5
12 23 34 45
Enter the choice:       1-Insert        2-Display       3-Preorder
4-Inorder       5-Postorder     6-Exit
6

[Program finished]
```