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

(Autonomous Institution under VTU)

BENGALURU-560019

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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 **XYZ (1BM19CS000)** 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.

Signature of the Guide

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F Laboratory Plan *(if applicable)*

Lab Program	Unit #	Program Details
1	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
2	1	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)
3	2	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
4	2	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
5	3	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) Display the contents of the linked list.
6	3	WAP to Implement Singly Linked List with following operations a) Create a linked list. b) Deletion of first element, specified element and last element in the list. c) Display the contents of the linked list.
7	3	WAP Implement Single Link List with following operations a) Sort the linked list. b) Reverse the linked list. c) Concatenation of two linked lists
8	3	WAP to implement Stack & Queues using Linked Representation
9	4	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. c) Display the contents of the list
10	5	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

```c
#include<stdio.h>
int stack[100],choice,n,top,x,i;
void push(void);
void pop(void);
void display(void);
int main()
{
    //clrscr();
    top=-1;
    printf("\n Enter the size of STACK[MAX=100]:");
    scanf("%d",&n);
    printf("\n\t STACK OPERATIONS USING ARRAY");
    printf("\n\t--------------------------------");
    printf("\n\t 1.PUSH\n\t 2.POP\n\t 3.DISPLAY\n\t 4.EXIT");
    do
    {
        printf("\n Enter the Choice:");
        scanf("%d",&choice);
        switch(choice)
        {
            case 1:
            {
                push();
                break;
            }
            case 2:
            {
                pop();
                break;
            }
            case 3:
            {
                display();
                break;
            }
            case 4:
            {
                printf("\n\t EXIT POINT ");
                break;
            }
            default:
            {
                printf ("\n\t Please Enter a Valid Choice(1/2/3/4)");
            }

```

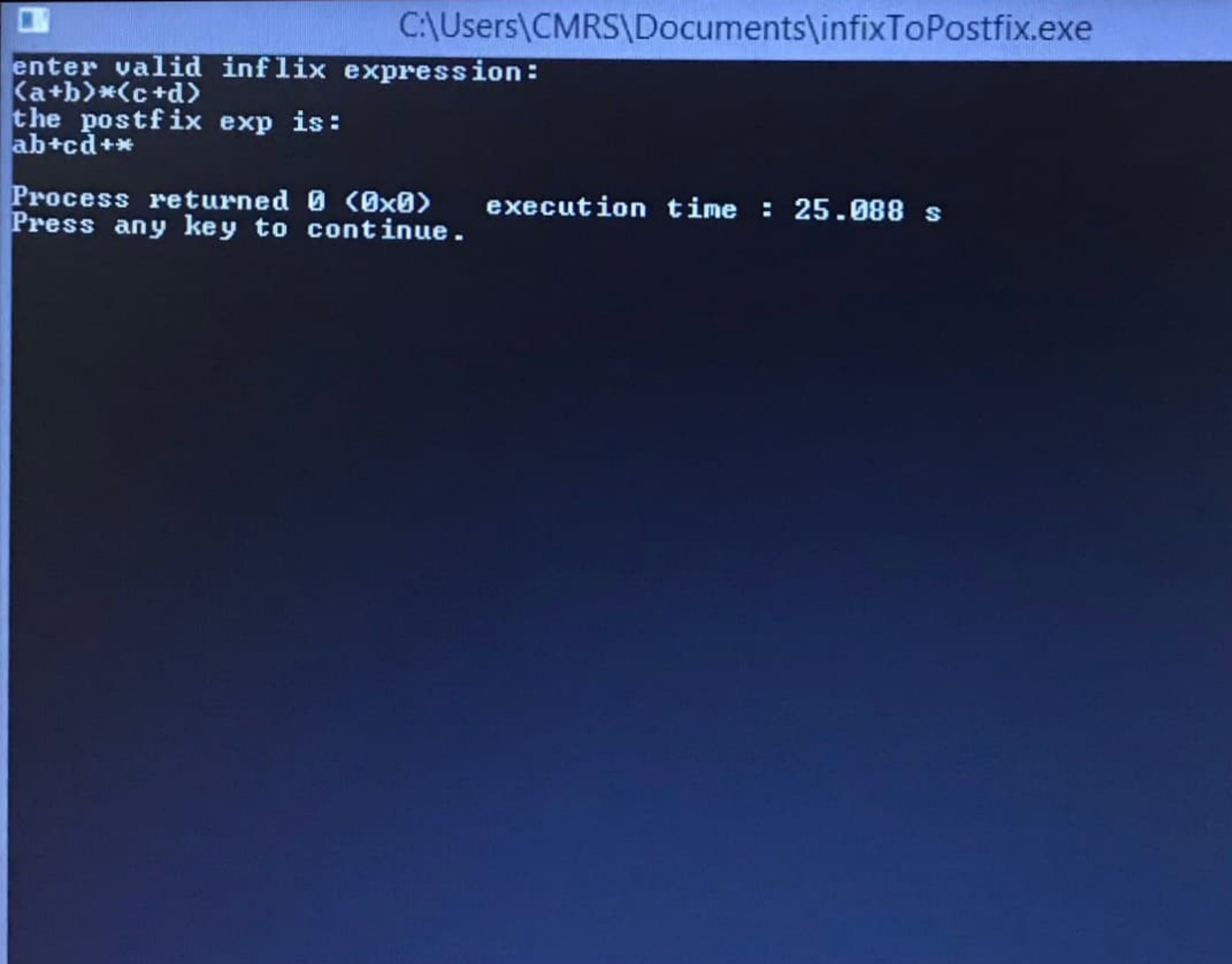
```
    while(choice!=4);
    return 0;
}
void push()
{
    if(top>=n-1)
    {
        printf("\n\tSTACK is over flow");

    }
    else
    {
        printf(" Enter a value to be pushed:");
        scanf("%d",&x);
        top++;
        stack[top]=x;
    }
}
void pop()
{
    if(top<=-1)
    {
        printf("\n\t Stack is under flow");
    }
    else
    {
        printf("\n\t The popped elements is %d",stack[top]);
        top--;
    }
}
void display()
{
    if(top>=0)
    {
        printf("\n The elements in STACK \n");
        for(i=top; i>=0; i--)
            printf("\n%d",stack[i]);
        printf("\n Press Next Choice");
    }
    else
    {
        printf("\n The STACK is empty");
    }

}
```

```
Enter the size of STACK[MAX=100]:3

        STACK OPERATIONS USING ARRAY
        ----------------------------

         1.PUSH
         2.POP
         3.DISPLAY
         4.EXIT
Enter the Choice:1
Enter a value to be pushed:20

Enter the Choice:1
Enter a value to be pushed:30

Enter the Choice:1
Enter a value to be pushed:40

Enter the Choice:3

The elements in STACK

40
30
20
 Press Next Choice
Enter the Choice:2

        The popped elements is 40
Enter the Choice:3

The elements in STACK

30
20
 Press Next Choice
Enter the Choice:_
```

```
Enter the Choice:1
Enter a value to be pushed:30

Enter the Choice:1
Enter a value to be pushed:40

Enter the Choice:3

The elements in STACK

40
30
20
Press Next Choice
Enter the Choice:1

      STACK is over flow
Enter the Choice:2

        The popped elements is 40
Enter the Choice:2

        The popped elements is 30
Enter the Choice:2

        The popped elements is 20
Enter the Choice:2

        Stack is under flow
Enter the Choice:_
```

```c
#include<stdio.h>
#include<string.h>
#include<process.h>
int F(char symbol)
{
switch(symbol)
{
case'+':
case'-':return 2;
case'*':
case'/':return 4;
case'^':
case'$':return 5;
case'(':return 0;
case'#':return -1;
default:return 8;
}
}
int G(char symbol)
{
switch(symbol)
{
case'+':
case'-':return 1;
case'*':
case'/':return 3;
case'^':
case'$':return 6;
case'(':return 9;
case')':return 0;
default:return 7;
}
}
void infix_postfix(char infix[],char postfix[])
{
int top,i,j;
char s[30],symbol;
top=-1;
s[++top]='#';
j=0;
for(i=0;i<strlen(infix);i++)
{
symbol=infix[i];
while(F(s[top])>G(symbol))
{
```

```
case'*':
case'/':return 3;
case'^':
case'$':return 6;
case'(':return 9;
case')':return 0;
default:return 7;
}
}
void infix_postfix(char infix[],char postfix[])
{
int top,i,j;
char s[30],symbol;
top=-1;
s[++top]='#';
j=0;
for(i=0;i<strlen(infix);i++)
{
symbol=infix[i];
while(F(s[top])>G(symbol))
{
postfix[j]=s[top--];
j++;
}
if(F(s[top])!=G(symbol))
s[++top]=symbol;
else
top--;
}
while(s[top]!='#')
{
postfix[j++]=s[top--];
}
postfix[j]='\0';
}
void main()
{
char infix[20];
char postfix[20];
printf("enter valid inflix expression:\n");
scanf("%s",infix);
infix_postfix(infix,postfix);
printf("the postfix exp is:\n");
printf("%s\n",postfix);
```


C:\Users\CMRS\Documents\infixToPostfix.exe
enter valid inflix expression:
(a+b)*(c+d)
the postfix exp is:
ab+cd+*
Process returned 0 (0x0)   execution time : 25.088 s
Press any key to continue.

```c
#include<stdio.h>
#include<process.h>
#define SIZE 10
void enQueue(int);
void deQueue();
void display();

int queue[SIZE], front = -1, rear = -1;

void main()
{
   int value, choice;

   while(1){
      printf("\n\n***** MENU *****\n");
      printf("1. Insertion\n2. Deletion\n3. Display\n4. Exit");
      printf("\nEnter your choice: ");
      scanf("%d",&choice);
      switch(choice){
case 1: printf("Enter the value to be insert: ");
scanf("%d",&value);
enQueue(value);
break;
case 2: deQueue();
break;
case 3: display();
break;
case 4: exit(0);
default: printf("\nWrong selection!!! Try again!!!");
      }
   }
}
void enQueue(int value){
   if(rear == SIZE-1)
      printf("\nQueue is Full!!! Insertion is not possible!!!");
   else{
      if(front == -1)
front = 0;
      rear++;
      queue[rear] = value;
      printf("\nInsertion success!!!");
   }
}
```

```c
case 1: printf("Enter the value to be insert: ");
scanf("%d",&value);
enQueue(value);
break;
case 2: deQueue();
break;
case 3: display();
break;
case 4: exit(0);
default: printf("\nWrong selection!!! Try again!!!");
      }
   }
}
void enQueue(int value){
   if(rear == SIZE-1)
      printf("\nQueue is Full!!! Insertion is not possible!!!");
   else{
      if(front == -1)
front = 0;
      rear++;
      queue[rear] = value;
      printf("\nInsertion success!!!");
   }
}
void deQueue(){
   if(front == rear)
      printf("\nQueue is Empty!!! Deletion is not possible!!!");
   else{
      printf("\nDeleted : %d", queue[front]);
      front++;
      if(front == rear)
front = rear = -1;
   }
}
void display(){
   if(rear == -1)
      printf("\nQueue is Empty!!!");
   else{
      int i;
      printf("\nQueue elements are:\n");
      for(i=front; i<=rear; i++)
 printf("%d\t",queue[i]);
   }
}
```

```
***** MENU *****
1. Insertion
2. Deletion
3. Display
4. Exit
Enter your choice: 1
Enter the value to be insert: 20

Insertion success!!!

***** MENU *****
1. Insertion
2. Deletion
3. Display
4. Exit
Enter your choice: 1
Enter the value to be insert: 30

Insertion success!!!

***** MENU *****
1. Insertion
2. Deletion
3. Display
4. Exit
Enter your choice: 1
Enter the value to be insert: 40

Insertion success!!!

***** MENU *****
1. Insertion
2. Deletion
3. Display
4. Exit
Enter your choice: 3

Queue elements are:
20      30      40

***** MENU *****
1. Insertion
2. Deletion
3. Display
4. Exit
Enter your choice: 2

Deleted : 20
```

```
Insertion success!!!

***** MENU *****
1. Insertion
2. Deletion
3. Display
4. Exit
Enter your choice: 1
Enter the value to be insert: 40

Insertion success!!!

***** MENU *****
1. Insertion
2. Deletion
3. Display
4. Exit
Enter your choice: 1
Enter the value to be insert: 50

Queue is Full!!! Insertion is not possible!!!

***** MENU *****
1. Insertion
2. Deletion
3. Display
4. Exit
Enter your choice: 2

Deleted : 20

***** MENU *****
1. Insertion
2. Deletion
3. Display
4. Exit
Enter your choice: 2

Deleted : 30

***** MENU *****
1. Insertion
2. Deletion
3. Display
4. Exit
Enter your choice: 2

Queue is Empty!!! Deletion is not possible!!!
```

```c
#include <stdio.h>
#define size 3
void insertq(int[], int);
void deleteq(int[]);
void display(int[]);

int front =  - 1;
int rear =  - 1;

int main()
{
    int n, ch;
    int queue[size];
    do
    {
        printf("\n\n Circular Queue:\n1. Insert \n2. Delete\n3. Display\n4. Exit");
printf("\n enter your choice:");
        scanf("%d", &ch);
        switch (ch)
        {
            case 1:
                printf("\nEnter number: ");
                scanf("%d", &n);
                insertq(queue, n);
                break;
            case 2:
                deleteq(queue);
                break;
            case 3:
                display(queue);
                break;
        }
    }while (ch != 0);
}


void insertq(int queue[], int item)
{
    if ((front == 0 && rear == size - 1) || (front == rear + 1))
    {
        printf("queue is full");
        return;
    }
    else if (rear ==  - 1)
    {
```

```
53      else
54      {
55          rear++;
56      }
57      queue[rear] = item;
58  }
59
60  void display(int queue[])
61  {
62      int i;
63      printf("\n");
64      if (front > rear)
65      {
66          for (i = front; i < size; i++)
67          {
68              printf("%d ", queue[i]);
69          }
70          for (i = 0; i <= rear; i++)
71              printf("%d ", queue[i]);
72      }
73      else
74      {
75          for (i = front; i <= rear; i++)
76              printf("%d ", queue[i]);
77      }
78  }
79
80  void deleteq(int queue[])
81  {
82      if (front ==  - 1)
83      {
84          printf("Queue is empty ");
85      }
86      else if (front == rear)
87      {
88          printf("\n %d deleted", queue[front]);
89          front =  - 1;
90          rear =  - 1;
91      }
92      else
93      {
94          printf("\n %d deleted", queue[front]);
95          front++;
96      }
```

```
 Circular Queue:
1. Insert
2. Delete
3. Display
4. Exit
 enter your choice:1

Enter number: 20


 Circular Queue:
1. Insert
2. Delete
3. Display
4. Exit
 enter your choice:1

Enter number: 30


 Circular Queue:
1. Insert
2. Delete
3. Display
4. Exit
 enter your choice:1

Enter number: 40


 Circular Queue:
1. Insert
2. Delete
3. Display
4. Exit
 enter your choice:1
```

```
 Circular Queue:
1. Insert
2. Delete
3. Display
4. Exit
 enter your choice:1

Enter number: 50
queue is full

 Circular Queue:
1. Insert
2. Delete
3. Display
4. Exit
 enter your choice:2

 20 deleted

 Circular Queue:
1. Insert
2. Delete
3. Display
4. Exit
 enter your choice:2

 30 deleted

 Circular Queue:
1. Insert
2. Delete
3. Display
4. Exit
 enter your choice:2

 40 deleted

 Circular Queue:
1. Insert
2. Delete
3. Display
4. Exit
 enter your choice:2
Queue is empty

 Circular Queue:
1. Insert
2. Delete
3. Display
4. Exit
 enter your choice:2
Queue is empty
```

```c
#include<stdio.h>
#include<conio.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("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 IF(NODE second,int item)
{
NODE temp;
temp=getnode();
temp->info=item;
temp->link=NULL;
if(second==NULL)
return temp;
```

```
{
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 IR(NODE second,int item)
{
NODE temp,cur;
temp=getnode();
temp->info=item;
temp->link=NULL;
if(second==NULL)
 return temp;
cur=second;
while(cur->link!=NULL)
 cur=cur->link;
cur->link=temp;
return second;
}
NODE delete_rear(NODE first)
{
NODE cur,prev;
```

```
105   prev=NULL;
106   cur=first;
107   while(cur->link!=NULL)
108   {
109   prev=cur;
110   cur=cur->link;
111   }
112   printf("iten deleted at rear-end is %d",cur->info);
113   free(cur);
114   prev->link=NULL;
115   return first;
116   }
117   NODE insert_pos(int item,int pos,NODE first)
118   {
119   NODE temp;
120   NODE prev,cur;
121   int count;
122   temp=getnode();
123   temp->info=item;
124   temp->link=NULL;
125   if(first==NULL && pos==1)
126   return temp;
127   if(first==NULL)
128   {
129    printf("invalid pos\n");
130    return first;
131   }
132   if(pos==1)
133   {
134   temp->link=first;
135   return temp;
136   }
137   count=1;
138   prev=NULL;
139   cur=first;
140   while(cur!=NULL && count!=pos)
141   {
142    prev=cur;
143    cur=cur->link;
144    count++;
145   }
146   if(count==pos)
147   {
148  prev->link=temp;
```

```
160  if(first==NULL || pos<=0)
161  {
162  printf("invalid position \n");
163  return NULL;
164  }
165  if (pos==1)
166  {
167  cur=first;
168   first=first->link;
169  freenode(cur);
170  return first;
171  }
172  prev=NULL;
173  cur=first;
174  count=1;
175  while(cur!=NULL)
176  {
177  if(count==pos)
178  break;  //if found
179  prev=cur;
180  cur=cur->link;
181  count++;
182  }
183  if(count!=pos)
184  {
185    printf("invalid position\n");
186     return first;
187  }
188  if(count!=pos)
189  {
190    printf("invalid position specified\n");
191    return first;
192  }
193
194  prev->link=cur->link;
195   freenode(cur);
196  return first;
197  }
198  NODE reverse(NODE first)
199    {
200      NODE cur,temp;
201      cur=NULL;
202      while(first!=NULL)
203      {
```

```
215         int temp;
216
217 if(first== NULL) {
218   return 0;
219   }
220 else {
221  while(prev!= NULL) {
222
223   cur = prev->link;
224
225   while(cur!= NULL) {
226
227         if(prev->info > cur->info) {
228   temp = prev->info;
229   prev->info = cur->info;
230   cur->info = temp;
231    }
232    cur = cur->link;
233   }
234   prev= prev->link;
235             }
236        }
237        return first;
238    }
239 NODE des(NODE first)
240 {
241     NODE prev=first;
242     NODE cur=NULL;
243        int temp;
244
245 if(first==NULL) {
246 return 0;
247 }
248 else {
249  while(prev!= NULL) {
250
251  cur = prev->link;
252
253   while(cur!= NULL) {
254
255         if(prev->info < cur->info) {
256   temp = prev->info;
257   prev->info = cur->info;
258   cur->info = temp;
```

```
280         cur->link=second;
281         return first;
282     }
283
284     void display(NODE first)
285     {
286      NODE temp;
287      if(first==NULL)
288      printf("list empty cannot display items\n");
289      for(temp=first;temp!=NULL;temp=temp->link)
290       {
291       printf("%d\n",temp->info);
292       }
293     }
294     void main()
295     {
296     int item,choice,pos,element,option,choice2,item1,num;
297     NODE first=NULL;
298     NODE second=NULL;
299
300     for(;;)
301     {
302     printf("\n 1:Insert_front\n 2:Delete_front\n 3:Insert_rear\n 4:Delete_rear\n 5:random_position\n 6:reverse\n 7:sort\n 8.
303     printf("enter the choice\n");
304     scanf("%d",&choice);
305     switch(choice)
306      {
307       case 1:printf("enter the item at front-end\n");
308     scanf("%d",&item);
309     first=insert_front(first,item);
310     break;
311       case 2:first=delete_front(first);
312     break;
313       case 3:printf("enter the item at rear-end\n");
314     scanf("%d",&item);
315     first=insert_rear(first,item);
316     break;
317       case 4:first=delete_rear(first);
318     break;
319      case 5:
320      printf("press 1 to insert or 2 to delete at any desired position \n");
321      scanf("%d",&element);
322      if(element==1){
323              printf("enter the position to insert \n");
```

```
break;
  case 6:
        first=reverse(first);
        break;
  case 7:
        printf("press 1 for ascending sort and 2 for descending sort:\n");
        scanf("%d",&option);
        if(option==1)
        first=asc(first);
        if(option==2)
        first=des(first);
        break;
  case 8:
        printf("create a second list\n");
        printf("enter the number of elements in second list\n");

        scanf("%d",&num);
         for(int i=1;i<=num;i++){
        printf("\n press 1 to insert front and 2 to insert rear \n");
        scanf("%d",&choice2);

            if(choice2==1){
            printf("enter the item at front-end\n");
      scanf("%d",&item1);
          second=IF(second,item1);
           }

          if(choice2==2){
          printf("enter the item at rear-end\n");
     scanf("%d",&item1);
          second=IR(second,item1);
          }
       }

       first=concate(first,second);
       break;

  case 9:display(first);
break;
 default:exit(0);
break;
 }
}
}
```