THE NEOTIA UNIVERSITY
COMPUTER SCIENCE & ENGINEERING
DATA STRUCTURES

LAB MANUAL
2nd year, Semester - III

THE NEOTIA UNIVERSITY

COMPUTER SCIENCE & ENGINEERING

Program Outcomes	
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
Program Specific Outcomes	
PSO1	**Professional Skills:** The ability to research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity.
PSO2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies.

DATA STRUCTURES LAB SYLLABUS

Recommended Systems/Software Requirements:
Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB RAM and 100MB free disk space. C compiler.

S. No.	List of Experiments
1	Write a C program that uses functions to perform the following: a) Create a singly linked list of integers. b) Delete a given integer from the above linked list. c) Display the contents of the above list after deletion.
2	Write a C program that uses functions to perform the following: a) Create a doubly linked list of integers. b) Delete a given integer from the above doubly linked list. c) Display the contents of the above list after deletion.
3	Write a C program that uses stack operations to convert a given infix expression into its postfix Equivalent, Implement the stack using an array.
4	Write C programs to implement a double ended queue ADT using i) array and ii) doubly linked list respectively.
5	Write a C program that uses functions to perform the following: a) Create a binary search tree of characters. b) Traverse the above Binary search tree recursively in Postorder.
6	Write a C program that uses functions to perform the following: a) Create a binary search tree of integers. b) Traverse the above Binary search tree non recursively in inorder.
7	Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order: a) Insertion sort b) Merge sort
8	Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order: a) Quick sort b) Selection sort
9	i) write a C program to perform the following operation: A) Insertion into a B-tree ii) Write a C program for implementing Heap sort algorithm for sorting a given list of integers in ascending order.
10	Write a C program to implement all the functions of a dictionary (ADT) using hashing.
11	Write a C program for implementing Knuth-Morris- Pratt pattern matching algorithm.
12	Write C programs for implementing the following graph traversal algorithms: a)Depth first traversal b)Breadth first traversal
13	Write a C Program to check whether two given lists are containing the same data.
14	Write a C program to find the largest element in a given doubly linked list.
15	Write a C program to reverse the elements in the stack using recursion.
16	Write a C program to implement stack using linked list.

DATA STRUCTURES LABORATORY

OBJECTIVE:

The objective of this lab is to teach students various data structures and to explain them algorithms for performing various operations on these data structures. This lab complements the data structures course. Students will gain practical knowledge by writing and executing programs in C using various data structures such as arrays, linked lists, stacks, queues, trees, graphs, hash tables and search trees.

OUTCOMES:

Upon the completion of Data Structures practical course, the student will be able to:

1. **Design** and analyze the time and space efficiency of the data structure.
2. **Identity** the appropriate data structure for given problem.
3. **Understand** the applications of data structures.
4. **Choose** the appropriate data structure and algorithm design method for a specified application.
5. **Understand** which algorithm or data structure to use in different scenarios.
6. **Understand** and apply fundamental algorithmic problems including Tree traversals, Graph traversals.
7. **Compare** different implementations of data structures and to recognize the advantages and disadvantages of them.
8. **Write** complex applications using structured programming methods.

EXPERIMENT 1

1.1 OBJECTIVE

1. To create a singly linked list of integers.
2. Delete a given integer from the above linked list.
3. Display the contents of the above list after deletion.

1.2 SOURCE CODE

program to create a single linked list, delete the contents and display the contents

```
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
#include<math.h>
/*declaring a structure to create a node*/
struct node
{
    int data;
    struct node *next;
};
struct node *start;

/* inserting nodes into the list*/
/*function to insert values from beginning of the the single linked list*/
void insertbeg(void)
{
    struct node *nn;
    int a;
    /*allocating implicit memory to the node*/
    nn=(struct node *)malloc(sizeof(struct node));
    printf("enter data:");
    scanf("%d",&nn->data);
    a=nn->data;
    if(start==NULL)          /*checking if List is empty*/
    {
        nn->next=NULL;
        start=nn;
    }
    else
    {
        nn->next=start;
        start=nn;
    }
    printf("%d succ. inserted\n",a);
    return;
}
 /*function to insert values from the end of the linked list*/
```

```
void insertend(void)
{
    struct node *nn,*lp;int b;
    nn=(struct node *)malloc(sizeof(struct node));
    printf("enter data:");
    scanf("%d",&nn->data);
    b=nn->data;
    if(start==NULL)
    {
        nn->next=NULL;
        start=nn;
    }
    else
    {
        lp=start;
        while(lp->next!=NULL)
        {
            lp=lp->next;
        }
        lp->next=nn;
        nn->next=NULL;
    }
    printf("%d is succ. inserted\n",b);
    return;
}
```

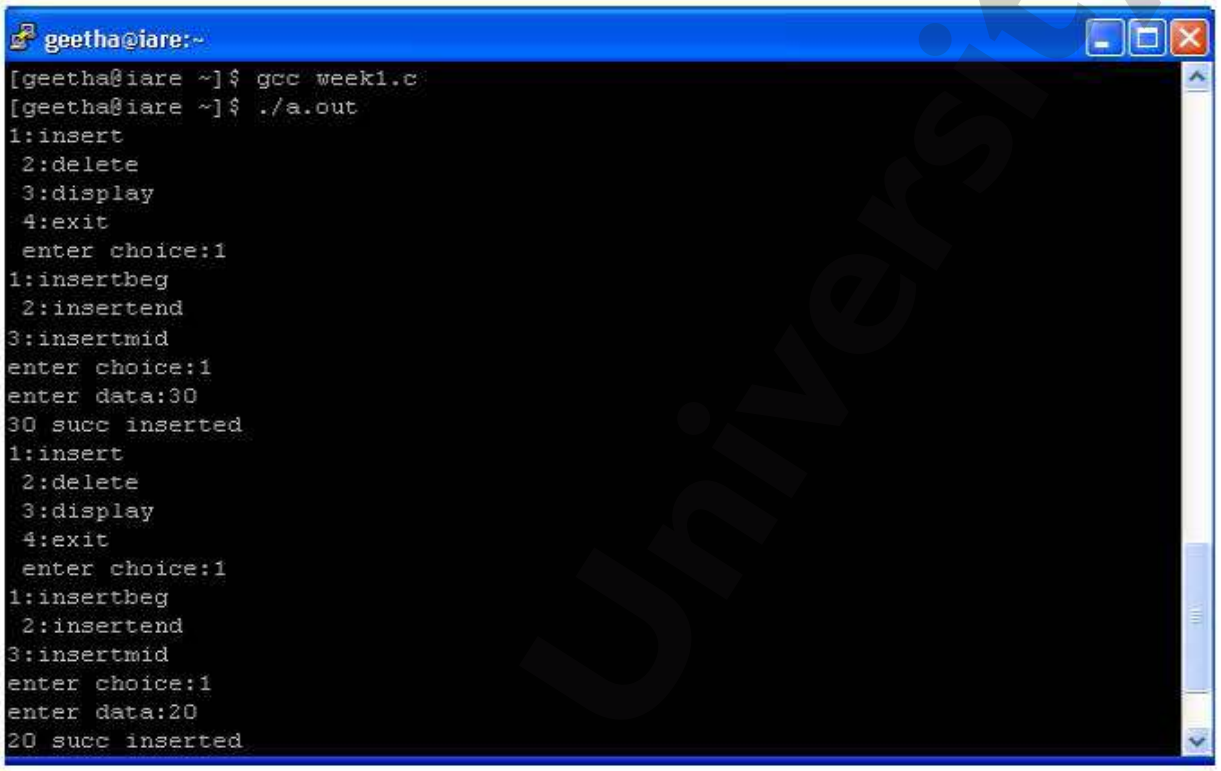
/*function to insert values from the middle of the linked list*/

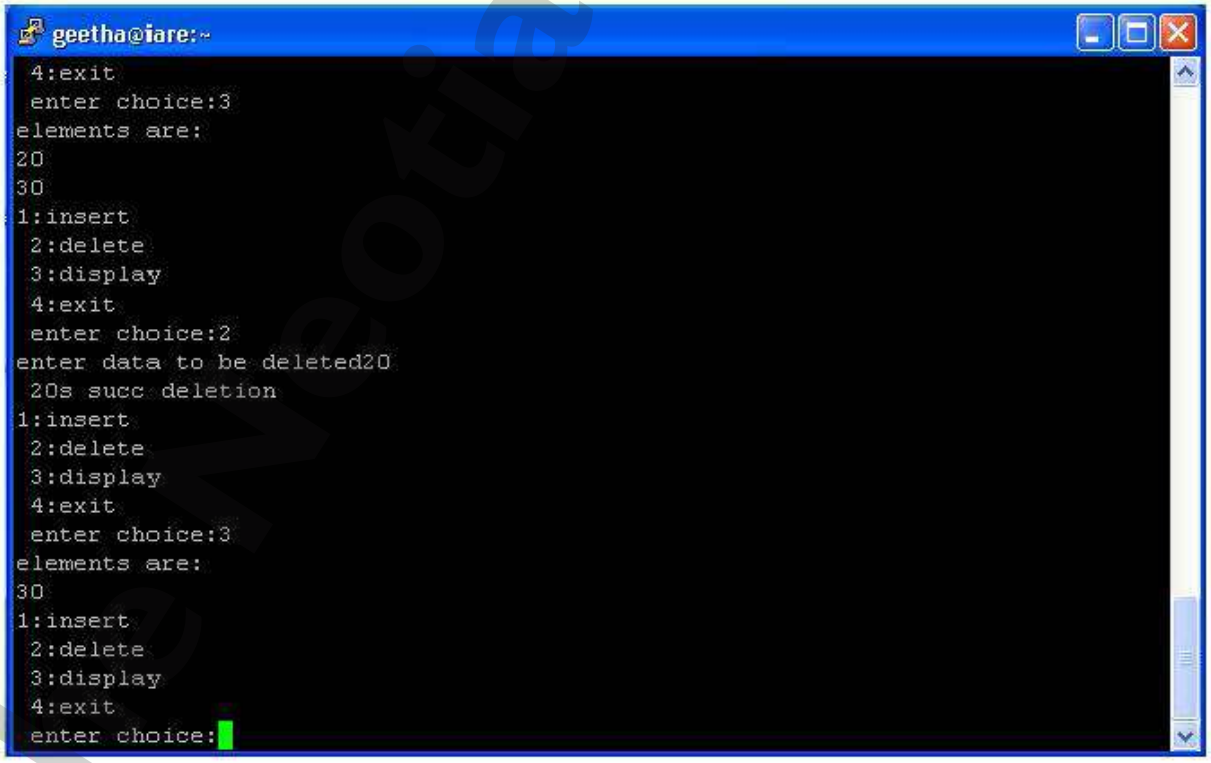
```
void insertmid(void)
{
    struct node *nn,*temp,*ptemp;int x,v;
    nn=(struct node *)malloc(sizeof(struct node));
    if(start==NULL)
    {
        printf("sll is empty\n"); return;
    }
    printf("enter data before which no. is to be inserted:\n");
    scanf("%d",&x);
    if(x==start->data)
    {
        insertbeg();
        return;
    }
    ptemp=start;
    temp=start->next;
    while(temp!=NULL&&temp->data!=x)
    {
        ptemp=temp;
        temp=temp->next;
    }
    if(temp==NULL)
    {
        printf("%d data does not exist\n",x);
    }
    else
    {                                   printf("enter data:"); scanf("%d",&nn->data);
                                        v=nn->data;
                                            ptemp->next=nn;
```

```
                                        nn->next=temp;
                                        printf("%d succ. inserted\n",v);
    }
    return;
}

 /*deletion operation*/
void deletion(void)
{
    struct node *pt,*t;
    int x;
    if(start==NULL)
    {
        printf("sll is empty\n");
       return;
    }
    printf("enter data to be deleted:");
    scanf("%d",&x);
    if(x==start->data)
    {
        t=start;
        /* assigning first node pointer to next nod pointer to delete a data
        from the starting of the node*/
        start=start->next;
        free(t);
        printf("%d is succ. deleted\n",x);
        return;
    }
    pt=start;
    t=start->next;
    while(t!=NULL&&t->data!=x)
    {
        pt=t;t=t->next;
    }
    if(t==NULL)
    {
        printf("%d does not exist\n",x);return;
     }
    else
    {
        pt->next=t->next;
    }
    printf("%d is succ. deleted\n",x);
    free(t);
    return;
}
void display(void)
{
    struct node *temp;
    if(start==NULL)
    {
        printf("sll is empty\n");
        return;
    }
    printf("elements are:\n");
    temp=start;
    while(temp!=NULL)
    {
```

```
                printf("%d\n",temp->data);

temp=temp->next;
            }
            return;
        }
        /* main program*/
        int main()
        {
            int c,a;    start=NULL;
            do
            {
                printf("1:insert\n2:delete\n3:display\n4:exit\nenter choice:");
                scanf("%d",&c);
                switch(c)
                {
                    case 1:
                    printf("1:insertbeg\n2:insert end\n3:insert mid\nenter choice:");
                    scanf("%d",&a);
                    switch(a)
                    {
                         case          1:insertbeg();
                        break; case 2:insertend();
                        break; case 3:insertmid();
                        break;
                    }
                    break;
                    case 2:deletion(); break;
                    case 3:display(); break;
                    case 4:printf("program ends\n");break;
                    default:printf("wrong choice\n");
                    break;
                }
            }while(c!=4);return 0;
        }
```

1.3 INPUT AND OUTPUT





EXPERIMENT 2

2.1 OBJECTIVE

1. Create a doubly linked list of integers.
2. Delete a given integer from the above doubly linked list.
3. Display the contents of the above list after deletion.

2.2 SOURCE CODE

Program to create a double linked list to inserting, deleting and displaying the contents

```
#include<stdio.h>
#include<stdlib.h>
/*declaring a structure to create a node*/
struct node
{
     struct node *prev;
     int data;
     struct node *next;
};
struct node *start,*nt;
/* inserting nodes into the list*/
/*function to insert values from beginning of the the double linked list*/

void insertbeg(void)
{
    int a;
    struct node *nn,*temp;
/*allocating implicit memory to the node*/
    nn=(struct node *)malloc(sizeof(struct node));
    printf("enter data:");
    scanf("%d",&nn->data);
    a=nn->data;
   if(start==NULL)     /*checking if List is empty*/
   {
      nn->prev=nn->next=NULL;
      start=nn;
   }
   else
   {
      nn->next=start;
      nn->prev=NULL;
      start->prev=nn;
      start=nn;
   }
   printf("%d succ inserted \n",a);
```

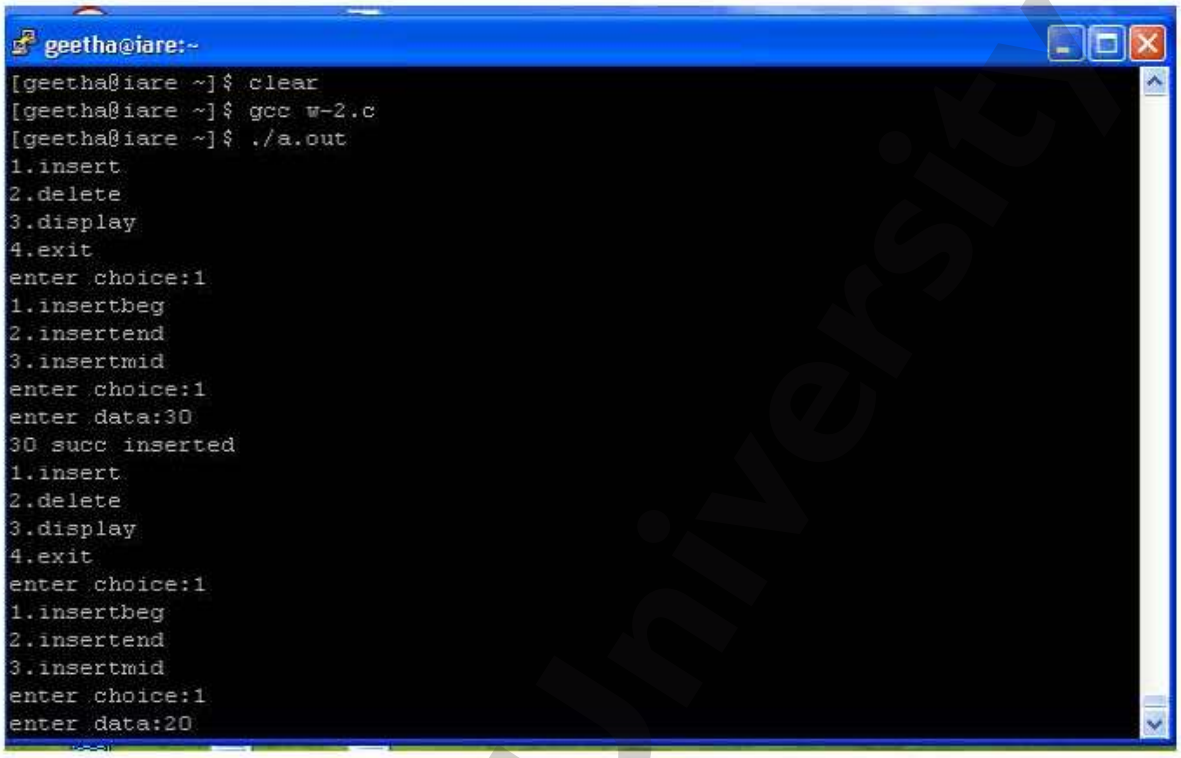
```
}
/*function to insert values from the end of the linked list*/

void insertend(void)
{
    int b;
    struct node *nn,*lp;
    nn=(struct node *)malloc(sizeof(struct node));
    printf("enter data:");
    scanf("%d",&nn->data);
    b=nn->data;
    if(start==NULL)
   {
/* assigning first node pointer to next nod pointer to delete a data from the starting
   of the node*/

       nn->prev=nn->next=NULL;
       start=nn;
   }
   else
  {
     lp=start;
    while(lp->next!=NULL)
    {
       lp=lp->next;
    }
    nn->prev=lp;
    lp->next=nn;
    nn->next=NULL;
  }
 printf("%d succ inserted\n",b);
}
/*function to insert values from the middle of the linked list*/

void insertmid(void)
{
    struct node *nn,*temp,*ptemp;
    int x,c;
   if(start==NULL)
    {
       printf("dll is empty\n");
      return;
    }
    printf("enter data before which nn is to be inserted\n");
    scanf("%d",&x);
    if(x==start->data)
    {
      insertbeg();
    }
    ptemp=start;
    temp=start->next;
    while(temp->next!=NULL&&temp->data!=x)
    {
      ptemp=temp;
      temp=temp->next;
    }
    if(temp==NULL)
    {
```

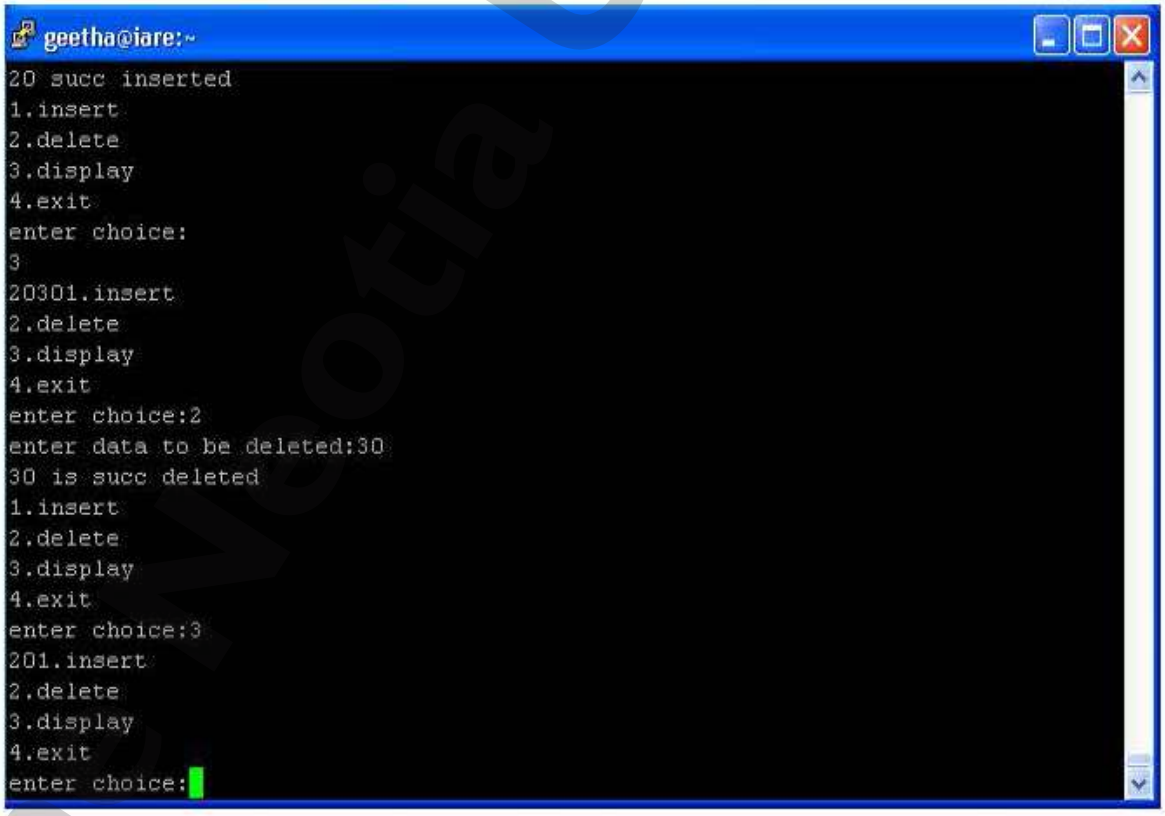
```
        printf("%d does not exit\n",x);
      }
      else
      {
/*allocating implicit memory to the node*/

        nn=(struct node *)malloc(sizeof(struct node));
        printf("enter data");
        scanf("%d",&nn->data);
       c=nn->data;
       nn->data;
      nn->prev=ptemp
      ; nn->next=temp;
      ptemp->next=nn;
      temp->prev=nn;
      printf("%d succ inserted \n",c);
   }
}
/*end of insertion operation*/
/*deletion operation*/
void deletion()
{
    struct node *pt,*t;
    int x;
    t=pt=start;
    if(start==NULL)
    {
        printf("dll is empty\n");
    }
    printf("enter data to be deleted:");
   scanf("%d",&x);
   if(x==start->data)
   {
     t=start;
     t=t->next;
     free(start)
     ; start=t;
     start=pt;
   }
   else
  {
    while(t->next!=NULL&&t->data!=x)
    {
      pt=t;   /*logic for traversing*/
      t=t->next;
    }
    if(t->next==NULL&&t->data==x)
    {
     free(t);
     pt->next=NULL;
    }
   else
   {
     if(t->next==NULL&&t->data!=x)
        printf("data not found");
    else
     {
```

```
        pt->next=t->next;
        free(t);
      }
    }
    printf("%d is succ deleted\n",x);
   }
}
/*end of deletion operation*/
/*display operation*/
void display()
{
    struct node *temp;
    if(start==NULL)
    printf("stack is empty ");
    temp=start;
    while(temp->next!=NULL)
    {
       printf("%d",temp->data);
       temp=temp->next;
    }
    printf("%d",temp->data);
 }
/*end of display operation*/
/*main program*/
int main()
{
    int c,a;
   start=NULL;
   do
   {
      printf("1.insert\n2.delete\n3.display\n4.exit\nenter choice:");
      scanf("%d",&c);
      switch(c)
      {
        case 1:printf("1.insertbeg\n2.insertend\n3.insertmid\nenter choice:");
               scanf("%d",&a);
               switch(a)
               {
                    case 1:insertbeg();
                           break;
                    case 2:insertend();
                           break;
                    case 3:insertmid();
                           break;
               }
              break;
       case
       2:deletion();
               break;
        case 3:display();
               break;
      case 4:printf("program ends\n");
             break;
      default:printf("wrong choice\n");
             break;
    }
  }
   while(c!=4);
```

```
return 0; }
```

2.3 INPUT AND OUTPUT





EXPERIMENT 3

3.1 OBJECTIVE

To convert a given infix expression into its postfix Equivalent, Implement the stack using an array.

3.2 SOURCE CODE:

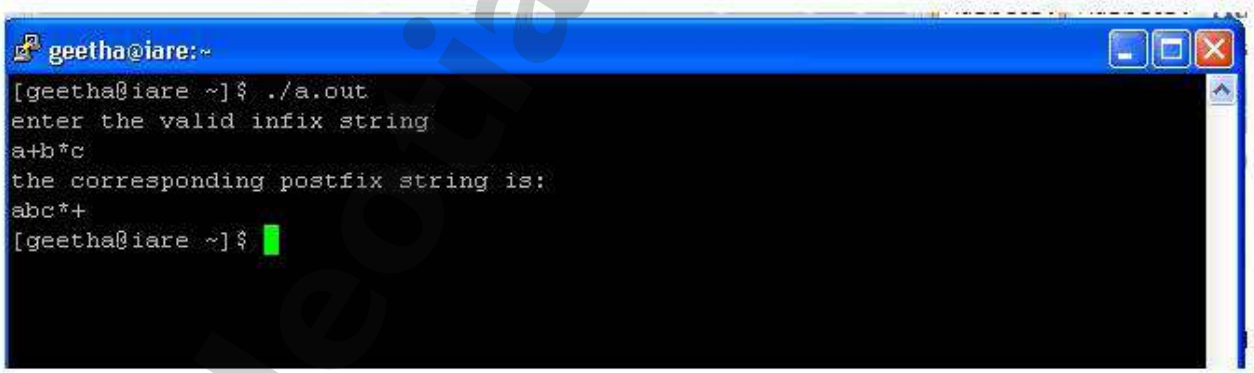
Program to convert a given infix expression into its postfix Equivalent, Implement the stack using an array.

```
#include<stdio.h>
#include<string.h>
#include<stdlib.h>
#define MAX 20
char stack[MAX];
int top=1;
char pop(); /*declaration of pop function*/
void push(char item); /*declaration of push function*/
int pred(char symbol) /*checking the precedence*/
{
  switch(symbol) /*assigning values for symbols*/
  {
     case '+':
     case '-': return 2;
     break;
     case '*':
     case '/': return 4;
     break;
     case '^':return 6;
     break;
     case '(':
     case ')':
     case '#':return 1;
    break;
  }
}
int(isoperator(char symbol)) /*assigning operators*/
{
  switch(symbol)
  {
      case '+':
      case '*':
```

```
    case '-':
    case '/':
    case '^':
    case '(':
    case ')':return 1;
    break;
    default:return 0;
  }
 }
/*converting infix to postfix*/
void convertip(char infix[],char postfix[])
{
 int i,symbol,j=0;
 stack[++top]='#';
 for(i=0;i<strlen(infix);i++)
 {
  symbol=infix[i];
  if(isoperator(symbol)==0)
  {
    postfix[j]=symbol;
     j++;
  }
  else
  {
    if(symbol=='(')
    push(symbol); /*function call for pushing elements into the stack*/
    else if(symbol==')')
    {
      while(stack[top]!='(')
      {
        postfix[j]=pop();
        j++;
      }
      pop();    /*function call for popping elements into the stack*/
   }
   else
   {
     if(prcd(symbol)>prcd(stack[top]))
     push(symbol);
     else
     {
       while(prcd(symbol)<=prcd(stack[top]))
       {
         postfix[j]=pop();
          j++;
       }
       push(symbol);
     }/*end of else loop*/
    }/*end of else loop*/
   } /*end of else loop*/
  }/*end of for loop*/
  While (stack[top]!='#')
  {
    postfix[j]=pop();
     j++;
  }
  postfix[j]='\0'; /*null terminate string*/ }
```

```
/*main program*/
void main()
 {
     char infix[20],postfix[20];
     printf("enter the valid infix string \n");
     gets(infix);
     convertip(infix,postfix);   /*function call for converting infix to postfix */
     printf("the corresponding postfix string is:\n");
    puts(postfix);
 }
/*push operation*/
void push(char item)
{
   top++;
   stack[top]=item
   ;
 }
/*pop operation*/
char pop()
{
   char a;
   a=stack[top]
   ; top--;
   return a;
 }
```

3.3 INPUT AND OUTPUT



EXPERIMENT 4

4.1 OBJECTIVE

1. To implement a double ended queue ADT using arrays.
2. To implement a double ended queue ADT using doubly linked list.

4.2 SOURCE CODE:

Programs to implement a double ended queue ADT using arrays

```
#include<stdio.h>
#define SIZE 30
int
dequeue[SIZE];
int front=-1,rear=-1; /* initializing front and rear*/
void insertrear(int);
void deletefront();
void insertfront(int);
void deleterear();
void traverse();
/*main program*/
void main()
{
     int choice,item;
     char ch;
     do
     {
        printf("\n options are");
        printf("\n press 1 to insert at rear");
        printf("\n press 2 to delete at
        front"); printf("\n press 3 to insert at
        front"); printf("\n press 4 to delete
        at rear"); scanf("%d",&choice);
        switch(choice)    /*switch case*/
        {
            case 1: printf("\n enter the element:");
                    scanf("%d",&item);
                    insertrear(item); /*function call for inserting element at rear*/
                    break;
            case 2: deletefront(); /*function call for deleting element at front*/

break;
            case 3: printf("enter the element:");
                    scanf("%d",&item);
                    insertfront(item); /*function call for inserting element at front*/
                    break;
           case 4: deleterear();/*function call for deleting element at rear*/
                    break;
           case 5: traverse(); /*traversing the list*/
                    break;
          default : printf("wrong choice");
        } /*end of switch case*/
        printf("\n do you want to perform more operations?(Y/N):");
        fflush(stdin);
        scanf(" %c",&ch);
    } while(ch=='Y'||ch=='y');
}
```

```
/*insertion at rear*/
void insertrear(int value) /*function definition*/
{
   if(rear==(SIZE-1))
   {
      printf("overflow");
       return;
   }
   else
   {
      if(front==-1)
      {
           printf("underflow so front will be modified");
          front=front+1;
      }
      rear=rear+1;
      dequeue[rear]=value;
   }
}

/*deletion at front*/
void deletefront() /*function definition*/
{
    int value;
    if(front==-1)
    {
        printf("queue is already
        empty"); value=-1;
    }
    else
    {
      value=dequeue[front];
      if(front==rear)
      {
          printf("queue contains only one
          item"); rear=-1;
          front=-1;
      }
      else
      front=front+1;
   }
```

```
  printf("removed element from front is %d",value);
}

/*insertion at front*/
void insertfront(int value) /*function definition*/
{
    if(front==0)
    {
       printf("front is at the beginning");
      printf("here insertion is not possible");
      return;
    }
    else
   {
     if(front==-1)
    {
       printf("queue is empty so both pointers will modified");
      front=front+1;
      rear=rear+1;
     }
     else
    {
      front=front-1;
    }
    dequeue[front]=value;
  }
}

/*deletion at rear*/
void deleterear() /*function definition*/
{
    int value;
    if(front==-1
    )
    {
                                                    else
                                          printf("queue is already empty"); return;
    }
      value=dequeue[rear];
      if(rear==front)
      {
       printf("queue contains only one item");
       printf("rear and front will be modified");
       rear=-1;
       front=-1;
      }
      else
      {
        rear=rear-1;
      }
  }
  printf("\n the removed element from rear is:%d",value);
}
/*traverse operation*/
void traverse() /*function definition*/
{
     int i;
```

```
            if(front==-1)
            {
               printf("queue empty");
               return;
            }
            else
            {
               printf("\n value in the queue are as follow:");
              for(i=front;i<=rear;i++)
              printf("\n%d",dequeue[i]);
            }
          }
```

program to implement double ended queue adt using doubly linked list

```
#include <stdio.h>
 #include <stdlib.h>
/*declaring a structure to create a node*/

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

 struct node *head = NULL, *tail = NULL;

 struct node * createNode(int data)
{
/*allocating implicit memory to the node*/

     struct node *newnode = (struct node *)malloc(sizeof (struct node));
     newnode->data = data;
     newnode->next = newnode->prev = NULL;
     return (newnode);
 }

  /* create sentinel(dummy head & tail) that helps us to do insertion and deletion
   operation at front and rear so easily. And these dummy head and tail wont get deleted
   till the end of execution of this program */

 void createSentinels() /*creating a head and tail*/
 {
     head = createNode(0);
     tail = createNode(0);
     head->next = tail;
     tail->prev = head;
 }

 /* insertion at the front of the queue */
 void enqueueAtFront(int data)
 {
     struct node *newnode, *temp;
     newnode = createNode(data);
     temp = head->next;
     head->next = newnode;
     newnode->prev = head;
     newnode->next = temp;
     temp->prev = newnode;
```

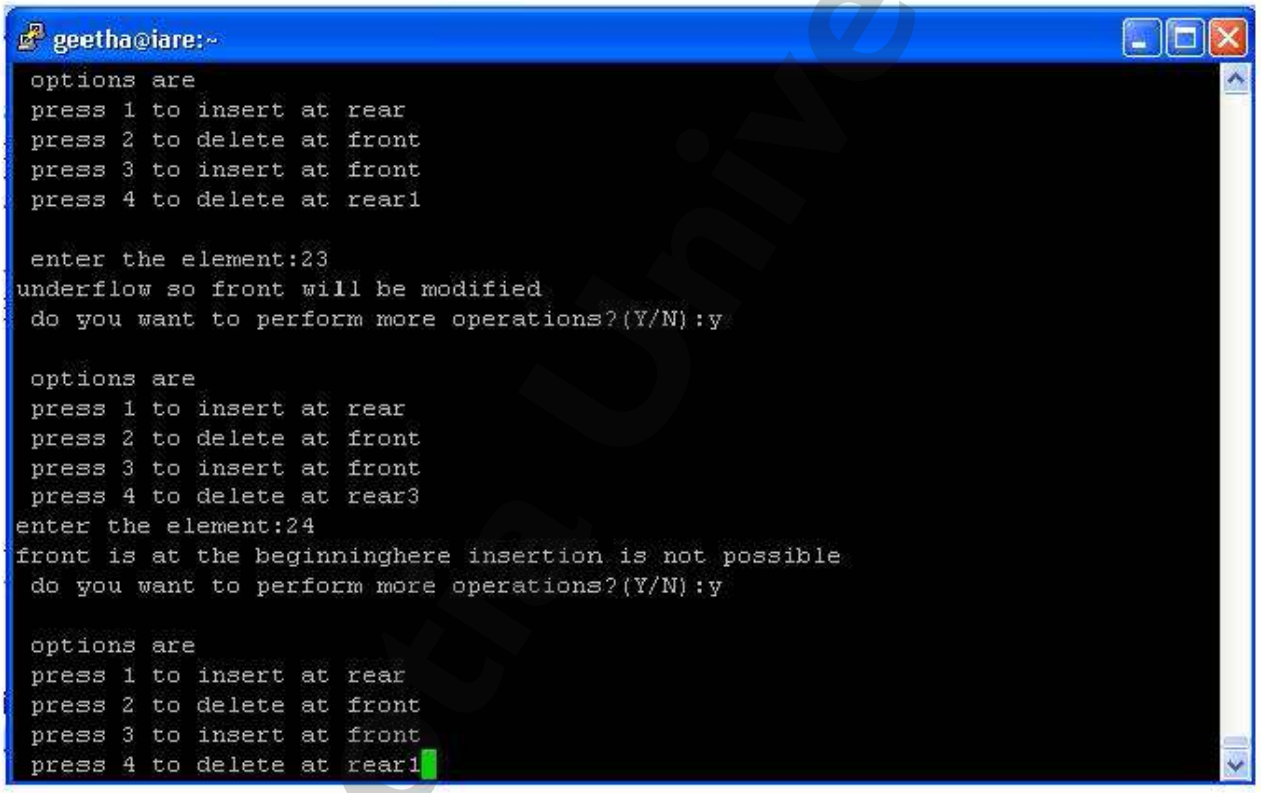
```
}

/*insertion at the rear of the queue */
void enqueueAtRear(int data)
{
    struct node *newnode, *temp;
    newnode  = createNode(data);
    temp = tail->prev;
    tail->prev = newnode;
    newnode->next = tail;
    newnode->prev = temp;
    temp->next = newnode;
}

/* deletion at the front of the queue */
void dequeueAtFront()
{
    struct node *temp;
    if (head->next == tail)
    {
                                        printf("Queue is empty\n");
    }
    Else                                temp = head->next;
    {
                                        head->next = temp->next;

                                        temp->next->prev = head; free(temp);


     }

     return;
}


/* deletion at the rear of the queue */

void dequeueAtRear()
{
    struct node *temp;
    if (tail->prev == head)
    {
                                        printf("Queue is empty\n");
    }
    Else                                temp = tail->prev; tail->prev = temp->prev;
                                        temp->prev->next = tail; free(temp);
     {


    }
    return;
}

/* display elements present in the queue */
void display()
{
    struct node *temp;
```

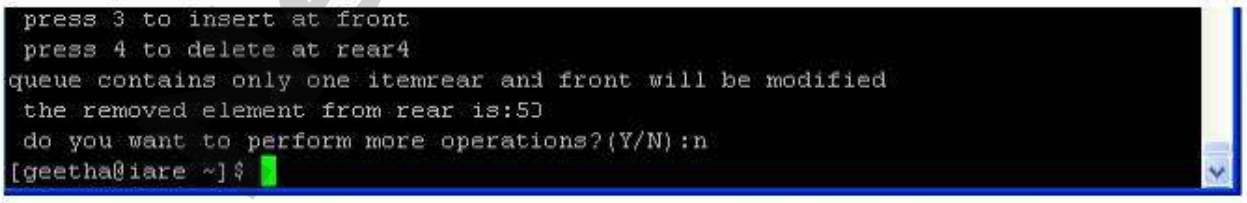
```
    if (head->next == tail)
     {

          printf("Queue is empty\n");
          return;
    }

    temp = head->next;
    while (temp != tail)
    {
          printf("%-3d", temp->data);
          temp = temp->next;
    }
    printf("\n");
 }

/*main program*/
 int main()
 {
    int data, ch;
    createSentinels();
    while (1)
    {
          printf("1. Enqueue at front\n2. Enqueue at rear\n");
          printf("3. Dequeue at front\n4. Dequeue at
          rear\n"); printf("5. Display\n6. Exit\n");
          printf("Enter your choice:");
          scanf("%d", &ch);
          switch (ch) /*switch case*/
          {
               case 1:
                    printf("Enter the data to insert:");
                    scanf("%d", &data);
                    enqueueAtFront(data);
                    break;

               case 2:
                    printf("Enter ur data to insert:");
                    scanf("%d", &data);
                    enqueueAtRear(data);
                    break;

               case 3:
                    dequeueAtFront();
                    break;

               case 4:
                    dequeueAtRear();
                    break;

               case 5:
                    display();
                    break;

               case 6:
                    exit(0);

               default:
```

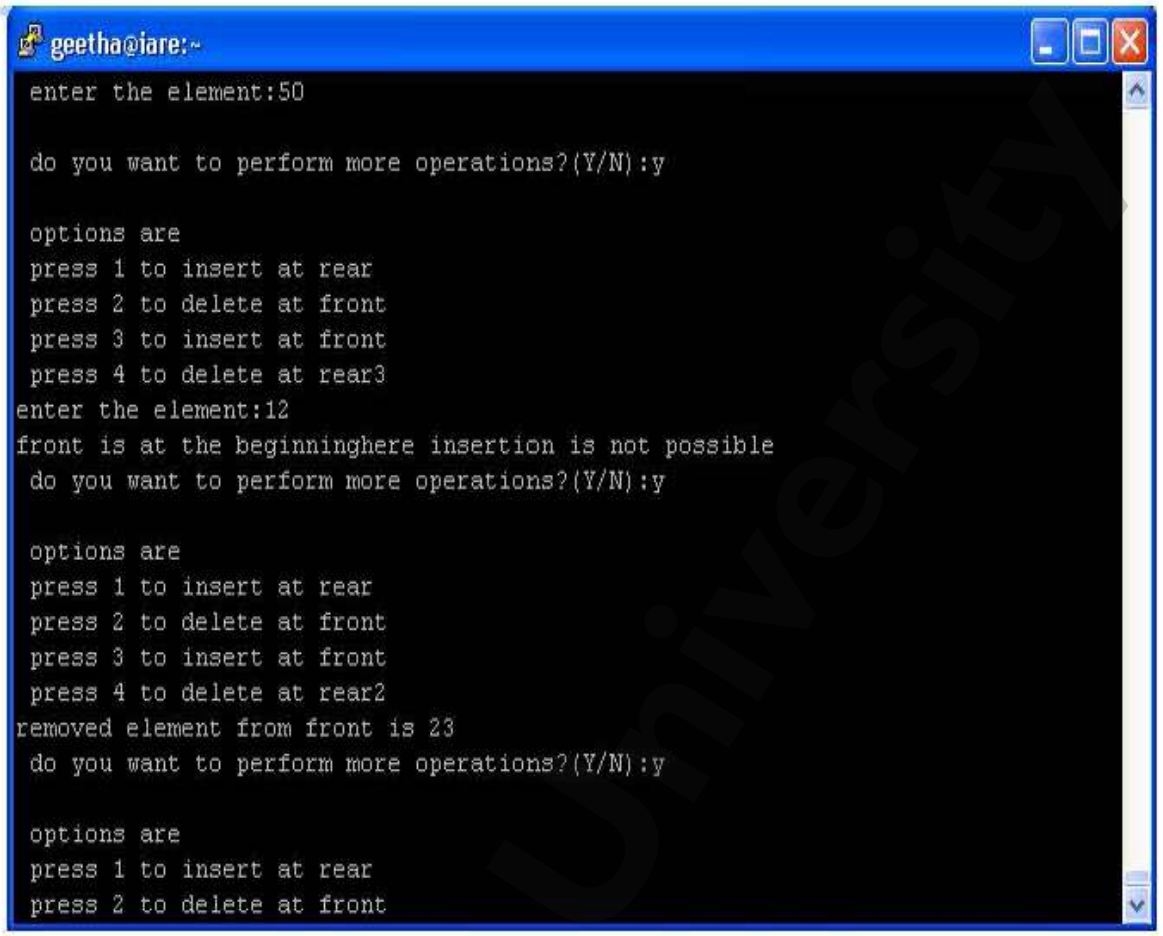
```
                printf("Pls. enter correct option\n");
                break;
        } /*end of switch case*/

    }
    return 0;
}
```

4.3 INPUT AND OUTPUT

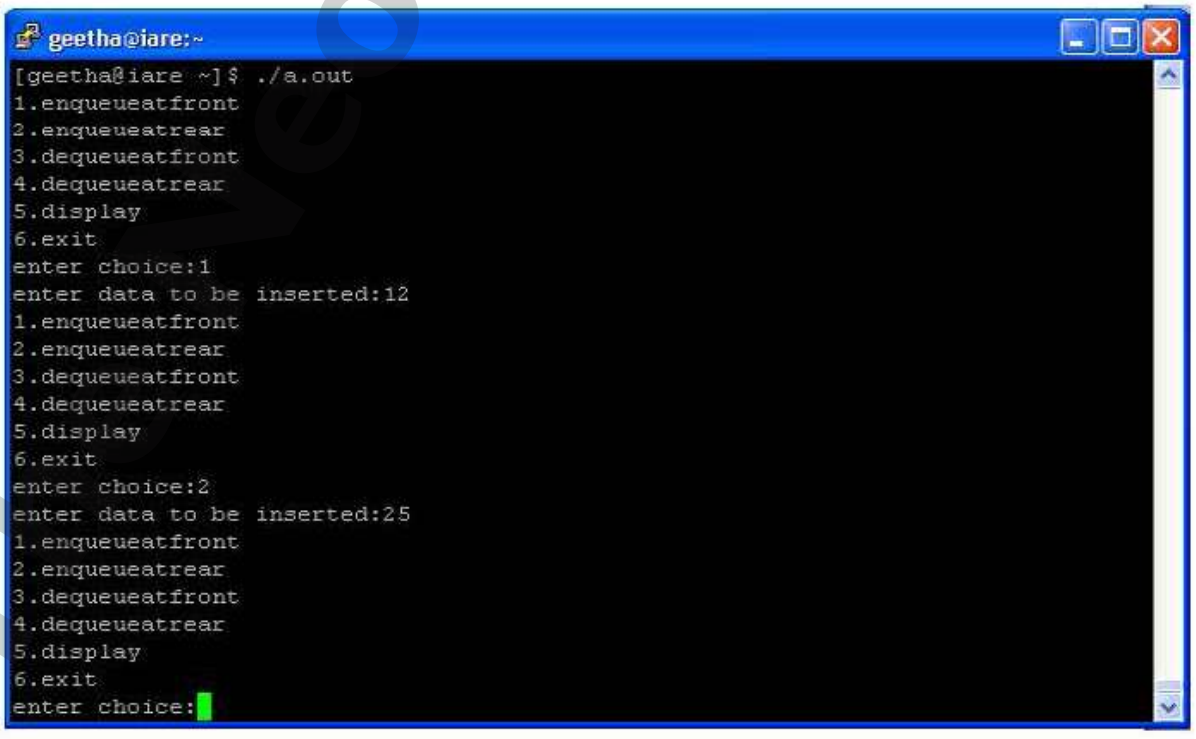
A double ended queue ADT using arrays

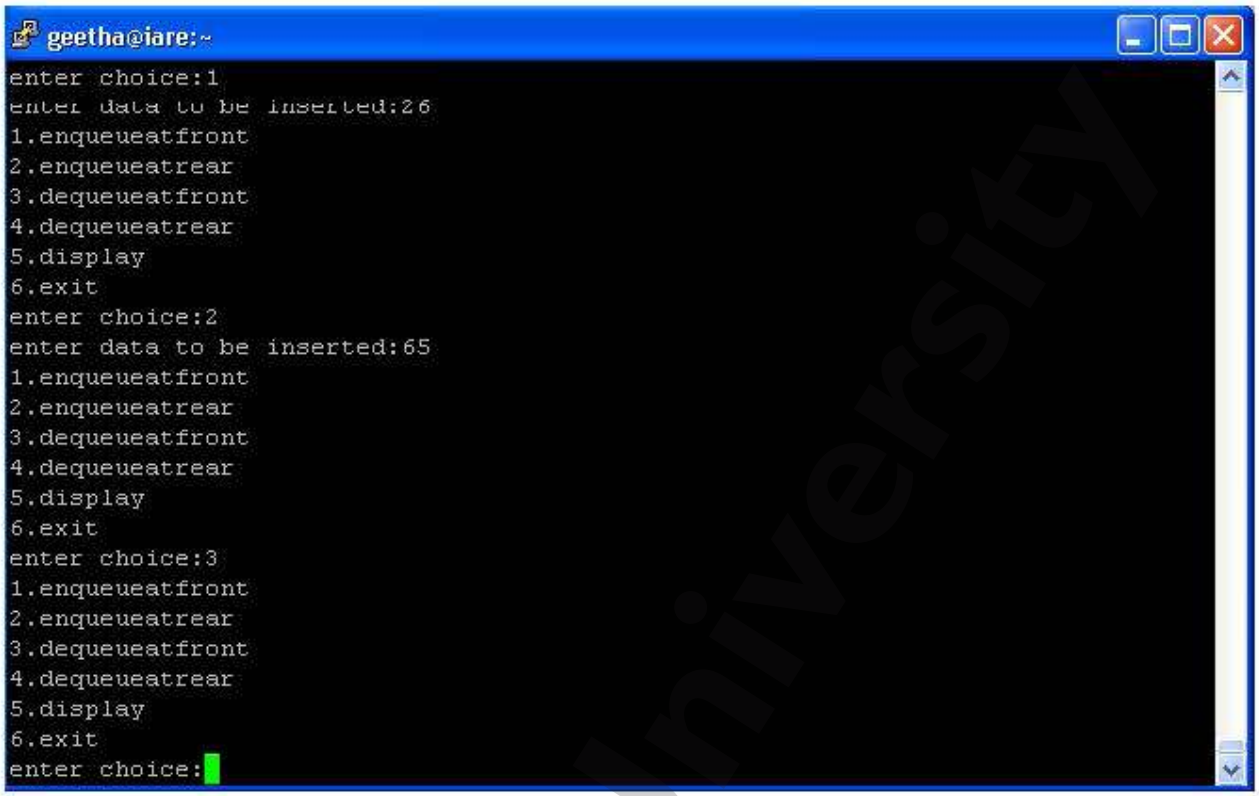






double ended queue adt using doubly linked list





EXPERIMENT 5

5.1 OBJECTIVE

1. To create a binary search tree of characters.
2. Traverse the above Binary search tree recursively in Post order.

5.2 SOURCE CODE:

/*program for creating and traversing the binary search tree*/

```
#include <stdio.h>
#include<conio.h>
#include <stdlib.h>
struct btnode
{
   int value;
   struct btnode *l;
   struct btnode *r;
};
struct btnode *root = NULL, *temp = NULL, *t2, *t1;
void insert();
void search(struct btnode *t);
void inorder(struct btnode *t);
void preorder(struct btnode *t);
void postorder(struct btnode *t);
void bstsearch(struct btnode *t);

int main()
{
   int ch;
   printf("\n  ---- OPERATIONS ---");
   printf("\n1 - Insert an element into tree\n");
   printf("2 - Inorder Traversal\n");
   printf("3 - Preorder Traversal\n");
   printf("4 - Postorder Traversal\n");
   printf("5 - Search element in BST \n");
   printf("6- Exit\n");
   while(1)
   {
      printf("\nEnter your choice : ");
      scanf("%d",&ch);
      switch (ch)
      {
```

```
        case 1:
             insert();
             break;
        case 2:
             inorder(root);
             break;
        case 3:
            preorder(root);
            break;
        case 4:
            postorder(root);
             break;
           case 5:
                              bstsearch(root);
                              break;
        case 6:
           exit(0);
        default :
           printf("Wrong choice, Please enter correct choice  ");
        }
    }
}

/* To insert a node in the tree */

void insert()
{
    int data;
    printf("Enter data of node to be inserted in BST: ");
    scanf("%d", &data);
    temp = (struct btnode *)malloc(sizeof(struct btnode));
    temp->value = data;
    temp->l = NULL;
        temp->r = NULL;
    if(root == NULL)
        root = temp;
    else
        search(root);
}
/* Function to search the appropriate position to insert the new node */
void search(struct btnode *t)
{
```

```
    if (temp->value > t->value)     /* value more than root node value insert at right */
            {
                    if (t->r != NULL)
                    search(t->r);
                    else
                    t->r = temp;
            }
            if (temp->value < t->value)    /* value less than root node value insert at left */
            {
                            if (t->l != NULL)
                            search(t->l);
                            else
                             t->l = temp;
            }
    }
/* recursive function to perform inorder traversal of tree */

void inorder(struct btnode *t)
{
   if (root == NULL)
   {
      printf("No elements in a tree to display");
      return;
   }
       if(t!=NULL)
       {
    inorder(t->l);
    printf("%d -> ", t->value);
    inorder(t->r);
   }
}
/* To find the preorder traversal */
void preorder(struct btnode *t)
{
   if (root == NULL)
   {
      printf("No elements in a tree to display");
      return;
   }
   if (t!= NULL)
   {
   printf("%d -> ", t->value);
```

```
    preorder(t->l);
    preorder(t->r);
    }
}
/* To find the postorder traversal */
void postorder(struct btnode *t)
{
    if (root == NULL)
    {
        printf("No elements in a tree to display ");
        return;
    }
    if (t!= NULL)
    {
        postorder(t->l);
        postorder(t->r);
        printf("%d -> ", t->value);
        }
}
/* Search element in BST*/
void bstsearch(struct btnode *t)
{
        int item,flag=0 ;
        printf("Enter the item to be search:  ");
        scanf("%d",&item);
        while(t!=NULL)
        {
        if(t->value==item)
      {
                flag=1;
                break;
      }
      else if(t->value>item)
                t=t->l;
                else
                t=t->r;
        }
        if (flag==1)
        printf("\nElement found in Binary Search Tree");
        else
        printf("\nElement not not found in Binary Search Tree");
}
```

EXPERIMENT 6

6.1 OBJECTIVE

1. Create a binary search tree of integers.
2. Traverse the above Binary search tree non recursively in inorder.

6.2 SOURCE CODE:

```
/*creating binary search tree of integer*/

#include<stdio.h>
#include<conio.h>
typedef struct bint
{
/*declaring a structure to create a node*/

  int data,flag;
  struct bint *left,*right;
}node;
node * create(node *r,int d)
{
   if(r == NULL)
   {
/*allocating implicit memory to the node*/

      r = (node *)malloc(sizeof(node));
      r->data = d;
      r->left = r->right = NULL;
   }
   else
  {
    if(r->data <= d)
       r->right = create(r->right,d);
    else
       r->left = create(r->left,d);
  }
  return r;
}
void non_in(node *r)
{
   int top=0;
   node *s[20],*pt=r;
   s[0]=NULL;
```

```
    while(pt != NULL)
    {
     s[++top] = pt;
     pt = pt->left;
    }
    pt = s[top--];
    while(pt != NULL)
    {
      printf("%d\t",pt->data);
      if(pt->right != NULL)
      {
        pt = pt->right;
        while(pt != NULL)
        {
          s[++top] = pt;
          pt = pt->left;
        }
      }
      pt = s[top--];
    }
  }
/*main program*/
void main()
{
  int d;
  char ch = 'Y';
  node *root = NULL;
  clrscr();
  while(toupper(ch) == 'Y')
  {
    printf("\n Enter the item to insert");
    scanf("%d", &d);
    head = create(root, d);
    printf("\n Do you want to continue(y/n)");
    fflush(stdin);
    ch = getchar();
  }

  printf("\n inorder non recursive\n");
  non_in(head);
}
```

6.3 INPUT AND OUTPUT

```
geetha@iare:~
[geetha@iare ~]$ ./a.out
enter the item to insert12

 do you want to continue (Y/N)y
enter the item to insert34

 do you want to continue (Y/N)y
enter the item to insert56

 do you want to continue (Y/N)y
enter the item to insert78

 do you want to continue (Y/N)n

 inorder non recursive
12      34      56      78      [geetha@iare ~]$
```

EXPERIMENT 7

7.1 OBJECTIVE

1. Arrange a list of integers in ascending order using Insertion sort
2. Arrange a list of integers in ascending order using Merge sort

7.2 SOURCE

CODE: **Insertion sort**

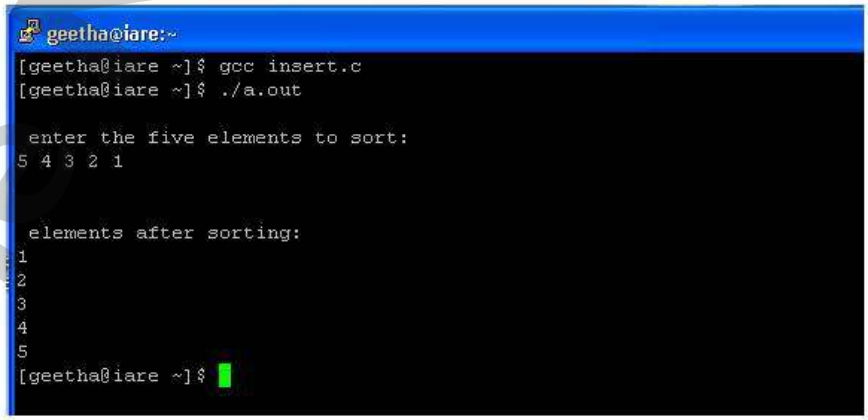
```
#include<stdio.h>
void inst_sort(int[]);
void main() {
        int num[5],count;
        printf("\n enter the five elements to sort:\n");
        for(count=0;count<5;count++)
        scanf("%d",&num[count]);
        inst_sort(num); /*function call for insertion sort*/
        printf("\n\n elements after sorting:\n");
        for(count=0;count<5;count++)
        printf("%d\n",num[count]);
}
void inst_sort(int num[]) { /* function definition for insertion sort*/
     int i,j,k;
     for(j=1;j<5;j++)
     {
       k=num[j];
       for(i=j-1;i>=0&&k<num[i];i--)

      num[i+1]=num[i];
      num[i+1]=k;
 }}
```

Merge sort

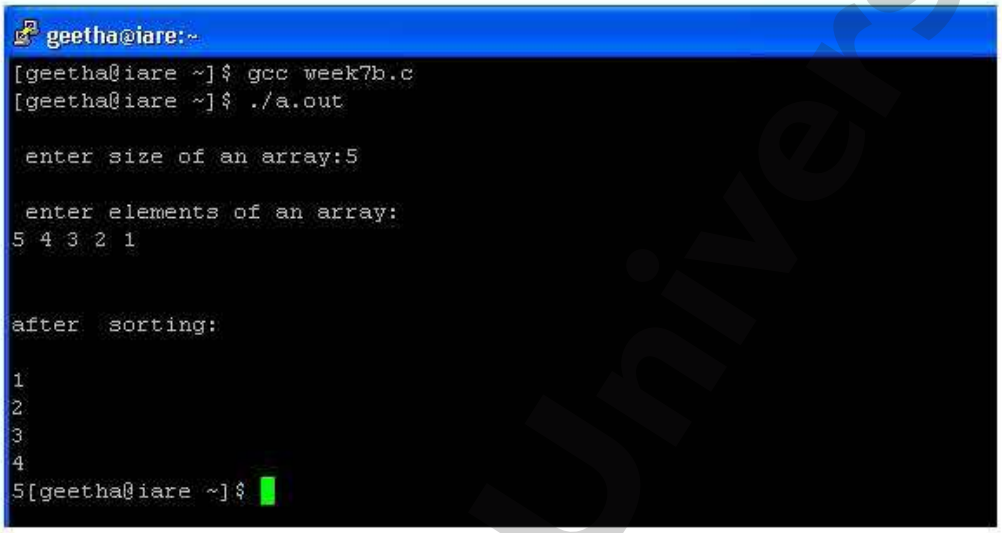
```
#include<stdio.h>
void mergesort(int[],int,int);
void mergearray(int[],int,int,int);
main() {
    int a[50],n,i;
   printf("\n enter size of an array:");
   scanf("%d",&n);
    printf("\n enter elements of an array:\n");
    for(i=0;i<n;i++)
      scanf("%d",&a[i]);
    mergesort(a,0,n-1);
    printf("\n\nafter sorting:\n");
    for(i=0;i<n;i++)
    printf("\n%d",a[i]);
}
/*merge operation*/
void mergesort(int a[],int beg,int end) {
   int mid;
   if(beg<end)    {
    mid=(beg+end)/2;
```

```
    mergesort(a,beg,mid);
    mergesort(a,mid+1,end);
    mergearray(a,beg,mid,end);
  } }
void mergearray(int a[],int beg,int mid,int end) {
   int i,leftend,num,temp,j,k,b[50];
   for(i=beg;i<=end;i++)
   b[i]=a[i];
   i=beg;
   j=mid+1;
   k=beg;
   while((i<=mid)&&(j<=end))     {
   if(b[i]<+b[j])
   {
     a[k]=b[i];
     i++;
     k++;
   }
   else    {
     a[k]=b[j]
     ; j++;
     k++;
   } }

 if(i<=mid) {
    while(i<=mid)     {
      a[k]=b[i];
      i++;
      k++;
    } }
  else {
    while(j<=end) {

     a[k]=b[j];
     j++;
     k++;
} } }
```

7.3 INPUT AND OUTPUT Insertion sort



Merge sort



EXPERIMENT 8

8.1. OBJECTIVE

1. Sorting the list of integers in ascending order using Quick sort
2. Sorting the list of integers in ascending order using Selection sort

8.2 SOURCE

CODE: QUICK

SORT

```
#include<stdio.h>
main()
{
    int x[10],i,n;
   printf("enter number of elements:");
   scanf("%d",&n);
   printf("enter %d elements:\n");
   for(i=0;i<n;i++)
   scanf("%d",&x[i]);
   quicksort(x,0,n-1);/*function call*/
   printf("sorted elements are:");
   for(i=0;i<n;i++)
    printf("%3d",x[i]);
}
/*called function*/
quicksort(int x[10],int first,int last)
{
    int pivot,i,j,t;
    if(first<last)
    {
      pivot=first;
      i=first;
      j=last;
      while(i<j)
      {
        while(x[i]<=x[pivot]&&i<last)
        i++;
       while(x[j]>x[pivot])
        j--;
       if(i<j)

       {
         t=x[i];
         x[i]=x[j];
         x[j]=t;
       }
     }
    t=x[pivot];
    x[pivot]=x[j];
    x[j]=t;
    quicksort(x,first,j-1);
    quicksort(x,j+1,last);
  }
```

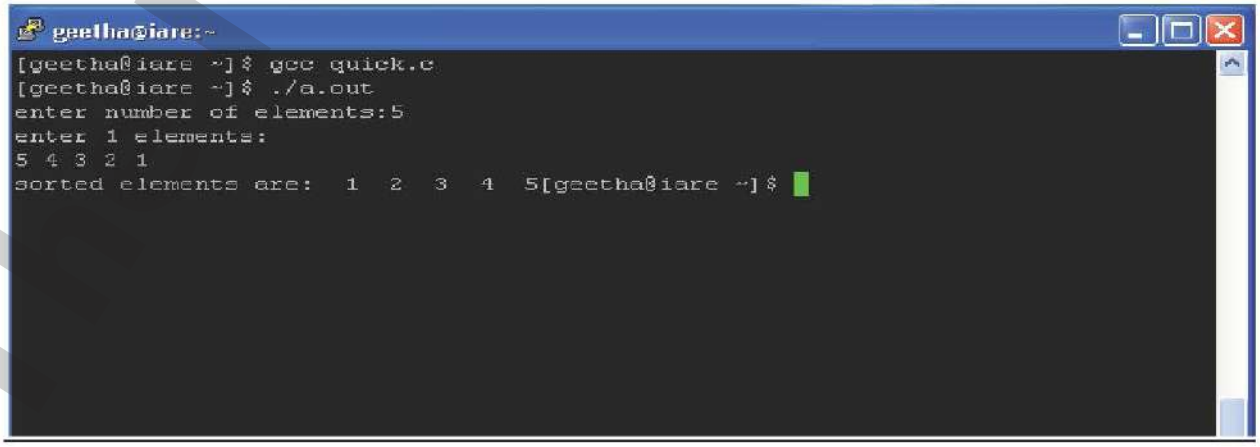
```
}
```

SELECTION SORT

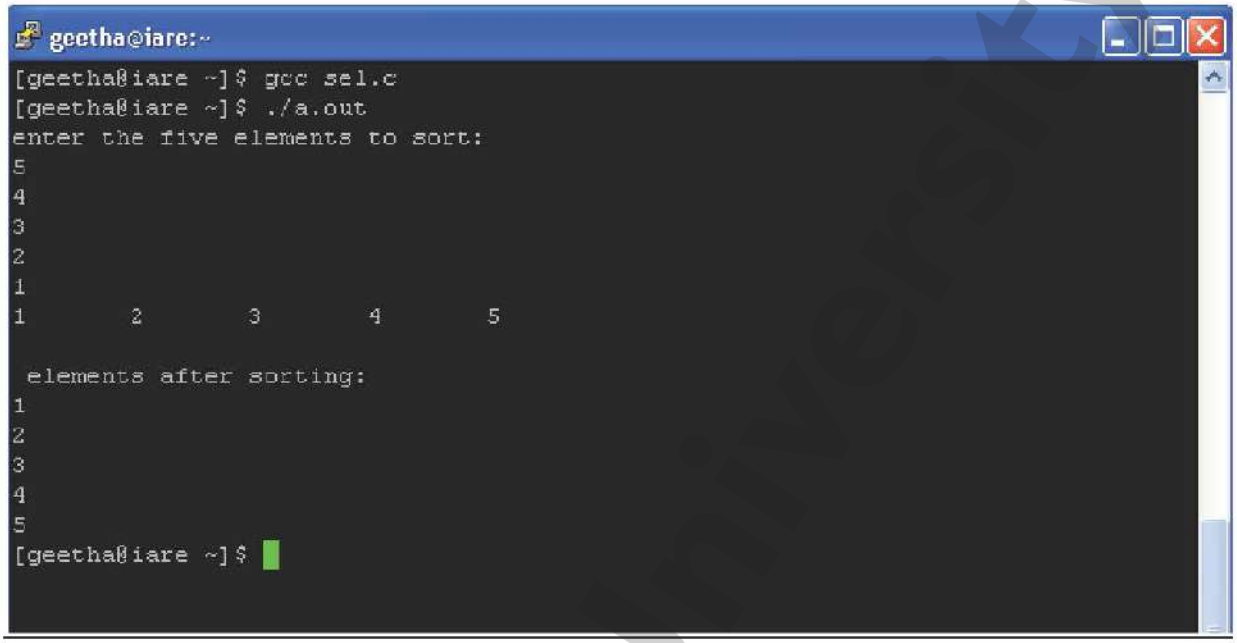
```
#include<stdio.h>
void sel_sort(int[]);
void main()
{
   int num[5],count;
   printf("enter the five elements to sort:\n");
   for(count=0;count<5;count++)
     scanf("%d",&num[count]);
   sel_sort(num); /*function call*/
   printf("\n\n elements after sorting:\n");
   for(count=0;count<5;count++)
     printf("%d\n",num[count]);
}
/*called function*/
void sel_sort(int num[])
{
   int i,j,min,temp;
   for(j=0;j<5;j++)
   {
    min=j;
    for(i=j;i<5;i++)
    if(num[min]>num[i])
    min=i;
   if(min<5)
   {
       temp=num[j];
       num[j]=num[min];
       num[min]=temp;
   }
   printf("%d\t",num[j]);
 }
```

8. 9 INPUT AND OUTPUT

QUICK SORT



SELECTION SORT



EXPERIMENT 9

9.1 OBJECTIVE

1. To perform the Insertion into a B-tree
2. Implement Heap sort algorithm

9.2 SOURCE

CODE: B-TREE

```
#include<stdio.h>
#include <stdlib.h>
#define M 5
struct node
{
int n; /* n < M No. of keys in node will always less than order of B
                    tree */
int keys[M-1];      /*array of keys*/
struct node *p[M]; /* (n+1 pointers will be in use) */
}*root=NULL;

enum KeyStatus { Duplicate,SearchFailure,Success,InsertIt,LessKeys };
void insert(int key);
void display(struct node *root,int);
void search(int x);
enum KeyStatus ins(struct node *r, int x, int* y, struct node** u);
int searchPos(int x,int *key_arr, int n);
int main()
{
int key;
int choice;
printf("Creation of B tree for node %d\n",M);
while(1)
{
printf("1.Insert\n");
printf("3.Search\n");
printf("4.Display\n");
printf("5.Quit\n");
printf("Enter your choice : ");
scanf("%d",&choice);
```

```
                switch(choice)
                {
                    case 1:                     insert(key);
printf("Enter the key : "); scanf("%d",&key);    break;

                    case 3:                     printf("Enter the key : "); scanf("%d",&key);
                                                search(key);
                                                break;
                                                printf("Btree is :\n"); display(root,0); break;

                    case 4:                     exit(1);

                                                printf(
                                                "Wron
                    case 5: default:            g
                                                choice
                                                \n");
                                                break;
                    }/*End of switch*/
                    }/*End of while*/
                return 0;
                }/*End of main()*/
                void insert(int key)
                {
                struct node *newnode;
                int upKey;
                enum KeyStatus value;
                value = ins(root, key, &upKey, &newnode);
                if (value == Duplicate)
                printf("Key already available\n");
                if (value == InsertIt)
                {
                struct node *uproot = root;
                root=malloc(sizeof(struct
                node)); root->n = 1;
                root->keys[0] = upKey;
                root->p[0] = uproot;
                root->p[1] = newnode;
                }/*End of if */
                }/*End of insert()*/

                enum KeyStatus ins(struct node *ptr, int key, int *upKey,struct node**newnode)
                {
                struct node *newPtr, *lastPtr;
                int pos, i, n,splitPos;
                int newKey, lastKey;
                enum KeyStatus value;
                if (ptr == NULL)
                {
                *newnode = NULL;
                *upKey = key;
                return InsertIt;
```

```
}
n = ptr->n;
pos = searchPos(key, ptr->keys, n);
if (pos < n && key == ptr->keys[pos])
return Duplicate;
value = ins(ptr->p[pos], key, &newKey, &newPtr);
if (value != InsertIt)
return value;
/*If keys in node is less than M-1 where M is order of B tree*/
if (n < M - 1)
{
pos = searchPos(newKey, ptr->keys, n);
/*Shifting the key and pointer right for inserting the new key*/
for (i=n; i>pos; i--)
{
ptr->keys[i] = ptr->keys[i-1];
ptr->p[i+1] = ptr->p[i];
}
/*Key is inserted at exact location*/
ptr->keys[pos] = newKey;
ptr->p[pos+1] = newPtr;
++ptr->n; /*incrementing the number of keys in node*/
        return Success;
}/*End of if */
/*If keys in nodes are maximum and position of node to be inserted is
last*/
if (pos == M - 1)
{
lastKey = newKey;
lastPtr = newPtr;
}
else /*If keys in node are maximum and position of node to be inserted
is not last*/
{
lastKey = ptr->keys[M-2];
lastPtr = ptr->p[M-1];
for (i=M-2; i>pos; i--)
{
ptr->keys[i] = ptr->keys[i-1];
ptr->p[i+1] = ptr->p[i];
}
ptr->keys[pos] = newKey;
ptr->p[pos+1] = newPtr;
}
splitPos = (M - 1)/2;
(*upKey) = ptr->keys[splitPos];

(*newnode)=malloc(sizeof(struct node));/*Right node after split*/
ptr->n = splitPos; /*No. of keys for left splitted node*/
(*newnode)->n = M-1-splitPos;/*No. of keys for right splitted node*/
for (i=0; i < (*newnode)->n; i++)
{
(*newnode)->p[i] = ptr->p[i + splitPos + 1];
if(i < (*newnode)->n - 1)
(*newnode)->keys[i] = ptr->keys[i + splitPos + 1];
else
(*newnode)->keys[i] = lastKey;
}
```

```
(*newnode)->p[(*newnode)->n] = lastPtr;
return InsertIt;
}/*End of ins()*/

void display(struct node *ptr, int blanks)
{
if (ptr)
{
int i;
for(i=1;i<=blanks;i++)
printf(" ");
for (i=0; i < ptr->n; i++)
printf("%d ",ptr->keys[i]);
printf("\n");
for (i=0; i <= ptr->n; i++)
display(ptr->p[i], blanks+10);
}/*End of if*/
}/*End of display()*/

void search(int key)
{
int pos, i, n;
struct node *ptr = root;
printf("Search path:\n");
while (ptr)
{
n = ptr->n;
for (i=0; i < ptr->n; i++)
printf(" %d",ptr->keys[i]);
printf("\n");
pos = searchPos(key, ptr->keys, n);
if (pos < n && key == ptr->keys[pos])
{
printf("Key %d found in position %d of last dispalyed node\n",key,i);
return;
}
ptr = ptr->p[pos];
}
printf("Key %d is not available\n",key);
}/*End of search()*/

int searchPos(int key, int *key_arr, int n)
{
int pos=0;
while (pos < n && key > key_arr[pos])
pos++;
return pos;
}/*End of searchPos()*/
```

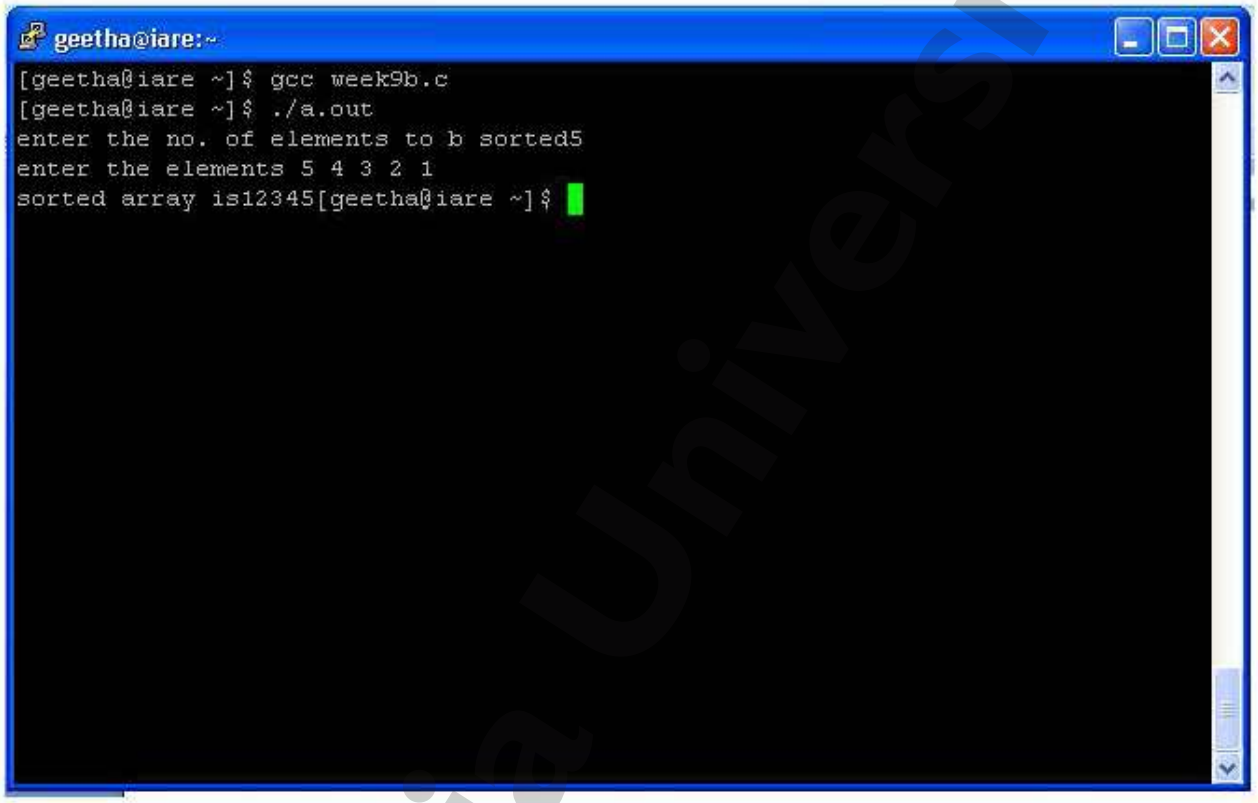
HEAP SORT

```
#include<stdio.h>
int p(int);
int left(int);
int right(int);
void heapify(int[],int,int);
void buildheap(int[],int);
```

```
void heapsort(int[],int);
void main()
 {
    int x[20],n,i;
    printf("enter the no. of elements to b sorted");
    scanf("%d",&n);
    printf("enter the elements ");
    for(i=0;i<n;i++)
    scanf("%d",&x[i]);
    heapsort(x,n);
    printf("sorted array is");
    for(i=0;i<n;i++)
    printf("%d",x[i]);
 }
 int p(int i)
 {
    return i/2;
 }
 int left(int i)
 {
   return 2*i+1;
 }
 int right(int i)
 {
   return 2*i+2;
 }
 void heapify(int a[],int i,int n)
 {
    int l,r,large,t;
    l=left(i);
    r=right(i);
      if((l<=n-1)&&(a[l]>a[i]))
        large=l;
     else
        large=i;
    if((r<=n-1)&&(a[r]>a[large]))
       large=r;
    if(large!=i)
    {
      t=a[i];
     a[i]=a[large];
     a[large]=t;
     heapify(a,large,n);
    }
 }
void buildheap(int a[],int n)
{
   int i;
  for(i=(n-1)/2;i>=0;i--)
    heapify(a,i,n);
}
void heapsort(int a[],int n)
{
   int i,m,t;
   buildheap(a,n);
   m=n ;
   for(i=n-1;i>=1;i--)
   {
```

```
a[0]=a[i];
a[i]=t;
m=m-1;
heapify(a,0,m);
}
}
```

9.9 INPUT AND OUTPUT



EXPERIMENT 10

10.1 OBJECTIVE

To implement all the functions of a dictionary (ADT) using hashing

10.2 SOURCE CODE:

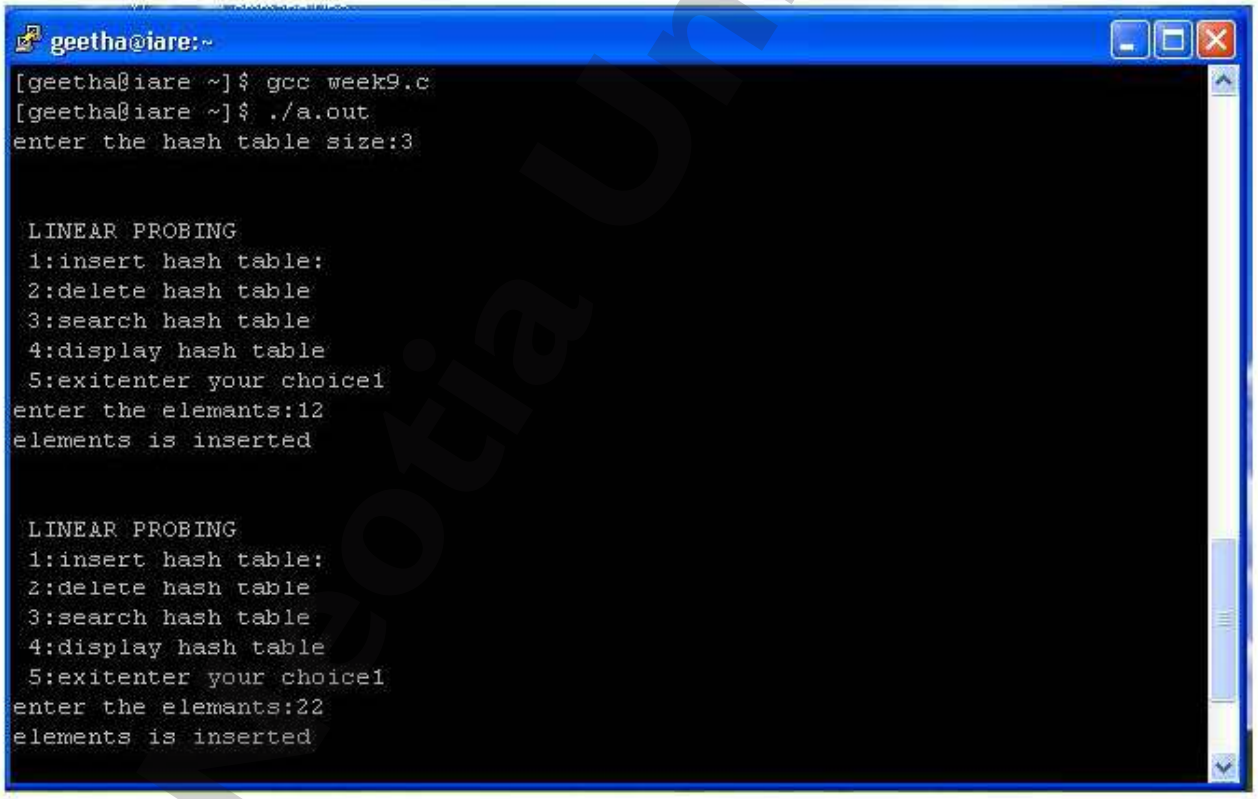
DICTIONARY USING HASHING

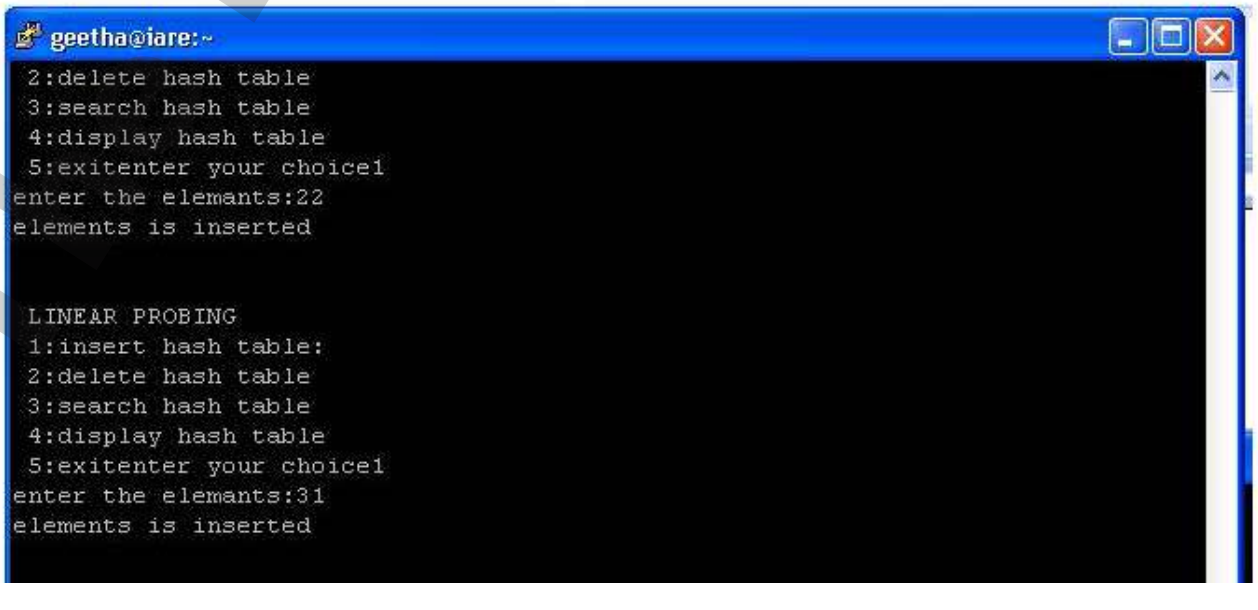
```
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
int b;

int hsearch(int key,int d,int *ht,int *empty)
{
        int i=key%(d);
        int j=i;
        int c=0;
        do
        {
           if(empty[j]||(*(ht+j)==key))
           return j;
           c++;
           j=(i+c)%(d);
        }while(j!=i);
        return 0;
}
int search(int key,int d,int *ht,int *empty)
{
     b=hsearch(key,d,ht,empty);
      printf("%d",b);
      if(empty[b]==1)
        return -1;
     else if(b==0)
        return 1;
     else
      return b;
}
/*insertion operation*/
void insert(int key,int d,int *ht,int *empty)
{
     b=hsearch(key,d,ht,empty);
    if(empty[b])
    {
```

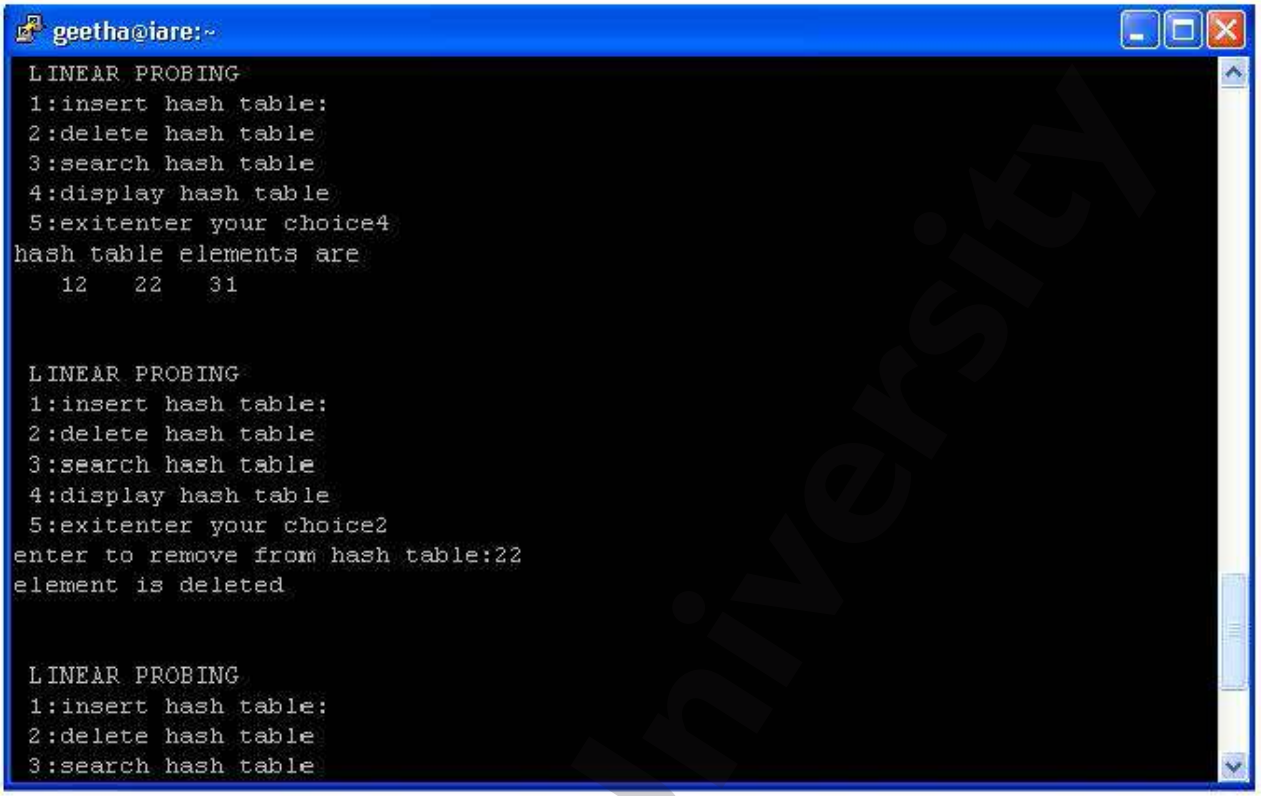
```
        empty[b]=0;
         *(ht+b)=key;
       printf("elements is inserted\n");
   }
}
/*deletion operation*/
void delete(int key,int d,int *ht,int *empty)
{
      int b=hsearch(key,d,ht,empty);
     *(ht+b)=0;
      empty[b]=1;
      printf("element is deleted\n");
}
void display(int d,int *ht,int *empty)
{
    int i;
    printf("hash table elements are\n");
    for(i=0;i<d;i++)
    {
      if(empty[i])
     printf(" 0");
    else
      printf("%5d",*(ht+i));
    }
   printf("\n");
 }
/*main program*/
void main()
{
      int choice=1;
      int key;
      int d,i,s;
      int *empty,*ht;
      printf("enter the hash table size:");
      scanf("%d",&d);
      ht=(int *)malloc(d *sizeof(int));
    empty=(int *)malloc(d *sizeof(int));
    for(i=0;i<d;i++)
    empty[i]=1;
    while(1)
    {
          printf("\n");
          printf("\n LINEAR PROBING");
          printf("\n 1:insert hash table:");
          printf("\n 2:delete hash table");
          printf("\n 3:search hash table");
          printf("\n 4:display hash table");
          printf("\n 5:exit");
          printf("enter your choice");
          scanf("%d",&choice);
          switch(choice)
          {
              case 1:printf("enter the elemants:");
                     scanf("%d",&key);
                     insert(key,d,ht,empty);
                     break;
              case 2:printf("enter to remove from hash table:");
                     scanf("%d",&key);
```

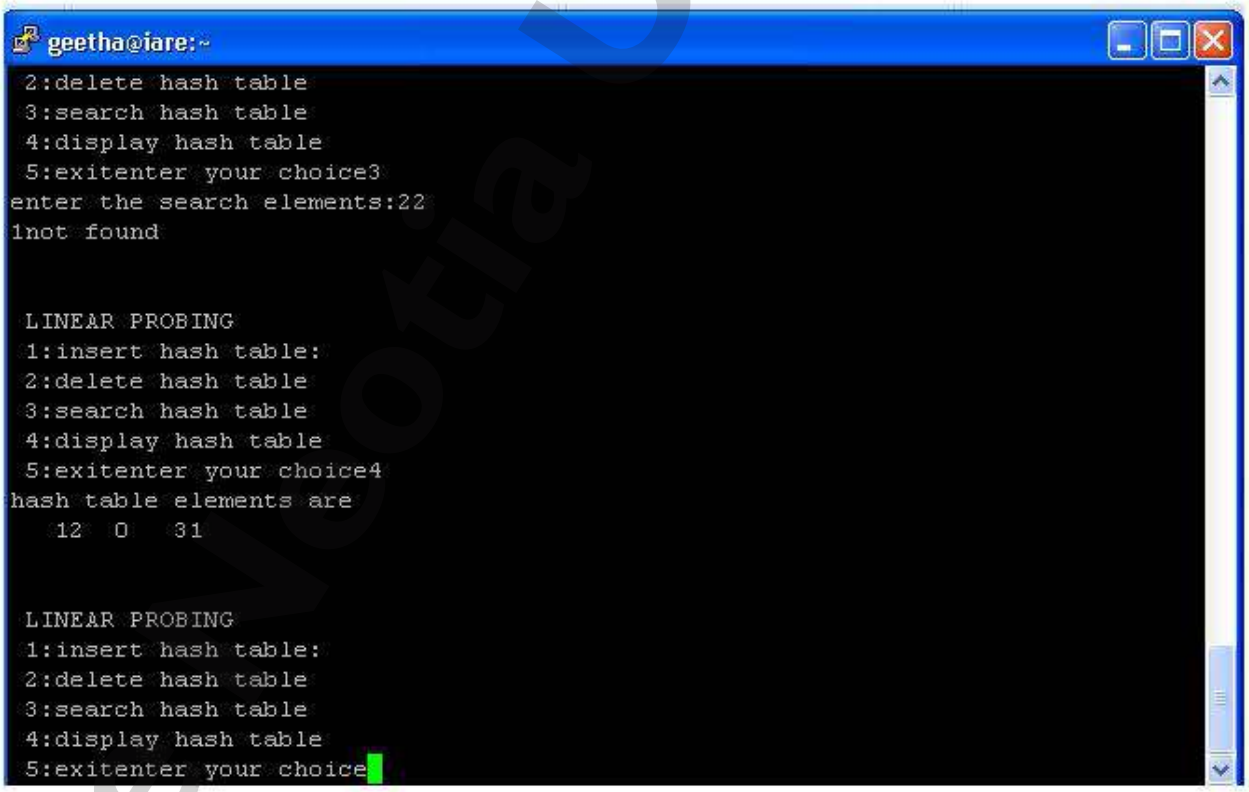
```
                delete(key,d,ht,empty);
                break;
            case 3:printf("enter the search elements:");
                scanf("%d",&key);
                s=search(key,d,ht,empty);
                 if(s==-1||s==0)
                  printf("not found\n");
                else
                  printf("element found at index %d",hsearch(key,d,ht,empty));
                break;
            case 4:display(d,ht,empty);
                   break;
            case 5:exit(0);
        }
    }return;
}
```

10.1 INPUT AND OUTPUT









EXPERIMENT 11

11.1 OBJECTIVE

To implementing Knuth-Morris- Pratt pattern matching algorithm

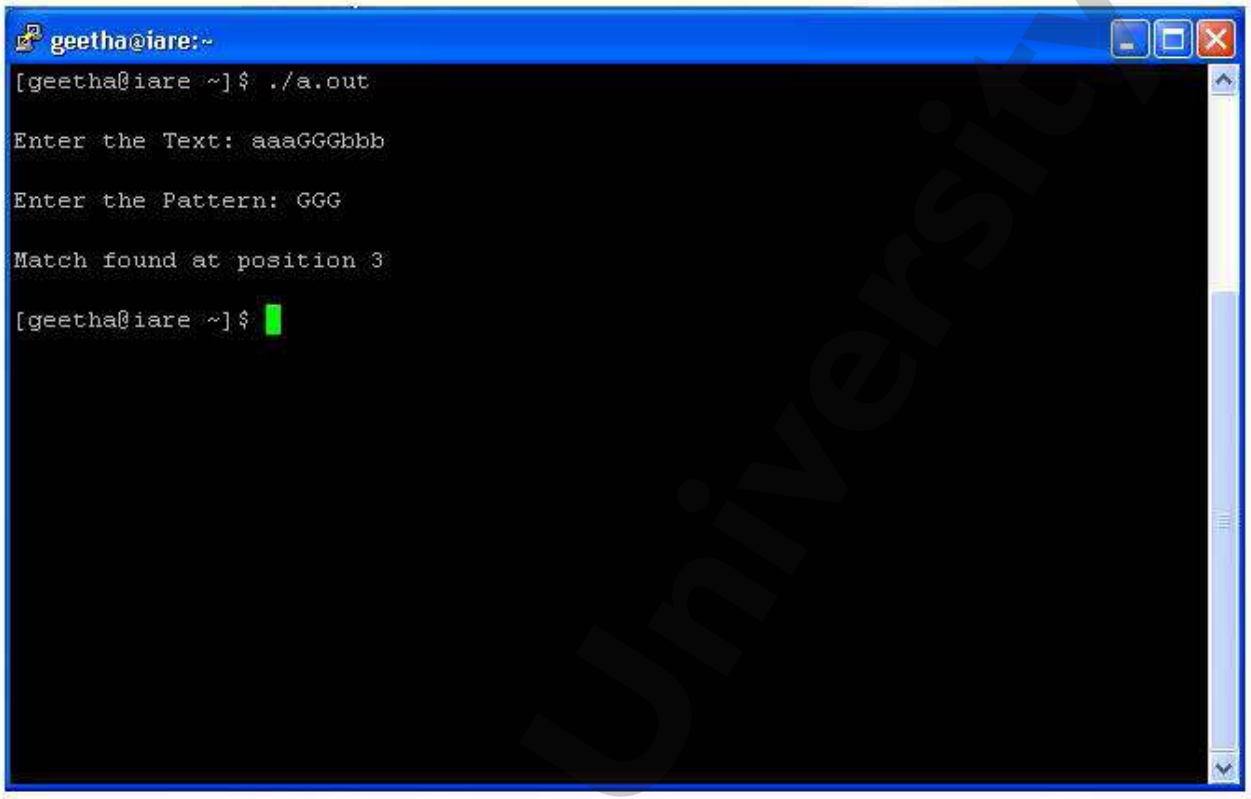
11.2 SOURCE CODE

Knuth-Morris- Pratt pattern matching algorithm

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

void computefailure(char *pat, int M, int *f);

void KMPSearch(char *pat, char *txt) //to implement kmp search
{
      int M = strlen(pat);//length of pattern
      int N = strlen(txt);//length of text

     int *f = (int *)malloc(sizeof(int)*M); //dynamic allocation
     int j = 0; // index for pat[]

     computefailure(pat, M, f);

      int i = 0; // index for txt[]
     while(i < N)
     {
       if(pat[j] == txt[i])
       {
        j++;
        i++;
     }
       if (j == M)
     {
       printf("Found pattern at index %d \n", i-j);
       j = f[j-1];
     }
        else if(pat[j] != txt[i])
    {
          if(j != 0)
      j = f[j-1];
     else
      i = i+1;
    }
```

```
    }
    free(f); }

void computefailure (char *pat, int M, int *f) //compute the failure function
{
        int len = 0;
        int i;

        f[0] = 0; // f[0] is always 0
        i = 1;

        while(i < M)
        {
                if(pat[i] == pat[len])
                {
                 len++;
                 f[i] = len;
                 i++;
                }
                else // (pat[i] != pat[len])
                {
                 if( len != 0 )
                 {
                     len = f[len-1];
                 }
                 else // if (len == 0)
                 {
                  f[i] = 0;
                  i++;
                 }
               }
            }
    }

int main()
{
    int match;
      printf("\nEnter the Text: ");
      gets(text); //reading the text
      printf("\nEnter the Pattern: ");
      gets(pattern); //reading the pattern
      m=strlen(text);
      n=strlen(pattern);
      match=KMPSearch(pat, txt);

      if(match>=0)
      {
              printf("\nMatch found at position %d\n\n",match);
      }
      else
      {
         printf("\nNo Match found!!!\n\n");
      }
      return 0;
}
```

11. 9 INPUT AND OUTPUT



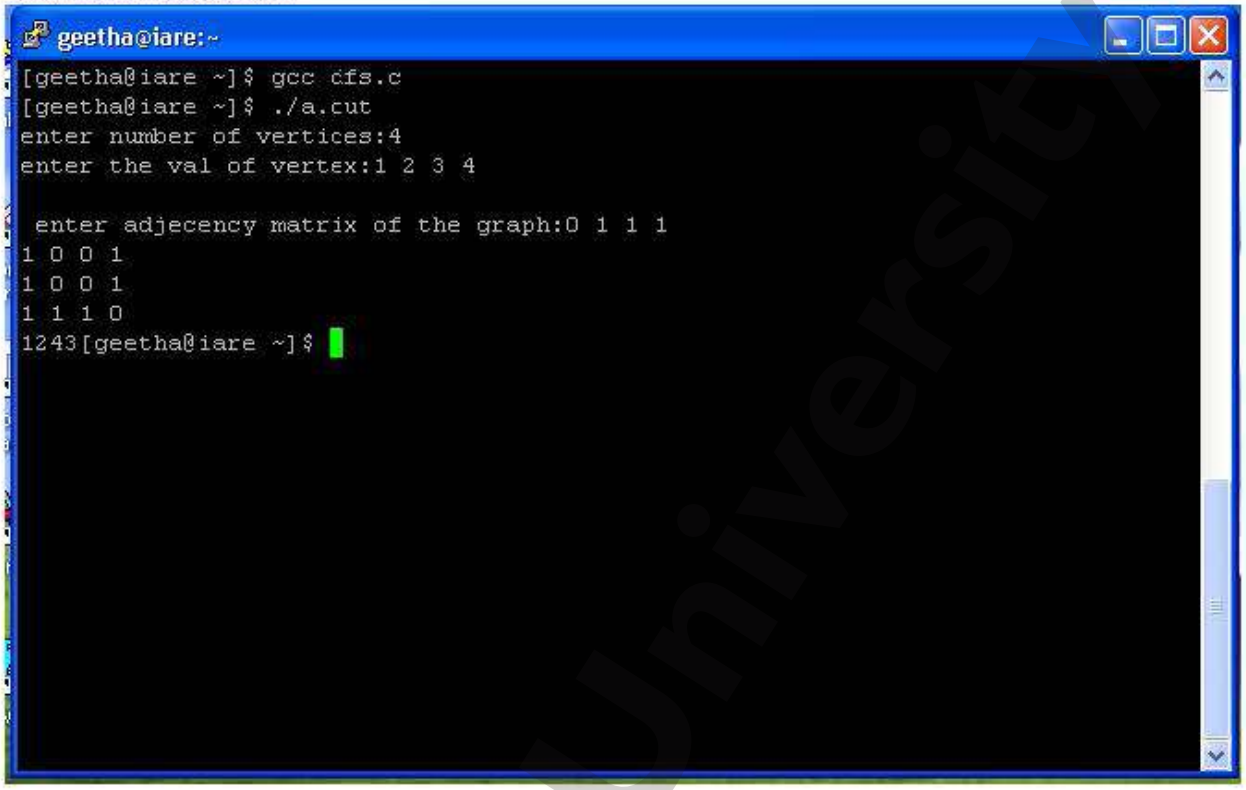
EXPERIMENT 12

A: Write C programs for implementing the following graph traversal algorithm for Depth first traversal

12.1 SOURCE CODE: DFS

```
#include <stdio.h>
void dfs(int);
int g[10][10],visited[10],n,vertex[10];
void main()
{
   int i,j;
   printf("enter number of vertices:");
   scanf("%d",&n);
   printf("enter the val of vertex:");
   for(i=0;i<n;i++)
            scanf("%d",&vertex[i]);
  printf("\n enter adjecency matrix of the graph:");
  for(i=0;i<n;i++)
             for(j=0;j<n;j++)
            scanf("%d",&g[i][j]);
 for(i=0;i<n;i++)
  visited[i]=0;
  dfs(0);
}
void dfs(int i)
{
  int j;
   printf("%d",vertex[i]);
 visited[i]=1;
 for(j=0;j<n;j++)
 if(!visited[j]&&g[i][j]==1)
  dfs(j);
}
```

12. 9 INPUT AND OUT



EXPERIMENT 13

1.1 OBJECTIVE

Write a C Program to check whether two given lists are containing the same data.

1.2 SOURCE CODE

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

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

void feedmember(struct node **);
int compare (struct node *, struct node *);
void release(struct node **);

int main() {
   struct node *p =
   NULL; struct node *q
   = NULL; int result;

   printf("Enter data into first list\n");
   feedmember(&p);
   printf("Enter data into second list\n");
   feedmember(&q);
   result = compare(p,
   q); if (result == 1) {
      printf("The 2 list are equal.\n");
   }
   else {
      printf("The 2 lists are unequal.\n");
   }
   release (&p);
   release (&q);

   return 0;
}

int compare (struct node *p, struct node *q){
   while (p != NULL && q != NULL)
   {
      if(p->num != q-> num)
         { return 0;
      }
      else
      {
         p = p->next;
         q = q->next;
      }
   }
   if (p != NULL || q != NULL)    {
      return 0;

}
```

```
    else    {
      return 1;
    }
}

void feedmember (struct node **head)
{
    int c, ch;
    struct node *temp;

    do      {
      printf("Enter number: ");
      scanf("%d", &c);
      temp = (struct node *)malloc(sizeof(struct node));
      temp->num = c;
      temp->next = *head;
      *head = temp;
      printf("Do you wish to continue [1/0]: ");
      scanf("%d", &ch);
    }while (ch != 0);
    printf("\n");
}

void release (struct node **head) {
    struct node *temp = *head;

    while ((*head) != NULL)
    {
      (*head) = (*head)->next;
      free(temp);
      temp = *head;
    }
}
```

INPUT/ OUTPUT

```
Enter data into first list
Enter number: 12
Do you wish to continue [1/0]: 1
Enter number: 3
Do you wish to continue [1/0]: 1
Enter number: 28
Do you wish to continue [1/0]: 1
Enter number: 9
Do you wish to continue [1/0]: 0

Enter data into second list
Enter number: 12
Do you wish to continue [1/0]: 1
Enter number: 3
Do you wish to continue [1/0]: 1
Enter number: 28
Do you wish to continue [1/0]: 1
Enter number: 9
Do you wish to continue [1/0]: 0

    The 2 list are equal.
```

EXPERIMENT 14

2.1 OBJECTIVE

Write a C program to find the largest element in a given doubly linked list.

2.2 SOURCE CODE

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

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

void create(struct node **);
int max(struct node *);
void release(struct node **);

int main()
{
   struct node *p = NULL;
   int n;

   printf("Enter data into the list\n");
   create(&p);
   n = max(p);
   printf("The maximum number entered in the list is %d.\n", n);
   release (&p);

   return 0;
}

int max(struct node *head)
{
   struct node *max, *q;

   q = max = head;
   while (q != NULL)
   {
      if (q->num > max->num)
      {
         max = q;
      }
      q = q->next;
   }

   return (max->num);
}

void create(struct node **head)
{
   int c, ch;
   struct node *temp, *rear;
```

```
    do
    {
        printf("Enter number: ");
        scanf("%d", &c);
        temp = (struct node *)malloc(sizeof(struct node));
        temp->num = c;
        temp->next = NULL;
        temp->prev = NULL;
        if (*head == NULL)
        {
            *head = temp;
        }
        else
        {
            rear->next = temp;
            temp->prev =
            rear;
        }
        rear = temp;
        printf("Do you wish to continue [1/0]: ");
        scanf("%d", &ch);
    } while (ch != 0);
    printf("\n");
}

void release(struct node **head)
{
    struct node *temp = *head;
    *head = (*head)->next;
    while ((*head) != NULL)
    {
        free(temp);
        temp = *head;
        (*head) = (*head)->next;
    }
}
```

INPUT/ OUTPUT:

```
Enter data into the list
Enter number: 12
Do you wish to continue [1/0]: 1
Enter number: 7
Do you wish to continue [1/0]: 1
Enter number: 23
Do you wish to continue [1/0]: 1
Enter number: 4
Do you wish to continue [1/0]: 1
Enter number: 1
Do you wish to continue [1/0]: 1
Enter number: 16
Do you wish to continue [1/0]: 0

The maximum number entered in the list is 23.
```

EXPERIMENT 15

3.1 OBJECTIVE

Write a C program to reverse the elements in the stack using recursion.

3.2 SOURCE CODE

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

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

void generate(struct node **);
void display(struct node *);
void stack_reverse(struct node **, struct node **);
void delete(struct node **);

int main()
{
   struct node *head = NULL;

   generate(&head);
   printf("\nThe sequence of contents in stack\n");
   display(head);
   printf("\nInversing the contents of the stack\n");
   if (head != NULL)
   {
      stack_reverse(&head, &(head->next));
   }
   printf("\nThe contents in stack after reversal\n");
   display(head);
   delete(&head);

   return 0;
}

void stack_reverse(struct node **head, struct node **head_next)
{
   struct node *temp;

   if (*head_next != NULL)
   {
       temp = (*head_next)->next;
      (*head_next)->next = (*head);
      *head = *head_next;
      *head_next = temp;
      stack_reverse(head, head_next);
   }
}

void display(struct node *head)
{
```

```
    if (head != NULL)
    {
        printf("%d ", head->a);
        display(head->next);
    }
}

void generate(struct node **head)
{
    int num, i;
    struct node *temp;

    printf("Enter length of list: ");
    scanf("%d", &num);
    for (i = num; i > 0; i--)
    {
        temp = (struct node *)malloc(sizeof(struct node));
        temp->a = i;
        if (*head == NULL)
        {
            *head = temp;
            (*head)->next = NULL;
        }
        else
        {
            temp->next = *head;
            *head = temp;
        }
    }
}

void delete(struct node **head)
{
    struct node *temp;
    while (*head != NULL)
    {
        temp = *head;
        *head = (*head)->next;
        free(temp);
    }
}
```

INPUT/OUTPUT:

```
Enter length of list: 10

The sequence of contents in stack
1 2 3 4 5 6 7 8 9 10

Reversing the contents of the stack

The contents in stack after reversal
10 9 8 7 6 5 4 3 2 1
```

EXPERIMENT 16

4.1 OBJECTIVE

Write a C program to implement stack using linked list.

4.2 SOURCE CODE

```
#include
```

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

struct node
{
   int info;
   struct node *ptr;
}*top,*top1,*temp;

int topelement();
void push(int data);
void pop();
void empty();
void display();
void destroy();
void stack_count();
void create();

int count = 0;

void main()
{
   int no, ch, e;

   printf("\n 1 - Push");
   printf("\n 2 - Pop");
   printf("\n 3 - Top");
   printf("\n 4 - Empty");
   printf("\n 5 - Exit");
   printf("\n 6 - Dipslay");
   printf("\n 7 - Stack Count");
   printf("\n 8 - Destroy
   stack");

   create();

   while (1)
   {
      printf("\n Enter choice : ");
      scanf("%d", &ch);

      switch (ch)
      {
      case 1:
         printf("Enter data : ");
         scanf("%d", &no);
         push(no);
         break;
      case 2:
         pop();
         break;

      case 3:
         if (top == NULL)
            printf("No elements in stack");
         else
         {
            e = topelement();
```

```
            printf("\n Top element : %d", e);
        }
        break;
    case 4:
        empty();
        break;
    case 5:
        exit(0);
    case 6:
        display();
        break;
    case 7:
        stack_count();
        break;
    case 8:
        destroy();
        break;
    default :
        printf(" Wrong choice, Please enter correct choice ");
        break;
    }
  }
}

/* Create empty stack */
void create()
{
  top = NULL;
}

/* Count stack elements */
void stack_count()
{
  printf("\n No. of elements in stack : %d", count);
}

/* Push data into stack */
void push(int data)
{
  if (top == NULL)
  {
    top =(struct node *)malloc(1*sizeof(struct node));
    top->ptr = NULL;
    top->info = data;
  }
  else
  {
    temp =(struct node *)malloc(1*sizeof(struct node));
    temp->ptr = top;
    temp->info = data;
    top = temp;
  }
```

```
    count++;
  }

  /* Display stack elements */
  void display()
  {
    top1 = top;

    if (top1 == NULL)
    {
      printf("Stack is empty");
      return;
    }

    while (top1 != NULL)
    {
      printf("%d ", top1->info);
      top1 = top1->ptr;
    }
  }

  /* Pop Operation on stack */
  void pop()
  {
    top1 = top;

    if (top1 == NULL)
    {
      printf("\n Error : Trying to pop from empty stack");
      return;
    }
    else
      top1 = top1->ptr;
    printf("\n Popped value : %d", top->info);
    free(top);
    top = top1;
    count--;
  }

  /* Return top element */
  int topelement()
  {
    return(top->info);
  }

  /* Check if stack is empty or not */
  void empty()
  {
    if (top == NULL)
      printf("\n Stack is empty");
    else
      printf("\n Stack is not empty with %d elements", count);
  }

  /* Destroy entire stack */
  void destroy()
  {
top1 = top;
```

```
        while (top1 != NULL)
    {
       top1 = top->ptr;
       free(top);
       top = top1;
       top1 = top1->ptr;
    }
    free(top1);
    top = NULL;

    printf("\n All stack elements destroyed");
    count = 0;
}
```

INPUT/OUTPUT:

```
1 - Push
2 - Pop
3 - Top
4 - Empty
5 - Exit
6 - Dipslay
7       - Stack
Count 8 -
Destroy stack
Enter choice : 1
Enter data : 56

Enter choice : 1
Enter data : 80

Enter choice : 2

Popped value : 80
Enter choice : 3

Top element : 56
Enter choice : 1
Enter data : 78

Enter choice : 1
Enter data : 90

Enter choice : 6
90 78 56
Enter choice : 7

No. of elements in stack : 3
Enter choice : 8

All stack elements destroyed
Enter choice : 4
Stack is empty Enter choice : 5
```