DATA STRUCTURES USING C++

LABORATORY MANUAL

B.TECH

(II YEAR – I SEM)

(2018-19)

DEPARTMENT OF INFORMATION TECHNOLOGY

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

Recognized under 2(f) and 12 (B) of UGC ACT 1956

(Affiliated to JNTUH, Hyderabad, Approved by AICTE - Accredited by NBA & NAAC – 'A' Grade - ISO 9001:2015 Certified)

Maisammaguda, Dhulapally (Post Via. Hakimpet), Secunderabad – 500100, Telangana State, India

DEPARTMENT OF INFORMATION TECHNOLOGY

VISION

- To improve the quality of technical education that provides efficient software engineers with an attitude to adapt challenging IT needs of local, national and international arena, through teaching and interaction with alumni and industry.

MISSION

- Department intends to meet the contemporary challenges in the field of IT and is playing a vital role in shaping the education of the 21st century by providing unique educational and research opportunities.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1 – ANALYTICAL SKILLS

To facilitate the graduates with the ability to visualize, gather information, articulate, analyze, solve complex problems, and make decisions. These are essential to address the challenges of complex and computation intensive problems increasing their productivity.

PEO2 – TECHNICAL SKILLS

To facilitate the graduates with the technical skills that prepare them for immediate employment and pursue certification providing a deeper understanding of the technology in advanced areas of computer science and related fields, thus encouraging to pursue higher education and research based on their interest.

PEO3 – SOFT SKILLS

To facilitate the graduates with the soft skills that include fulfilling the mission, setting goals, showing self-confidence by communicating effectively, having a positive attitude, get involved in team-work, being a leader, managing their career and their life.

PEO4 – PROFESSIONAL ETHICS

To facilitate the graduates with the knowledge of professional and ethical responsibilities by paying attention to grooming, being conservative with style, following dress codes, safety codes, and adapting themselves to technological advancements.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After the completion of the course, B. Tech Information Technology, the graduates will have the following Program Specific Outcomes:

1. **Fundamentals and critical knowledge of the Computer System:-** Able to Understand the working principles of the computer System and its components , Apply the knowledge to build, asses, and analyze the software and hardware aspects of it .

2. **The comprehensive and Applicative knowledge of Software Development:** Comprehensive skills of Programming Languages, Software process models, methodologies, and able to plan, develop, test, analyze, and manage the software and hardware intensive systems in heterogeneous platforms individually or working in teams.

3. **Applications of Computing Domain & Research:** Able to use the professional, managerial, interdisciplinary skill set, and domain specific tools in development processes, identify the research gaps, and provide innovative solutions to them.

PROGRAM OUTCOMES (POs)

Engineering Graduates should possess the following:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **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.
5. **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.
6. **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.
7. **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.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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 multi disciplinary environments.
12. **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.

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DEPARTMENT OF INFORMATION TECHNOLOGY

GENERAL LABORATORY INSTRUCTIONS

1. Students are advised to come to the laboratory at least 5 minutes before (to the starting time), those who come after 5 minutes will not be allowed into the lab.
2. Plan your task properly much before to the commencement, come prepared to the lab with the synopsis / program / experiment details.
3. Student should enter into the laboratory with:

a. Laboratory observation notes with all the details (Problem statement, Aim, Algorithm, Procedure, Program, Expected Output, etc.,) filled in for the lab session.

b. Laboratory Record updated up to the last session experiments and other utensils (if any) needed in the lab.

c. Proper Dress code and Identity card.

4. Sign in the laboratory login register, write the TIME-IN, and occupy the computer system allotted to you by the faculty.
5. Execute your task in the laboratory, and record the results / output in the lab observation note book, and get certified by the concerned faculty.
6. All the students should be polite and cooperative with the laboratory staff, must maintain the discipline and decency in the laboratory.
7. Computer labs are established with sophisticated and high end branded systems, which should be utilized properly.
8. Students / Faculty must keep their mobile phones in SWITCHED OFF mode during the lab sessions. Misuse of the equipment, misbehaviors with the staff and systems etc., will attract severe punishment.
9. Students must take the permission of the faculty in case of any urgency to go out; if anybody found loitering outside the lab / class without permission during working hours will be treated seriously and punished appropriately.
10. Students should LOG OFF/ SHUT DOWN the computer system before he/she leaves the lab after completing the task (experiment) in all aspects. He/she must ensure the system / seat is kept properly.

HEAD OF THE DEPARTMENT **PRINCIPAL**

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WEEK-1: **DATE:**

Aim: write a C++ programs to implement recursive and non recursive
i) Linear search ii) Binary

Description:

i) LINEAR SEARCH (SEQUENTIAL SEARCH): Search begins by comparing the first element of the list with the target element. If it matches, the search ends. Otherwise, move to next element and compare. In this way, the target element is compared with all the elements until a match occurs. If the match do not occur and there are no more elements to be compared, conclude that target element is absent in the list.

For example consider the following list of elements.

5 9 7 8 11 2 6 4

To search for element 11(i.e Key element = 11). first compare the target element with first element in list i.e. 5. Since both are not matching we move on the next elements in the list and compare. Finally found the match after 5 comparisons.

Algorithm for Linear search

```
Linear_Search (A[ ], N, val , pos )
Step 1 : Set pos = -1 and k = 0
Step 2 : Repeat  while k < N
          Begin
Step 3 :   if A[ k ] = val
                Set pos = k
                print pos
                Goto step 5
          End while
Step 4 : print "Value is not present"
Step 5 : Exit
```

Source code: Non recursive C++ program for Linear search

```
#include<iostream>
using namespace std;
int Lsearch(int list[ ],int n,int key);
int main()
{
        int  n,i,key,list[25],pos;
        cout<<"enter no of elements\n";
        cin>>n;
        cout<<"enter "<<n<<" elements ";
        for(i=0;i<n;i++)
                cin>>list[i];
        cout<<"enter key to search";
        cin>>key;
        pos= Lsearch (list,n,key);
```

```
        if(pos==-1)
                cout<<"\nelement not found";
        else
                cout<<"\n element found at index "<<pos;
}
/*function for linear search*/
int Lsearch(int list[],int n,int key)
{
int i,pos=-1;
        for(i=0;i<n;i++)
        if(key==list[i])
        {
                pos=i;
                break;
        }
return pos;
}
  // Calling non recursive function of fib
   class. f.nonrecursive(n);
  System.out.println("the recursion using recursive is"); ffor(int i=0;i<=n;i++)
  {
  // Calling recursive function of fib class. int F1=f.recursive(i);
  System.out.print(F1);}}}
```

Output (minimum three outputs)

Signature of the Faculty

Source code: Recursive C++ program for Linear search

```
#include<iostream>
using namespace std;
int Rec_Lsearch(int list[ ],int n,int key);
int main()
{
int  n,i,key,list[25],pos;
        cout<<"enter no of elements\n";
        cin>>n;
        cout<<"enter "<<n<<" elements ";
        for(i=0;i<n;i++)
                cin>>list[i];
        cout<<"enter key to search";
        cin>>key;
        pos=Rec_Lsearch(list,n,key);
        if(pos==-1)
                cout<<"\nelement not found";
        else
        cout<<"\n element found at index "<<pos;
}
/*recursive function for linear search*/
int Rec_Lsearch(int list[],int n,int key)
{
if(n<=0)
   return -1;
if(list[n]==key)
   return n;
   else
   return Rec_Lsearch(list,n-1,key);
}
```

Output (minimum three outputs)

Signature of the Faculty

ii) Binary Searching: Before searching, the list of items should be sorted in ascending order. First compare the key value with the item in the mid position of the array. If there is a match, we can return immediately the position. if the value is less than the element in middle location of the array, the required value is lie in the lower half of the array.if the value is greater than the element in middle location of the array, the required value is lie in the upper half of the array. We repeat the above procedure on the lower half or upper half of the array.

Algorithm:

```
Binary_Search (A [ ], U_bound, VAL)
Step 1 : set BEG = 0 , END = U_bound , POS = -1
Step 2 : Repeat while (BEG <= END )
Step 3 :      set MID = ( BEG + END ) / 2
Step 4 :      if  A [ MID ] == VAL then
                  POS = MID
                  print  VAL " is available at ", POS
                  GoTo Step 6
                 End if
                 if A [ MID ] > VAL then
                   set END = MID – 1
                  Else
                   set BEG = MID + 1
                  End if
              End while
Step 5 :   if POS = -1 then
                 print  VAL " is not present "
              End if
Step 6 : EXIT
```

Source code: Non recursive C++ program for binary search

```
#include<iostream>
using namespace std;
int binary_search(int list[],int key,int low,int high);
int main()
{
int n,i,key,list[25],pos;
        cout<<"enter no of elements\n" ;
        cin>>n;
        cout<<"enter "<<n<<" elements in ascending order ";
        for(i=0;i<n;i++)
        cin>>list[i];
        cout<<"enter key to search" ;
        cin>>key;
        pos=binary_search(list,key,0,n-1);
        if(pos==-1)
                cout<<"element not found" ;
        else
```

```
                cout<<"element found at index "<<pos;
}

/*  function for binary search*/
 int binary_search(int list[],int key,int low,int high)
{

        int mid,pos=-1;
        while(low<=high)
        {
                mid=(low+high)/2;
                if(key==list[mid])
                {
                        pos=mid;
                        break;
                }
                else  if(key<list[mid])
                        high=mid-1;
                else
                        low=mid+1;
         }
        return pos;
}
```

Output (minimum three outputs)

Signature of the Faculty

Source code: Recursive C++ program for binary search

```
#include<iostream>
using namespace std;
int rbinary_search(int list[],int key,int low,int high);
int main()
{
int n,i,key,list[25],pos;
        cout<<"enter no of elements\n" ;
        cin>>n;
        cout<<"enter "<<n<<" elements in ascending order ";
        for(i=0;i<n;i++)
        cin>>list[i];
        cout<<"enter key to search" ;
        cin>>key;
        pos=rbinary_search(list,key,0,n-1);
        if(pos==-1)
                cout<<"element not found" ;
        else
                cout<<"element found at index "<<pos;
}
 /*recursive function for binary search*/
int rbinary_search(int list[ ],int key,int low,int high)
{
int mid,pos=-1;
        if(low<=high)
        {
                mid=(low+high)/2;
                if(key==list[mid])
                {
                        pos=mid;
                          return pos;
                }
                else  if(key<list[mid])
                     return rbinary_search(list,key,low,mid-1);
                else
                        return rbinary_search(list,key,mid+1,high);
         }
        return pos;
}
```

Output (minimum three outputs)

Signature of the Faculty

EXERCISE:

1. Write a program to find an element in the list of elements using linear and binary search non recursively, provide a provision to select between linear and binary searching.
2. Write a program to find an element in the list of elements using linear and binary search recursively, provide a provision to select between linear and binary searching.

WEEK-2: **DATE:**

write a C++ programs to implement i) Bubble sort ii) Selection sort
iii) quick sort iv) insertion sort

Aim: To implement i) Bubble sort ii) Selection sort iii) Quick sort iv) Insertion sort
Description:

i)Bubble sort

The bubble sort is an example of exchange sort. In this method, repetitive comparison is performed among elements and essential swapping of elements is done. Bubble sort is commonly used in sorting algorithms. It is easy to understand but time consuming i.e. takes more number of comparisons to sort a list . In this type, two successive elements are compared and swapping is done. Thus, step-by-step entire array elements are checked. It is different from the selection sort. Instead of searching the minimum element and then applying swapping, two records are swapped instantly upon noticing that they
are not in order.

ALGORITHM:

Bubble_Sort (A [ ] , N)

Step 1: Start
Step 2: Take an array of n elements
Step 3: for i=0,…….n-2
Step 4: for j=i+1,…….n-1
Step 5: if arr[j]>arr[j+1] then
Interchange arr[j] and arr[j+1]
End of if
Step 6: Print the sorted array arr
Step 7:Stop

Source code: Write a program to sort a list of numbers using bubble sort

```
#include<iostream>
using namespace std;
void bubble_sort(int list[30],int n);
int main()
{
int n,i;
int  list[30];
        cout<<"enter no of elements\n";
        cin>>n;
        cout<<"enter "<<n<<" numbers ";
        for(i=0;i<n;i++)
        cin>>list[i];
        bubble_sort (list,n);
        cout<<"  after sorting\n";
```

```
        for(i=0;i<n;i++)
        cout<<list[i]<<endl;
return 0;
}
void bubble_sort (int list[30],int n)
{
int temp ;
int i,j;
        for(i=0;i<n;i++)
        for(j=0;j<n-1;j++)
        if(list[j]>list[j+1])
        {
                temp=list[j];
                list[j]=list[j+1];
                list[j+1]=temp;
        }
}
```

Output (minimum three outputs)

Signature of the Faculty

ii) Selection sort (Select the smallest and Exchange):

The first item is compared with the remaining n-1 items, and whichever of all is lowest, is put in the first position. Then the second item from the list is taken and compared with the remaining (n-

2) items, if an item with a value less than that of the second item is found on the (n-2) items, it is swapped (Interchanged) with the second item of the list and so on.

Algorithm:

```
Selection_Sort ( A [ ] , N )
    Step 1 :start
    Step 2: Repeat  For  K  =  0  to N –  2
              Begin
    Step 3 :     Set  POS = K
    Step 4 :     Repeat for J = K + 1 to N –  1
                  Begin
                     If A[ J ] < A [ POS ]
                                Set  POS  =  J
                  End  For
    Step 5 :     Swap  A [ K ]  with A [ POS ]
               End For
    Step 6 : stop
```

Source code: Program to implement selection sort

```
#include<iostream>
using namespace std;
void selection_sort (int list[],int n);
int main()
{
int n,i;
int  list[30];
        cout<<"enter no of elements\n";
        cin>>n;
        cout<<"enter "<<n<<" numbers ";
        for(i=0;i<n;i++)
        cin>>list[i];
        selection_sort (list,n);
        cout<<"  after sorting\n";
        for(i=0;i<n;i++)
        cout<<list[i]<<endl;
return 0;
}

void selection_sort (int list[],int n)
{
int min,temp,i,j;
        for(i=0;i<n;i++)
        {
                min=i;
                for(j=i+1;j<n;j++)
                {
```

```
                    if(list[j]<list[min])
                    min=j;
                }
                temp=list[i];
                list[i]=list[min];
                list[min]=temp;
        }
}
```

Output (minimum three outputs)

Signature of the Faculty

iii) Quick sort: It is a divide and conquer algorithm. Quick sort first divides a large array into two smaller sub-arrays: the low elements and the high elements. Quick sort can then recursively sort the sub-arrays.

ALGORITHM:

Step 1: Pick an element, called a pivot, from the array.

Step 2: Partitioning: reorder the array so that all elements with values less than the pivot come before the pivot, while all elements with values greater than the pivot come after it (equal values can go either way). After this partitioning, the pivot is in its final position. This is called the partition operation.

Step 3: Recursively apply the above steps to the sub-array of elements with smaller values and separately to the sub-array of elements with greater values.

Source code: program to implement Quick sort

```
#include<iostream>
using namespace std;
void quicksort(int x[],int Lb,int Ub)
{
int down,up,pivot,t;
        if(Lb<Ub)
        {
        down=Lb;
        up=Ub;
        pivot=down;
        while(down<up)
        {
                while((x[down]<=x[pivot])&&(down<Ub))down++;
                while(x[up]>x[pivot])up--;
                if(down<up)
                {
                        t=x[down];
                        x[down]=x[up];
                        x[up]=t;
                }/*endif*/
          }
            t=x[pivot];
            x[pivot]=x[up];
            x[up]=t;
         quicksort( x,Lb,up-1);
         quicksort( x,up+1,Ub);
         }
}
int main()
{
int n,i;
int  list[30];
        cout<<"enter no of elements\n";
        cin>>n;
        cout<<"enter "<<n<<" numbers ";
        for(i=0;i<n;i++)
        cin>>list[i];
        quicksort(list,0,n-1);
        cout<<"  after sorting\n";
        for(i=0;i<n;i++)
        cout<<list[i]<<endl;
return 0;
  }
```

Output (minimum three outputs)

Signature of the Faculty

iv) Insertion sort: It iterates, consuming one input element each repetition, and growing a sorted output list. Each iteration, insertion sort removes one element from the input data, finds the location it belongs within the sorted list, and inserts it there. It repeats until no input elements remain

ALGORITHM:

Step 1: start
Step 2: for i ← 1 to length(A)
Step 3: j ← i
Step 4: while j > 0 and A[j-1] > A[j]
Step 5: swap A[j] and A[j-1]
Step 6: j ← j - 1
Step 7: end while
Step 8: end for
Step9: stop

Source code: program to implement insertion sort

```
#include<iostream>
using namespace std;
void insertion_sort(int a[],int n)
{
int i,t,pos;
        for(i=0;i<n;i++)
        {
                t=a[i];
                pos=i;
                while(pos>0&&a[pos-1]>t)
```

```
                {
                        a[pos]=a[pos-1];
                        pos--;
                }
                a[pos]=t;
        }
}
int main()
{
int n,i;
int  list[30];
        cout<<"enter no of elements\n";
        cin>>n;
        cout<<"enter "<<n<<" numbers ";
        for(i=0;i<n;i++)
        cin>>list[i];
        insertion_sort(list,n);
        cout<<"  after sorting\n";
        for(i=0;i<n;i++)
        cout<<list[i]<<endl;
return 0;
}
```

Output (minimum three outputs)

Signature of the Faculty

EXERCISE:

1.Write a program to implement all above sorting techniques in a single program. provide a menu for selection of various sorting techniques during runtime.

2.Write a program to implement above sorting techniques using dynamic memory allocation.

WEEK-3: **DATE:**

Write C++ programs to implement the following using an array.
a)Stack ADT b) Queue ADT

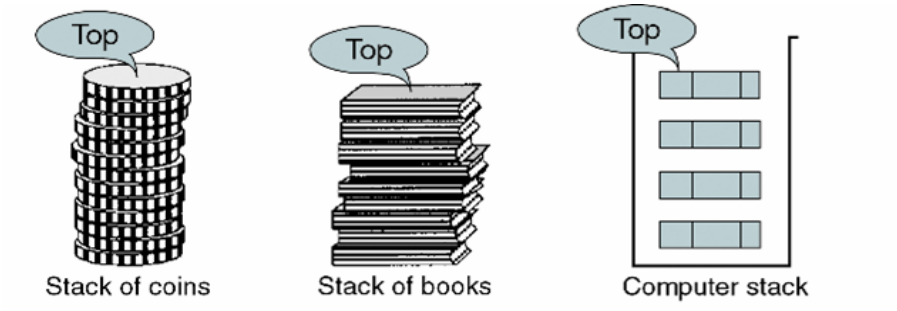
Aim: To implement Stack ADT and Queue ADT using an array

Description:

Stack:It is an ordered collection of data elements into which new elements may be inserted and from which elements may be deleted at one end called the "TOP" of stack.

- A stack is a last-in-first-out (LIFO) structure.
- Insertion operation is referred as "PUSH" and deletion operation is referred as "POP".
- The most accessible element in the stack is the element at the position "TOP".
- Stack must be created as empty.
- Whenever an element is pushed into stack, it must be checked whether the stack is full or not.
- Whenever an element is popped form stack, it must be checked whether the stack is empty or not.

We can implement the stack ADT either with array or linked list.



ALGORITHM: push()

Step 1: if top> =max-1 then
Step 2: Display the stack overflows
Step 3: else then
Step 4: top ++
Step 5: assign stack[top]=x
Step 6: Display element is inserted

ALGORITHM pop()

Step 1: if top = =-1 then
Step 2: Display the stack is underflows

Step 3: else
Step 4: assign x=stack[top]
Step 5: top- -
Step 6: return x

Source code: To implement Stack ADT using an array

```
#include<iostream>
using namespace std;
#include<stdlib.h>
#define max 50
template <class T>
class stack
{
private:
        T top,stk[50],item;
public:
                stack();
        void push();
        void pop();
        void display();
};
template <class T>
stack<T>::stack()
{
top=-1;
}
//code to push an item into stack;
template <class T>
void stack<T>::push()
{
if(top==max-1)
        cout<<"Stack Overflow...\n";
else
   {
   cout<<"Enter an item to be pushed:";
   top++;
   cin>>item;
   stk[top]=item;
   cout<<"Pushed Sucesfully....\n";
   }
}
template <class T>
void stack<T>::pop()
{
```

```
if(top==-1)
        cout<<"Stack is Underflow";
else
        {
        item=stk[top];
        top--;
        cout<<item<<" is poped Sucesfully....\n";
        }
}
template <class T>
void stack<T>::display()
{
        if(top==-1)
                cout<<"Stack Under Flow";
        else
        {
                for(int i=top;i>-1;i--)
                {
                        cout<<"|"<<stk[i]<<"|\n";
                        cout<<"----\n";
                }
        }
}
int main()
{
int choice;
stack<int>st;
        while(1)
        {
        cout<<"\n\n*****Menu for Skack operations*****\n\n";
        cout<<"1.PUSH\n2.POP\n3.DISPLAY\n4.EXIT\n";
        cout<<"Enter Choice:";
        cin>>choice;
        switch(choice)
        {
        case 1:
                st.push();
                break;
        case 2:
                st.pop();
                break;
        case 3: cout<<"Elements in the Stack are....\n";
                st.display();
                break;
```

```
            case 4:
                    exit(0);
            default:cout<<"Invalid choice...Try again...\n";
            }
      }
}
```

Output (minimum three outputs)

Signature of the Faculty

QUEUE DESCRIPTION:

Queue is a data structure in which the elements are added at one end, called the rear, and deleted from the other end, called the front. A First In First Out data structure (FIFO).The rear of the queue is accessed whenever a new element is added to the queue, and the front of the queue is accessed whenever an element is deleted from the queue. As in a stack, the middle elements in the queue are in accessible, even if the queue elements are sorted in an array.

BASIC QUEUE OPERATIONS:

1. initializeQueue(): Initializes the queue to an empty state.
2. Determines whether the queue is empty. If the queue is empty, it returns the value true; otherwise, it returns the value false.
3. Determines whether the queue is full. If the queue is empty, it returns the value true; otherwise, it returns the value false.
4. rear: Returns the last element of the queue. Prior to this operation, the queue must exit.
5. front: Returns the front, that is, the first element of the queue. Priority to this operation, the queue must exit.

Queue can be stored either in an array or in linked list. We will consider both implementations. Because elements are added at one end and remove from the other end, we need two pointers to keep track of the front and rear of the queue, called queueFront and

queueRear. Queues are restricted versions of arrays and linked lists. The middle terms of queue should not be accessed directly.

Source code: To implement Queue ADT using an array

```
#include<stdlib.h>
#include<iostream>
using namespace std;
#define max 5
template <class T>
class queue
{
private:T q[max],item;
        int front,rear;
public: queue();
        void insert_q();
        void delete_q();
        void display_q();
};
template <class T>
queue<T>::queue()
{
        front=rear=-1;
}

//code to insert an item into queue;
template <class T>
void queue<T> ::insert_q()
{
if(rear>=max-1)
        cout<<"queue Overflow...\n";
else
        {
                if(front>rear)
                  front=rear=-1;
                else
```

```
                {               if(front==-1)
                                        front=0;
                        rear++;
                cout<<"Enter an item to be inserted:";
                        cin>>item;
                        q[rear]=item;
                        cout<<"inserted Sucesfully..into queue..\n";
                }
        }
}

template <class T>
void queue<T>::delete_q()
{
if(front==-1||front>rear)
        {
                front=rear=-1;
                cout<<"queue is Empty....\n";
        }
else
        {
                item=q[front];
                front++;
                cout<<item<<" is deleted Sucesfully....\n";
        }
}
template <class T>
void queue<T>::display_q()
{
         if(front==-1||front>rear)
        {
                front=rear=-1;
                cout<<"queue is Empty....\n";
        }
        else
        {
                 for(int i=front;i<=rear;i++)
                cout<<"|"<<q[i]<<"|<--";
        }
}
int main()
{
int choice;
queue<int> q;
```

```
while(1)
    {
        cout<<"\n\n*****Menu for QUEUE operations*****\n\n";
        cout<<"1.INSERT\n2.DELETE\n3.DISPLAY\n4.EXIT\n";
        cout<<"Enter Choice:";
        cin>>choice;
        switch(choice)
        {
            case 1:     q.insert_q();
                        break;
            case 2:     q.delete_q();
                        break;
            case 3:     cout<<"Elements in the queue are....\n";
                        q.display_q();
                        break;
            case 4:     exit(0);
            default: cout<<"Invalid choice...Try again...\n";
        }
    }
return 0;}
```

Output (minimum three outputs)

Signature of the Faculty

EXERCISE:

1.Write a program to perform matching of parenthesis using stack.
2.Write a program to perform evaluation of postfix expression
3.Write a program to convert given infix expression to post fix.

WEEK-4: **DATE:**

Aim: To implement list ADT to perform following operations

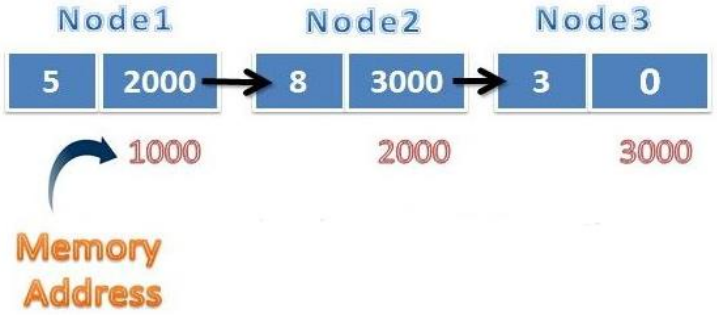
a) Insert an element into a list. b) Delete an element from list

c) Search for a key element in list d)count number of nodes in list

Description:

List ADT

A **linked list** is a data structure consisting of a group of nodes which together represent a sequence. Each node is composed of a data part and a reference (in other words, a *link*) to the next node in the sequence.



The Linked List is a collection of elements called nodes, each node of which stores two items of information, i.e., data part and link field.

The data part of each node consists the data record of an entity.

The link field is a pointer and contains the address of next node.

The beginning of the linked list is stored in a pointer termed as head which points to the first node.

The head pointer will be passed as a parameter to any method, to perform an operation.

First node contains a pointer to second node, second node contains a pointer to the third node and so on.

The last node in the list has its next field set to NULL to mark the end of the list.

- There are several variants of linked lists. These are as follows:
  - Singly linked list
  - Circular linked list
  - Doubly linked list
  - Doubly circular linked list

SINGLE LINKED LIST:

Single Linked List is a collection of nodes. Each node contains 2 fields: I) info where the information is stored and ii) link which points to the next node in the list.

The node is like this:

Node

Info (or) data	Link (or) next

The operations that can be performed on single linked lists includes: insertion, deletion and traversing the list.

Various operations on a single linked list are

1.Insertion of a node into list

2.Deletion of a node from list

3.Traversal of the list

Source code: To Implement LIST ADT in C++

```
#include<stdlib.h>
#include<iostream.h>
#include<conio.h>
class node{
public:
        int data;
        node *next;
};
class List
{
int item;
node *head;
public: List( );
        void insert_front( );
        void insert_end( );
        void delete_front( );
        void delete_end( );
        void display( );
                int node_count();
                void delete_before_pos();
                void delete_after_pos();
};
List::List( )
{
        head=NULL;
}
//code to insert an item at front List;
void List::insert_front( )
{
        node *p;
        cout<<"Enter an element to be inserted:";
        cin>>item;
```

```
        p=new node;
        p->data=item;
        p->next=NULL;
        if(head==NULL)
        {
                head=p;
        }
        else{
                p->next=head;
                head=p;
                }
        cout<<"\nInserted at front of  Linked List  Sucesfully....\n";
}
//code to insert an item at end List
void List::insert_end( )
{
        node *p;
        cout<<"Enter an element to be inserted:";
        cin>>item;
        p=new node;
        p->data=item;
        p->next=NULL;
        if(head==NULL)
        {
                head=p;
        }
        else{
                node*t;
                t=head;
                while(t->next!=NULL)
                t=t->next;
                t->next=p;
        }
        cout<<"\nInserted an element at end of Linked List  Sucesfully....\n";
}
void List::delete_front( )
{
        node*t;
        if(head==NULL)
        cout<<"\nList is Underflow";
        else{
                item=head->data;
                t=head;
                head=head->next;
```

```
                cout<<"\n"<<item<<" is deleted Sucesfully from List....\n";
                delete(t);
        }
}
void List::delete_end( )
{
        node*t,*prev;
        if(head==NULL)
        cout<<"\nList is Underflow";
        else
        {
                t=head;
                if(head->next==NULL)
                {
                        cout<<"\n"<<t->data<<" is deleted Sucesfully from List....\n";
                        delete(t);
                        head=NULL;
                }
                else
                {
                        while(t->next!=NULL)
                        {
                                prev=t;
                                t=t->next;
                        }
                        prev->next=NULL;
                        cout<<"\n"<<t->data<<" is deleted Sucesfully from List....\n";
                        delete(t);
                }
        }
}
//Delete a node  before a position
void List::delete_before_pos( )
{
        int i=1;
        int pos;
        node*t,*prev;
        if(head==NULL)
        cout<<"\nList is Underflow";
        else
        {
                cout<<"Enter position at which node has to be deleted:";
                cin>>pos;
                t=head;
```

```
                int nc=node_count();
                if(pos>nc||pos<=0)
                cout<<"invalid position ...try again\n";
                else
                {
                        cout<<"Before Deletion elements in the List are..\n";
                        display();
                        while(i<pos)
                        {
                                prev=t;
                                t=t->next;
                                i++;
                        }
                        if(i==1)
                        {
                                cout<<"\n"<<t->data<<" is deleted Successfully from List....\n";
                                if(head->next==NULL)
                                head=NULL;
                                else
                                {
                                        t=head;
                                        head=head->next;
                                cout<<"\n"<<t->data<<"is deleted Successfully from List....\n";
                                                delete(t);
                                }
                        }
                        else
                        {
                                prev->next=t->next;
                                cout<<"\n"<<t->data<<" is deleted Successfully from List....\n";
                                delete(t);
                        }
                                cout<<"After Deletion elements in the List are..\n";
                                display();
                }
        }
}
//Delete a node after a position
void List::delete_after_pos( )
{
        int i=1;
        int pos;
        node *t,*prev;
        if(head==NULL)
```

```
        cout<<"\nList is Underflow";
        else
        {
                cout<<"Enter position at which node has to be deleted:";
                cin>>pos;
                t=head;
                int nc=node_count();
                if(pos>nc||pos<=0)
                cout<<"invalid position ...try again\n";
                else
                {
                        cout<<"Before Deletion elements in the List are..\n";
                        display();
                        while(i<pos)
                        {
                                prev=t;
                                t=t->next;
                                i++;
                        }
                        if(i==1)
                        {
                        cout<<"\n"<<t->data<<" is deleted Successfully from List....\n";
                                if(head->next==NULL)
                                head=NULL;
                                else
                                {
                                        t=head;
                                        head=head->next;
                                        cout<<"\n"<<t->data<<"      is      deleted      Successfully
                                                fromList....\n";
                                         delete(t);
                                }
                        }
                        else
                        {
                                prev->next=t->next;
                                cout<<"\n"<<t->data<<" is deleted Successfully from List....\n";
                                delete(t);
                        }
                        cout<<"After Deletion elements in the List are..\n";
                        display();
                }
        }
}
```

```
void List::display()
{
	node*t;
	if(head==NULL)
	cout<<"\nList Under Flow";
	else
	{
		cout<<"\nElements in the List are....\n";
		t=head;
		while(t!=NULL)
		{
			cout<<"|"<<t->data<<"|->";
			t=t->next;
		}
	}
}
//code to count no of nodes
int List::node_count( )
{
	int nc=0;
	node*t;
	if(head==NULL)
	{
		cout<<"\nList Under Flow"<<endl;
		//   cout<<"No Nodes in the Linked List are: "<<nc<<endl;
	}
	else
	{
		t=head;
		while(t!=NULL)
		{
			nc++;
			t=t->next;
		}
		 //cout<<"No Nodes in the Linked List are: "<<nc<<endl;
	}
	return nc;
}
int main( )
{
	int choice;
	List LL;
	while(1)
	{
```

```
                cout<<"\n\n***Menu for Linked List operations***\n\n";
                cout<<"1.Insert Front\n2.Insert end\n3.Delete front\n4.Delete End\n5.DISPLAY\n";
                cout<<"6.Node Count\n7.Del before a position\n8.Del after position\n";
                cout<<"9.Clear Scrn\n10.Exit\nEnter Choice:";
                cin>>choice;
                switch(choice)
                {
                        case 1:  LL.insert_front( );
                                 break;
                        case 2:  LL.insert_end( );
                                 break;
                        case 3:  LL.delete_front( );
                                 break;
                        case 4:  LL.delete_end( );
                                 break;
                        case 5: LL.display( );
                                 break;
                        case 6:cout<<"No of nodes in List:"<<LL.node_count();
                                 break;
                        case 7:LL.delete_before_pos();
                                 break;
                        case 8:LL.delete_after_pos();
                                 break;
                        case 9:clrscr();
                              break;
                        case 10:exit(0);
                        default:cout<<"Invalid choice...Try again...\n";
                }
        }
}
```

Output (minimum three outputs)

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EXERCISE:

1.Write a program to concatenate two linked lists

2.Write a program to generate two lists from a given linked list such that first list contains all elements in odd places and second list consists of all elements in even places

WEEK-5: **DATE:**

Aim: To implement Stack ADT and Queue ADT using a singly linked list.

Description:

A Stack is a collection of items in which new items may be deleted at end to implement stack using linked list we need to define a node which in turn consist of data a pointer to the next node. The advantage of representing stack using linked lists is that we can decide which end should be top of a stack. And since the array size is fixed, in the array (linear) representation of stack, only fixed number of elements can be pushed onto the stack. If in a program the number of elements to be pushed exceeds the size of the array, the program may terminate in an error. We must overcome these problems.

By using linked lists we can dynamically organize data (such as an ordered list).Therefore, logically the stack is never full. The stack is full only if we run out of memory space. In the below program we select front end as top if stack in which we can add or remove data.

Source code: To implement Stack ADT using a singly linked list.

```
#include<stdlib.h>
#include<iostream>
using namespace std;
template <class T>
class node
{
public:
        T data;
        node<T>*next;
};

template <class T>
class stack
{
private:
          T item;
          node<T> *top;
public: stack();
                    void push();
                    void pop();
                    void display();
};
template <class T>
stack<T>::stack()
{
          top=NULL;
}
```

```
//code to push an item into stack;
template <class T>
void stack<T>::push()
{
        node<T>*t;
        node<T>*p;
        cout<<"Enter an item to be pushed:";
        cin>>item;
        p=new node<T>;
        p->data=item;
        p->next=top;
        top=p;
        cout<<"\nPushed Sucesfully....\n";
 }
template <class T>
void stack<T>::pop()
{
        node<T>*t;
        if(top==NULL)
        cout<<"\nStack is Underflow";
        else
        {
                item=top->data;
                top=top->next;
                cout<<"\n"<<item<<" is poped Sucesfully....\n";
        }

}
template <class T>
void stack<T>::display()
{
        node<T>*t;
        if(top==NULL)
                cout<<"\nStack Under Flow";
        else
        {
                cout<<"\nElements in the Stack are....\n";
                t=top;
                while(t!=NULL)
                {
                        cout<<"|"<<t->data<<"|\n";
                        cout<<"----\n";
                        t=t->next;
                }
```

```
        }
}
int main()
{
int choice;
stack<int>st;
while(1)
{
        cout<<"\n\n***Menu for Skack operations***\n\n";
        cout<<"1.PUSH\n2.POP\n3.DISPLAY\n4.EXIT\n";
        cout<<"Enter Choice:";
        cin>>choice;
        switch(choice)
        {
        case 1:
                st.push();
                break;
        case 2:
                st.pop();
                break;
        case 3: st.display();
                break;
        case 4:
                exit(0);
        default:cout<<"Invalid choice...Try again...\n";
        }
  }
}
```

Output (minimum three outputs)

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Description: Queue is a data structure in which the elements are added at one end, called the **rear**, and deleted from the other end, called the **front**. A First In First Out data structure (FIFO). The rear of the queue is accessed whenever a new element is added to the queue, and the front of the queue is accessed whenever an element is deleted from the queue. As in a stack, the middle elements in the queue are in accessible, even if the queue elements are sorted in an array.

Source code: To implement QUEUE ADT using a singly linked list

```
#include<stdlib.h>
#include<iostream.h>
template <class T>
class node
{
public:
        T data;
        node<T>*next;
};
template <class T>
class queue
{
private:
        T item;
        friend class node<T>;
        node<T> *front,*rear;
public: queue();
        void insert_q();
        void delete_q();
        void display_q();
};
template <class T>
queue<T>::queue()
{
        front=rear=NULL;
}
//code to push an item into queue;
template <class T>
void queue<T>::insert_q()
{
        node<T>*p;
        cout<<"Enter an element to be inserted:";
        cin>>item;
        p=new node<T>;
        p->data=item;
        p->next=NULL;
        if(front==NULL)
        {
```

```
        rear=front=p;
        }
        else
        {
                rear->next=p;
                rear=p;
        }
        cout<<"\nInserted into Queue Sucesfully....\n";
 }
//code to delete an element
template <class T>
void queue<T>::delete_q()
{
        node<T>*t;
        if(front==NULL)
                cout<<"\nqueue is Underflow";
        else
        {
                item=front->data;
                t=front;
                front=front->next;
                cout<<"\n"<<item<<" is deleted Sucesfully from queue....\n";
        }
delete(t);
}
//code to display elements in queue
template <class T>
void queue<T>::display_q()
{
        node<T>*t;
        if(front==NULL)
                cout<<"\nqueue Under Flow";
        else
        {
                cout<<"\nElements in the queue are....\n";
                t=front;
                while(t!=NULL)
                {
                cout<<"|"<<t->data<<"|<-";
                t=t->next;
                }
        }
}
```

```
int main()
{
int choice;
queue<int>q1;
        while(1)
        {
                cout<<"\n\n***Menu for Queue operations***\n\n";
                cout<<"1.Insert\n2.Delete\n3.DISPLAY\n4.EXIT\n";
                cout<<"Enter Choice:";
                cin>>choice;
                switch(choice)
                {
                        case 1:  q1.insert_q();
                                 break;
                        case 2:  q1.delete_q();
                                 break;
                        case 3: q1.display_q();
                                 break;
                        case 4:  exit(0);
                        default:cout<<"Invalid choice...Try again...\n";
                }
  }
  return 0;
}
```

Output (minimum three outputs)

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EXERCISE:

1.Implement any one application using Stack.

2.Implement any one application using Queue.

WEEK-6: **DATE:**

Aim: To implement the de queue (double ended queue) ADT using a doubly linked list and an array.

Source code: To implement the de queue (double ended queue) ADT

```
#include <iostream.h>
#include<stdlib.h>
#include <conio.h>
template<class T>
class node
{
public:
        T data;
        node*prev;
        node*next;
};
template<class T>
class dll
{
        node<T>*head;
public:
        dll();
        void insert_front();
        void insert_end();
        void delete_front();
        void delete_end();
        void display();
        void insert_at_pos();
        int node_count();
};
template<class T>
 dll<T>::dll()
{
        head=NULL;
}

//code to insert node at front of list...
template<class T>
void dll<T>::insert_front()
{
        node<T>*new_node;
        int x;
        new_node=new node<T>;
        cout<<"Enter data into node:\n";
```

```
        cin>>x;
        new_node->data=x;
        new_node->prev=NULL;
        new_node->next=NULL;
        if(head==NULL)
                head=new_node;
        else
        {
                new_node->next=head;
                head->prev=new_node;
                head=new_node;
         }
        cout<<"Inserted node sucesfully...";
}
//code to insert node at end of list...
template<class T>
void dll<T>::insert_end()
{
        node<T>*new_node;
        node<T>*t;
        int x;
        new_node=new node<T>;
        cout<<"Enter data into node:\n";
        cin>>x;
        new_node->data=x;
        new_node->next=NULL;
        new_node->prev=NULL;
        if(head==NULL)
                head=new_node;
        else
        {
                t=head;
                while(t->next!=NULL)
                        t=t->next;
                t->next= new_node;
                new_node->prev=t;
          }
        cout<<"Inserted node sucesfully...";
}

template<class T>
void dll<T>::delete_front()
{
        node<T>*temp;
```

```
        if(head==NULL)
                cout<<"List is empty....\n ";
        else if(head->next==NULL)
        {
        temp=head;
        cout<<"Deleted element from Doubly Linked List is "<<temp->data<<endl;
        delete temp;
        head=NULL;
        }
        else
        {
                temp=head;
                head=head->next;
                head->prev=NULL;
                cout<<"Deleted element from Doubly Linked List is "<<temp->data<<endl;
                delete temp;
                cout<<"Elements after deletion from Front are...\n";
                display();
        }
}

template<class T>
void dll<T>::delete_end()
{
        node<T>*t1;
        node<T>*t2;
        if(head==NULL)
                cout<<"List is empty....\n ";
        else
        {
                t1=t2=head;
                if(head->next==NULL)
                {
                        head=NULL;
                        cout<<"Deleted element from Doubly Linked List is "<<t1->data<<endl;
                        delete t1;
                }
                else
                {
                        while(t1->next!=NULL)
                        {
                                t2=t1;
                                t1=t1->next;
                        }
```

```
                        t2->next=NULL;
                        cout<<"Deleted element from Doubly Linked List is "<<t1->data<<endl;
                        delete t1;
                        cout<<"Elements after Deletion from End are...\n";
                        display();
                }
        }
}
template<class T>
void dll<T>::insert_at_pos()
{
        node<T>*new_node;
        node<T>*t1;
        node<T>*t2;
        int x,pos,nc;
        new_node=new node<T>;
         cout<<"Enter data into node:\n";
        cin>>x;
        cout<<"enter Pos at which node has to be inserted:";
        cin>>pos;
         new_node->data=x;
         new_node->next=NULL;
         new_node->prev=NULL;
         nc=node_count();
         cout<<"node count="<<nc<<endl;
        if(pos<=0||pos>nc+1)
                cout<<"invalid position";
        else
         {
                if(pos==1)
                {

                        if(head==NULL)
                                head=new_node;
                        else
                        {
                                new_node->next=head;
                                head->prev=new_node;
                                head=new_node;
                        }
                }
                else
                {
                        t1=t2=head;
```

```
                        int i=1;
                        while(i<pos)
                        {
                                t2=t1;
                                t1=t1->next;
                                i++;
                        }
                        if(t1==NULL)
                        {
                                new_node->next=NULL;
                        }
                        else
                        {
                                t1->prev=new_node;
                        }
                 t2->next= new_node;
                 new_node->prev=t2;
                }
                cout<<"Inserted node sucesfully...";
        }
}

template<class T>
int dll<T>:: node_count()
{
        int i=0;
        node<T> *t;
        t=head;
        while(t!=NULL)
        {
                t=t->next;
                i++;
        }
        return i;
}
template<class T>
void dll<T>::display()
{
        node<T>*t;
        int count;
        t=head;
        if(head==NULL)
        {
                cout<<"Doubly linked list is empty.....\n";
```

```
        }
        else
        {
                cout<<"Elements in the list are.....\n";
                while(t!=NULL)
                 {
                        cout<<"|"<<t->data<<"|-> ";
                        t=t->next;
                 }
        }

        count=node_count();
        cout<<"\n Total No of nodes in Doubly linked List are:"<<count<<endl;
}

int main()
{
dll<int> d;
int choice;
        while(1)
        {       cout<<"\n***Menu for Doubly linked list operations***\n";
                cout<<"\n1.insert front";
                cout<<"\n2.insert end";
                cout<<"\n3.delete front";
                cout<<"\n4.delete end";
                cout<<"\n5.Display";
                cout<<"\n6.insert at pos";
                cout<<"\n7.Exit";
                cout<<"\nEnter Choice:";
                cin>>choice;
                switch(choice)
                {
                        case 1:d.insert_front();
                                        break;
                        case 2:d.insert_end();
                                        break;
                        case 3:d.delete_front();
                                        break;
                        case 4:d.delete_end();
                                        break;
                        case 5:d.display();
                                        break;
                        case 6:d.insert_at_pos();
                                        break;
```

```
                    case 7:exit(0);
                }
        }
//return 0;
}
```

Output (Minimum Three Outputs)

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EXERCISE:

1.Implement queue using doubly linked list
2.Implement circular Queue using doubly linked list

WEEK-7: **DATE**:

Aim: Write a C++ program to perform the following operations:

a) Insert an element into a binary search tree.

b) Delete an element from a binary search tree.

c) Search for a key element in a binary search tree.

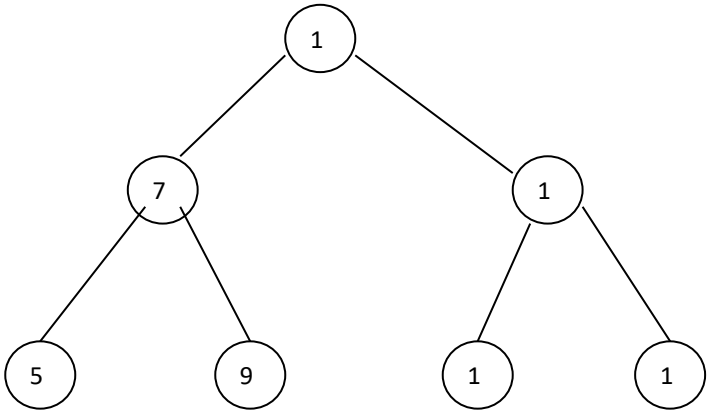
Description:

Binary Search Tree:

So to make the searching algorithm faster in a binary tree we will go for building the binary search tree. The binary search tree is based on the binary search algorithm. While creating the binary search tree the data is systematically arranged.

That means values at

left sub-tree < root node value < right sub-tree values.



Source code:

```
#include<stdlib.h>
#include<iostream.h>
class node
{
public:
        int data;
        node*lchild;
        node*rchild;
};
class bst:public node
{       int item;
        node *root;
public: bst();
        void insert_node();
        void delete_node();
```

```
        void display_bst();
        void inorder(node*);
};
bst::bst()
{
root=NULL;
}
void bst:: insert_node()
{
node *new_node,*curr,*prev;
        new_node=new node;
        cout<<"Enter data into new node";
        cin>>item;
        new_node->data=item;
        new_node->lchild=NULL;
        new_node->rchild=NULL;
        if(root==NULL)
                root=new_node;
        else
        {       curr=prev=root;
                while(curr!=NULL)
                {       if(new_node->data>curr->data)
                        {       prev=curr;
                                curr=curr->rchild;
                        }
                        else
                        {       prev=curr;
                                curr=curr->lchild;
                        }
                }
                cout<<"Prev:"<<prev->data<<endl;
                if(prev->data>new_node->data)
                        prev->lchild=new_node;
                else
                        prev->rchild=new_node;
                }
}

//code to delete a node
void bst::delete_node()
{
if(root==NULL)
        cout<<"Tree is Empty";
else
```

```
{
int key;
        cout<<"Enter the key value to be deleted";
        cin>>key;
        node* temp,*parent,*succ_parent;
        temp=root;
        while(temp!=NULL)
        {       if(temp->data==key)
                {   //deleting node with two childern
                  if(temp->lchild!=NULL&&temp->rchild!=NULL)
                        {       //search for inorder sucessor
                                node*temp_succ;
                                temp_succ=temp->rchild;
                                while(temp_succ->lchild!=NULL)
                                {
                                        succ_parent=temp_succ;
                                        temp_succ=temp_succ->lchild;
                                }
                                temp->data=temp_succ->data;
                                succ_parent->lchild=NULL;
                           cout<<"Deleted sucess fully";
                           return;
                        }
                        //deleting a node having one left child
                        if(temp->lchild!=NULL&temp->rchild==NULL)
                        {
                        if(parent->lchild==temp)
                                parent->lchild=temp->lchild;
                        else
                                parent->rchild=temp->lchild;
                        temp=NULL;
                        delete(temp);
                        cout<<"Deleted sucess fully";
                         return;
                        }
                     //deleting a node having one right child
                        if(temp->lchild==NULL&temp->rchild!=NULL)
                        {
                        if(parent->lchild==temp)
                                parent->lchild=temp->rchild;
                        else
                                parent->rchild=temp->rchild;
                        temp=NULL;
                        delete(temp);
```

```
                        cout<<"Deleted sucess fully";
                        return;
                        }
                    //deleting a node having no child
                        if(temp->lchild==NULL&temp->rchild==NULL)
                        {
                        if(parent->lchild==temp)
                                parent->lchild=NULL;
                        else
                                parent->rchild=NULL;
                        temp=NULL;
                        delete(temp);
                        cout<<"Deleted sucess fully";
                        return;
                        }
                }
                else if(temp->data<key)
                     {          parent=temp;
                                temp=temp->rchild;
                        }
                else if(temp->data>key)
                        {          parent=temp;
                                temp=temp->lchild;
                        }
        }//end while
  }//end if
 }//end delnode func
void bst::display_bst()
{
        if(root==NULL)
                cout<<"\nBST Under Flow";
        else
                inorder(root);
}
void bst::inorder(node*t)
{
        if(t!=NULL)
        {
                inorder(t->lchild);
                cout<<" "<<t->data;
                inorder(t->rchild);
        }
}
int main()
```

```
{
bst bt;
int i;
        while(1)
        {
                cout<<"****BST Operations****";
                cout<<"\n1.Insert\n2.Display\n3.del\n4.exit\n";
                cout<<"Enter Choice:";
                cin>>i;
                switch(i)
                {
                        case 1:bt.insert_node();
                                        break;
                        case 2:bt.display_bst();
                                        break;
                        case 3:bt.delete_node();
                                break;
                        case 4:exit(0);
                        default: cout<<"Enter correct choice";
                }
        }
}
```

Output (minimum three outputs)

Signature of the Faculty

EXERCISE:

1.Implement one of Application using binary search tree (Searching Algorithm).

WEEK-8: **DATE:**

Aim: To implement Merge sort and Heap sort

Description:

Merge sort is an O(*n* log *n*) comparison-based sorting algorithm. It is stable, meaning that it preserves the input order of equal elements in the sorted output. It is an example of the divide and conquer algorithmic paradigm. Merge sort is so inherently sequential that it's practical to run it using slow tape drives as input and output devices. It requires very little memory, and the memory required does not change with the number of data elements. If you have four tape drives, it works as follows:

1. Divide the data to be sorted in half and put half on each of two tapes
2. Merge individual pairs of records from the two tapes; write two-record chunks alternately to each of the two output tapes
3. Merge the two-record chunks from the two output tapes into four-record chunks; write these alternately to the original two input tapes
4. Merge the four-record chunks into eight-record chunks; write these alternately to the original two output tapes
5. Repeat until you have one chunk containing all the data, sorted --- that is, for log *n* passes, where *n* is the number of records.

Conceptually, merge sort works as follows:

1. Divide the unsorted list into two sublists of about half the size
2. Divide each of the two sublists recursively until we have list sizes of length 1, in which case the list itself is returned
3. Merge the two sublists back into one sorted list.

Source code:

```
#include<iostream>
using namespace std;
 #define max 15
template<class T>
 void merge(T a[],int l,int m,int u)
  {
  T b[max];
   int i,j,k;
          i=l; j=m+1;
           k=l;
           while((i<=m)&&(j<=u))
            {
                  if(a[i]<=a[j])
                    {
                          b[k]=a[i];
                           ++i;
```

```
                }
                else
                {
                        b[k]=a[j];
                        ++j;
                }
                ++k;
        }
        if(i>m)
        {
                while(j<=u)
                {
                        b[k]=a[j];
                        ++j;
                        ++k;
                }
        }
        else
        {
                while(i<=m)
                {
                        b[k]=a[i];
                        ++i;
                        ++k;
                }
        }
        for(int r=l;r<=u;r++)
        a[r]=b[r];
}

template <class T>
void mergesort(T a[],int p,int q)
 {
 int mid;
 if(p<q)
  {
        mid=(p+q)/2;
        mergesort(a,p,mid);
        mergesort(a,mid+1,q);
        merge(a,p,mid,q);
        }
}
```

```
int main()
{
int n,i;
int  list[30];
        cout<<"enter no of elements\n";
        cin>>n;
        cout<<"enter "<<n<<" numbers ";
        for(i=0;i<n;i++)
        cin>>list[i];
        mergesort (list,0,n-1);
        cout<<"  after sorting\n";
        for(i=0;i<n;i++)
        cout<<list[i]<<endl;
return 0;
}
```

Output (minimum three outputs)

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HEAP SORT

Heap sort is a method in which a binary tree is used. In this method first the heap is created using binary tree and then heap is sorted using priority queue.

Source code:// C++ program for implementation of Heap Sort

```
#include <iostream>
using namespace std;

// To heapify a subtree rooted with node i which is
// an index in arr[]. n is size of heap
void heapify(int arr[], int n, int i)
{
   int largest = i;  // Initialize largest as root
   int l = 2*i + 1;  // left = 2*i + 1
   int r = 2*i + 2;  // right = 2*i + 2

   // If left child is larger than root
   if (l < n && arr[l] > arr[largest])
      largest = l;

   // If right child is larger than largest so far
   if (r < n && arr[r] > arr[largest])
      largest = r;

   // If largest is not root
   if (largest != i)
   {
      swap(arr[i], arr[largest]);

      // Recursively heapify the affected sub-tree
      heapify(arr, n, largest);
   }
}
// main function to do heap sort
void heapSort(int arr[], int n)
{
   // Build heap (rearrange array)
   for (int i = n / 2 - 1; i >= 0; i--)
      heapify(arr, n, i);
   // One by one extract an element from heap
   for (int i=n-1; i>=0; i--)
   {
      // Move current root to end
      swap(arr[0], arr[i]);
```

```
        // call max heapify on the reduced heap
        heapify(arr, i, 0);
    }
}
/* A utility function to print array of size n */
void printArray(int arr[], int n)
{
    for (int i=0; i<n; ++i)
        cout << arr[i] << " ";
    cout << "\n";
}

int main()
{
int n,i;
int  list[30];
            cout<<"enter no of elements\n";
            cin>>n;
            cout<<"enter "<<n<<" numbers ";
            for(i=0;i<n;i++)
            cin>>list[i];
            heapSort(list, n);
            cout << "Sorted array is \n";
    printArray(list, n);
return 0;
  }
```

Output (minimum three outputs)

Signature of the Faculty

EXERCISE:

1.Explain time complexity in Merge sort.

2.Explain about heap sort.

WEEK-9 : **DATE:**

Write C++ programs that use recursive functions to traverse the given binary tree in a)Preorder b) inorder and c) postorder

Aim: To implement Binary tree traversals

Description:

It is often convenient to a single list containing all the nodes in a tree. This list may correspond to an order in which the nodes should be visited when the tree is being searched. We define three such lists here, the **preorder**, **postorder** and **inorder** traversals of the tree. The definitions themselves are recursive:

- if T is the empty tree, then the empty list is the preorder, the inorder and the postorder traversal associated with T;
- if $T = [N]$ consists of a single node, the list $[N]$ is the preorder, the inorder and the postorder traversal associated with T;
- otherwise, T contains a root node n, and subtrees T_1,..., T_n: and
  - the *preorder* traversal of the nodes of T is the list containing N, followed, in order by the preorder traversals of T_1..., T_n;
  - the *inorder* traversal of the nodes of T is the list containing the inorder traversal of T_1 followed by N followed in order by the inorder traversal of each of T_2,..., T_n.
  - the *postorder* traversal of the nodes of T is the list containing in order the postorder traversal of each of T_1,..., T_n, followed by N.

Source code:

```
 #include<stdlib.h>
#include<iostream.h>
class node
{
public:
        int data;
        node*Lchild;
        node*Rchild;
};
class bst
{
        int item;
        node *root;
public: bst();
        void insert_node();
        void delete_node();
        void display_bst();
        void preeorder(node*);
        void inorder(node*);
        void postorder(node*);
};
```

```
bst::bst()
{
root=NULL;
}
void bst:: insert_node()
{
node *new_node,*curr,*prev;
        new_node=new node;
        cout<<"Enter data into new node";
        cin>>item;
        new_node->data=item;
        new_node->Lchild=NULL;
        new_node->Rchild=NULL;
        if(root==NULL)
                root=new_node;
        else
        {
                curr=prev=root;
                while(curr!=NULL)
                {
                        if(new_node->data>curr->data)
                        {
                                prev=curr;
                                curr=curr->Rchild;
                        }
                        else
                        {
                                prev=curr;
                                curr=curr->Lchild;
                        }
                }
                cout<<"Prev:"<<prev->data<<endl;
                if(prev->data>new_node->data)
                        prev->Lchild=new_node;
                else
                        prev->Rchild=new_node;
                }
}
//code to delete a node
void bst::delete_node()
{
if(root==NULL)
        cout<<"Tree is Empty";
else
```

```
{
        int key;
        cout<<"Enter the key value to be deleted";
        cin>>key;
        node* temp,*parent,*succ_parent;
        temp=root;
        while(temp!=NULL)
        {
            if(temp->data==key)
            {    //deleting node with two childern
               if(temp->Lchild!=NULL&&temp->Rchild!=NULL)
                    {          //search for sucessor
                               node*temp_succ;
                               temp_succ=temp->Rchild;
                               while(temp_succ->Lchild!=NULL)
                               {
                                        succ_parent=temp_succ;
                                        temp_succ=temp_succ->Lchild;
                               }
                               temp->data=temp_succ->data;
                               succ_parent->Lchild=NULL;
                          cout<<"Deleted sucess fully";
                          return;
                    }
                    //deleting a node having one left child
                    if(temp->Lchild!=NULL&temp->Rchild==NULL)
                    {
                    if(parent->Lchild==temp)
                               parent->Lchild=temp->Lchild;
                    else
                               parent->Rchild=temp->Lchild;
                    temp=NULL;
                    delete(temp);
                    cout<<"Deleted sucess fully";
                     return;
                    }
                  //deleting a node having one right child
                    if(temp->Lchild==NULL&temp->Rchild!=NULL)
                    {
                    if(parent->Lchild==temp)
                               parent->Lchild=temp->Rchild;
                    else
                               parent->Rchild=temp->Rchild;
                    temp=NULL;
```

```
                        delete(temp);
                        cout<<"Deleted sucess fully";
                        return;
                        }
                    //deleting a node having no child
                        if(temp->Lchild==NULL&temp->Rchild==NULL)
                        {
                        if(parent->Lchild==temp)
                                parent->Lchild=NULL;
                        else
                                parent->Rchild=NULL;
                        temp=NULL;
                        delete(temp);
                        cout<<"Deleted sucess fully";
                        return;
                        }
                }
                else if(temp->data<key)
                     {
                          parent=temp;
                          temp=temp->Rchild;
                        }
                else if(temp->data>key)
                        {
                                parent=temp;
                                temp=temp->Lchild;
                        }
        }//end while
  }//end if
 }//end delnode func

void bst::display_bst()
{
        if(root==NULL)
                cout<<"\nBinary Search Tree is Under Flow";
        else
        {
                int ch;
                cout<<"\t\t**Binart Tree Traversals**\n";
                cout<<"\t\t1.Pree order\n\t\t2.Inorder\n\t\t3:PostOrder\n";
                cout<<"\t\tEnter Your Chice:";
                cin>>ch;
                switch(ch)
                {
```

```
                case 1: cout<<"Pree order Tree Traversal\n ";
                        preeorder(root);
                        break;
                case 2: cout<<"Inorder Tree Traversal is\n ";
                        inorder(root);
                        break;
                case 3: cout<<"Inorder Tree Traversal is\n";
                        postorder(root);
                        break;
                }
        }
}
void bst::inorder(node*t)
{
        if(t!=NULL)
        {
                inorder(t->Lchild);
                cout<<" "<<t->data;
                inorder(t->Rchild);
        }
}

void bst::preeorder(node*t)
{
        if(t!=NULL)
        {
                cout<<" "<<t->data;
                preeorder(t->Lchild);
                preeorder(t->Rchild);
        }
}
void bst::postorder(node*t)
{
        if(t!=NULL)
        {
                postorder(t->Lchild);
                postorder(t->Rchild);
                cout<<" "<<t->data;
        }
}
int main()
{
bst bt;
int i;
```

```
        while(1)
        {       cout<<"\n\n***Operations Binary Search Tree***\n";
                cout<<"1.Insert\n2.Display\n3.del\n4.exit\n";
                cout<<"Enter Choice:";
                cin>>i;
                switch(i)
                {

                        case 1:bt.insert_node();
                                        break;
                        case 2:bt.display_bst();
                                        break;
                        case 3:bt.delete_node();
                                break;
                        case 4:exit(0);

                        default:cout<<"Enter correct choice";
                }
        }
}
```

Output (minimum three outputs)

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EXERCISE:

1.Implement one application of Trees.

WEEK-10: **DATE:**

Write a C++ program to perform the following operations

a)Insertion into a B-tree b) Deletion from a B-tree

Aim: To implement B Tree

Source code:

```
#include<iostream.h>
#include<stdio.h>
#include<string.h>
#include<conio.h>
#include<stdlib.h>
#define MAX 4
#define MIN 2
typedef char Type[10];
typedef struct Btree
{
Type key;
}BT;

typedef struct treenode
{
int count;
BT entry[MAX+1];
treenode *branch[MAX+1];
}node;
class B
{
node *root;
public:
int LT(char *,char *);
int EQ(char *,char *);
node *Search(Type target,node *root,int *targetpos);
int SearchNode(Type target,node *current,int *pos);
node *Insert(BT New,node *root);
int MoveDown(BT New,node *current,BT *med,node **medright);
void InsertIn(BT med,node *medright,node *current,int pos);
void Split(BT med,node *medright,node *current,int pos,BT *newmedian,node
**newright);
void Delete(Type target,node **root);
void Del_node(Type target,node *current);
void Remove(node *current,int pos);
void Successor(node *current,int pos);
void Adjust(node *current,int pos);
void MoveRight(node *current,int pos);
void MoveLeft(node *current,int pos);
```

```
 void Combine(node *current,int pos);
void InOrder(node *root);
};
int B::LT(char *a,char *b)
{
if((strcmp(a,b))<(0))
return 1;
else
return 0;
}
int B::EQ(char *a,char *b)
{
if((strcmp(a,b))==(0))
return 1;
else
return 0;
}
node* B::Search(Type target,node *root,int *targetpos)
{
if(root==NULL)
return NULL;
else if(SearchNode(target,root,targetpos))
return root;
else
return Search(target,root->branch[*targetpos],targetpos);
}

int B::SearchNode(Type target,node *current,int *pos)
{
if(LT(target,current->entry[1].key))
{
*pos=0;
return 0;
}
else
{
for(*pos=current->count;
LT(target,current->entry[*pos].key) && *pos>1;(*pos)--);
return EQ(target,current->entry[*pos].key);
}
}
node *B::Insert(BT newentry,node *root)
{
BT medentry;
```

```
node *medright;
node *New;
if(MoveDown(newentry,root, &medentry, &medright))
{
New=new node;
New->count=1;
New->entry[1]=medentry;
New->branch[0]=root;
New->branch[1]=medright;
return New;
}
return root;
}
int B::MoveDown(BT New,node *current,BT *med,node **medright)
{
int pos;
if(current==NULL)
{
*med=New;
*medright=NULL;
return 1;
}
else
{
if(SearchNode(New.key,current,&pos))
cout<<"Duplicate key\n";
if(MoveDown(New,current->branch[pos],med,medright))
if(current->count<MAX)
{
InsertIn(*med,*medright,current,pos);
return 0;
}
else
{
Split(*med,*medright,current,pos,med,medright);
return 1;
}
return 0;
}
}
void B::InsertIn(BT med,node *medright,node *current,int pos)
{
int i;
for(i=current->count;i>pos;i--)
```

```
{
current->entry[i+1]=current->entry[i];
current->branch[i+1]=current->branch[i];
}
current->entry[pos+1]=med;
current->branch[pos+1]=medright;
current->count++;
}
void B::Split(BT med,node *medright,node *current,int pos,BT *newmedian,node **newright)
{
int i;
 int median;
 if(pos<=MIN)
        median=MIN;
 else
        median=MIN+1;
 *newright=new node;
for(i=median+1;i<=MAX;i++)
{
(*newright)->entry[i-median]=current->entry[i];
 (*newright)->branch[i-median]=current->branch[i];
}
 (*newright)->count=MAX-median;
 current->count=median;
 if(pos<=MIN)
        InsertIn(med,medright,current,pos);
 else
InsertIn(med,medright,*newright,pos-median);
 *newmedian=current->entry[current->count];
 (*newright)->branch[0]=current->branch[current->count];
 current->count--;
}

void B::Delete(Type target,node **root)
{
node *prev;
Del_node(target,*root);
if((*root)->count==0)
{
prev=*root;
*root=(*root)->branch[0];
free(prev);
}
}
```

```
void B::Del_node(Type target,node *current)
{
int pos;
if(!current)
{
        cout<<"Item not in the Btree\n";
        return;
}
else
{
if(SearchNode(target,current,&pos))
if(current->branch[pos-1])
{
Successor(current,pos);
Del_node(current->entry[pos].key,current->branch[pos]);
}
else
        Remove(current,pos);
else
        Del_node(target,current->branch[pos]);
if(current->branch[pos])
if(current->branch[pos]->count<MIN)
Adjust(current,pos);
}
}

void B::Remove(node *current,int pos)
{
int i;
for(i=pos+1;i<=current->count;i++)
{
current->entry[i-1]=current->entry[i];
current->branch[i-1]=current->branch[i];
}
current->count--;
}
void B::Successor(node *current,int pos)
{
node *leaf;
for(leaf=current->branch[pos];leaf->branch[0];
leaf=leaf->branch[0]);
current->entry[pos]=leaf->entry[1];
}
```

```
void B::Adjust(node *current,int pos)
{
if(pos==0)
if(current->branch[1]->count > MIN)
MoveLeft(current,1);
else
Combine(current,1);
else if(pos==current->count)
if(current->branch[pos-1]->count > MIN)
MoveRight(current,pos);
else
Combine(current,pos);
else if(current->branch[pos-1]->count > MIN)
MoveRight(current,pos);
else if(current->branch[pos+1]->count > MIN)
MoveLeft(current,pos+1);
else
Combine(current,pos);
}
void B::MoveRight(node *current,int pos)
{
int i;
node *t;
t=current->branch[pos];
for(i=t->count;i>0;i--)
{
t->entry[i+1]=t->entry[i];
t->branch[i+1]=t->branch[i];
}
t->branch[1]=t->branch[0];
t->count++;
t->entry[1]=current->entry[pos];
t=current->branch[pos-1];
current->entry[pos]=t->entry[t->count];
current->branch[pos]->branch[0]=t->branch[t->count];
t->count--;
}
void B::MoveLeft(node *current,int pos)
{
int c;
node *t;
        t=current->branch[pos-1];
        t->count++;
        t->entry[t->count]=current->entry[pos];
```

```
        t->branch[t->count]=current->branch[pos]->branch[0];
        t=current->branch[pos];
        current->entry[pos]=t->entry[1];
        t->branch[0]=t->branch[1];
        t->count--;
        for(c=1;c<=t->count;c++)
        t->entry[c]=t->entry[c+1];
        t->branch[c]=t->branch[c+1];
}

void B::Combine(node *current,int pos)
{
int c;
node *right;
node *left;
right=current->branch[pos];
left=current->branch[pos-1];
left->count++;
left->entry[left->count]=current->entry[pos];
left->branch[left->count]=right->branch[0];
for(c=1;c<=right->count;c++)
{
left->count++;
left->entry[left->count]=right->entry[c];
left->branch[left->count]=right->branch[c];
}

for(c=pos;c<current->count;c++)
{
current->entry[c]=current->entry[c+1];
current->branch[c]=current->branch[c+1];
}
current->count--;
free(right);
}


void B::InOrder(node *root)
{
int pos;
if(root)
{
InOrder(root->branch[0]);
for(pos=1;pos<=root->count;pos++)
```

```
{
cout<<" "<<root->entry[pos].key;
InOrder(root->branch[pos]);
}
}
}

int main()
{
int choice,targetpos;
Type inKey;
BT New;
B obj;
node *root,*target;
root=NULL;
while(1)
{
cout<<"\n IMPLEMENTATION OF B-TREE\n";
cout<<"\n1.INSERT\n2.DELETE\n3.SEARCH\n4.DISPLAY\n5.EXIT\n";
cout<<"Enter Your Choice\n";
cin>>choice;
switch(choice)
{
case 1:cout<<"enter the key to be inserted\n";
        fflush(stdin);
        gets(New.key);
        root=obj.Insert(New,root);
        break;

case 2:cout<<"enter the key to be deleted\n";
        fflush(stdin);
        gets(New.key);
        cout<<"Deleting the desired item\n";
        obj.Delete(New.key,&root);
        break;
case 3:cout<<"enter the key to be searched\n";
        fflush(stdin);
        gets(New.key);
        target=obj.Search(New.key,root,&targetpos);
        if(target)
        cout<<"The searched item"<<target->entry[targetpos].key<<endl;
        else
        cout<<"Element not found\n";
        break;
```

```
case 4:cout<<"\n InOrder Traversal\n";
            obj.InOrder(root);
            break;
case 5:exit(0);

}
}
  }
```

Output (minimum three outputs)

Signature of the Faculty

EXERCISE:

1.Impliment one application of B-Tree.

WEEK -11 **DATE:**

Write a C++ program to perform the following operations

a) Insertion into an AVL-tree b) Deletion from an AVL-tree

Aim: To implement AVL tree

Source code:

```
# include <iostream.h>
# include <stdlib.h>
# include <conio.h>
struct node
{
        int element;
        node *left;
        node *right;
        int height;
};
typedef struct node *np;
class bstree
{
  public:
        void insert(int,np &);
        void del(int, np &);
        int deletemin(np &);
        void find(int,np &);
        np findmin(np);
        np findmax(np);
        void copy(np &,np &);
        void makeempty(np &);
        np nodecopy(np &);
        void preorder(np);
        void inorder(np);
        void postorder(np);
        int bsheight(np);
        np srl(np &);
        np drl(np &);
        np srr(np &);
        np drr(np &);
        int max(int,int);
        int nonodes(np);
};
//Inserting a node
void bstree::insert(int x,np &p)
{
  if (p == NULL)
```

```
  {
        p = new node;
        p->element = x;
        p->left=NULL;
        p->right = NULL;
        p->height=0;
        if (p==NULL)
              cout<<"Out of Space";
  }
  else
  {
        if (x<p->element)
        {
          insert(x,p->left);
          if ((bsheight(p->left) - bsheight(p->right))==2)
          {
            if (x < p->left->element)
                  p=srl(p);
            else
                  p = drl(p);
          }
        }
        else if (x>p->element)
        {
            insert(x,p->right);
            if ((bsheight(p->right) - bsheight(p->left))==2)
            {
                  if (x > p->right->element)
                        p=srr(p);
                  else
                        p = drr(p);
               }
        }
        else
              cout<<"Element Exists";
        }
        int m,n,d;
        m=bsheight(p->left);
        n=bsheight(p->right);
        d=max(m,n);
        p->height = d + 1;
}
```

```
//Finding the Smallest
np bstree::findmin(np p)
{
        if (p==NULL)
        {
          cout<<"Empty Tree ";
          return p;
        }
        else
        {
          while(p->left !=NULL)
                p=p->left;
          return p;
        }
}
//Finding the Largest
np bstree::findmax(np p)
{
        if (p==NULL)
        {
          cout<<"Empty Tree ";
          return p;
        }
        else
        {
          while(p->right !=NULL)
             p=p->right;
          return p;
        }
}
//Finding an element
void bstree::find(int x,np &p)
{
        if (p==NULL)
          cout<<" Element not found ";
        else
        if (x < p->element)
          find(x,p->left);
        else
        if (x>p->element)
          find(x,p->right);
        else
          cout<<"       Element found !";
}
```

```
//Copy a tree
void bstree::copy(np &p,np &p1)
{
        makeempty(p1);
        p1 = nodecopy(p);
}
//Make a tree empty
void bstree::makeempty(np &p)
{
        np d;
        if (p != NULL)
        {
          makeempty(p->left);
          makeempty(p->right);
          d=p;
          free(d);
          p=NULL;
        }
}
//Copy the nodes
np bstree::nodecopy(np &p)
{
        np temp;
        if (p==NULL)
          return p;
        else
        {
          temp = new node;
          temp->element = p->element;
          temp->left = nodecopy(p->left);
          temp->right = nodecopy(p->right);
          return temp;
        }
}
//Deleting a node
void bstree::del(int x,np &p)
{
        np d;
        if (p==NULL)
          cout<<"Element not found ";
        else if ( x < p->element)
          del(x,p->left);
        else if (x > p->element)
          del(x,p->right);
```

```
        else if ((p->left == NULL) && (p->right == NULL))
        {
          d=p;
          free(d);
          p=NULL;
          cout<<" Element deleted !";
        }
        else if (p->left == NULL)
        {
         d=p;
         free(d);
         p=p->right;
         cout<<" Element deleted !";
        }
        else if (p->right == NULL)
        {
         d=p;
         p=p->left;
         free(d);
         cout<<" Element deleted !";
        }
        else
         p->element = deletemin(p->right);
}
int bstree::deletemin(np &p)
{
        int c;
        cout<<"inside deltemin";
        if (p->left == NULL)
        {
         c=p->element;
         p=p->right;
         return c;
        }
        else
        {
         c=deletemin(p->left);
         return c;
        }
}
void bstree::preorder(np p)
{
        if (p!=NULL)
        {
```

```
            cout<<p->element<<"-->";
            preorder(p->left);
            preorder(p->right);
          }
}
//Inorder Printing
void bstree::inorder(np p)
{
        if (p!=NULL)
        {
          inorder(p->left);
          cout<<p->element<<"-->";
          inorder(p->right);
        }
}
//                PostOrder Printing
void bstree::postorder(np p)
{
        if (p!=NULL)
        {
          postorder(p->left);
          postorder(p->right);
          cout<<p->element<<"-->";
        }
}
int bstree::max(int value1, int value2)
{
        return ((value1 > value2) ? value1 : value2);
}
int bstree::bsheight(np p)
{
        int t;
        if (p == NULL)
                return -1;
        else
        {
                t = p->height;
                return t;
        }
}
np bstree:: srl(np &p1)
{
        np p2;
        p2 = p1->left;
```

```
        p1->left = p2->right;
        p2->right = p1;
        p1->height = max(bsheight(p1->left),bsheight(p1->right)) + 1;
        p2->height = max(bsheight(p2->left),p1->height) + 1;
        return p2;
}
np bstree:: srr(np &p1)
{
        np p2;
        p2 = p1->right;
        p1->right = p2->left;
        p2->left = p1;
        p1->height = max(bsheight(p1->left),bsheight(p1->right)) + 1;
        p2->height = max(p1->height,bsheight(p2->right)) + 1;
        return p2;
}
np bstree:: drl(np &p1)
{
        p1->left=srr(p1->left);
        return srl(p1);
}
np bstree::drr(np &p1)
{
        p1->right = srl(p1->right);
        return srr(p1);
}
int bstree::nonodes(np p)
{
        int count=0;
        if (p!=NULL)
        {
                nonodes(p->left);
                nonodes(p->right);
                count++;
        }
        return count;
}
int main()
{
        //clrscr();
        np root,root1,min,max;//,flag;
        int a,choice,findele,delele,leftele,rightele,flag;
        char ch='y';
        bstree bst;
```

```
//system("clear");
root = NULL;
root1=NULL;

while(1)
{
cout<<"    \nAVL Tree\n";
cout<<"          ========\n";
          cout<<"1.Insertion\n2.FindMin\n";
          cout<<"3.FindMax\n4.Find\n5.Copy\n";
          cout<<"6.Delete\n7.Preorder\n8.Inorder\n";
          cout<<"9.Postorder\n10.height\n11.EXIT\n";
          cout<<"Enter the choice:";
          cin>>choice;
          switch(choice)
          {
          case 1:
                    cout<<"New node's value ?";
                    cin>>a;
                    bst.insert(a,root);
                    break;
          case 2:
                    if (root !=NULL)
                    {
                    min=bst.findmin(root);
                    cout<<"Min element :    "<<min->element;
                    }
                    break;
           case 3:
                    if (root !=NULL)
                    {
                    max=bst.findmax(root);
                    cout<<"Max element :   "<<max->element;
                    }
                    break;
          case 4:
                    cout<<"Search node : ";
                    cin>>findele;
                    if (root != NULL)
                              bst.find(findele,root);
                    break;
          case 5:
                    bst.copy(root,root1);
                    bst.inorder(root1);
```

```
                    break;
                case 6:
                    cout<<"Delete Node ?";
                    cin>>delele;
                    bst.del(delele,root);
                    bst.inorder(root);
                    break;
                case 7:
                    cout<<" Preorder Printing... :";
                    bst.preorder(root);
                    break;
                case 8:
                      cout<<" Inorder Printing.... :";
                       bst.inorder(root);
                          break;
                case 9:
                          cout<<" Postorder Printing... :";
                          bst.postorder(root);
                          break;
                case 10:
                    cout<<" Height and Depth is ";
                    cout<<bst.bsheight(root);
                    //cout<<"No. of nodes:"<<bst.nonodes(root);
                    break;
                case 11:exit(0);
                }
                }
        return 0;
}
```

Output (minimum three outputs)

Signature of the Faculty

EXERCISE:

1.Impliment Depth First Search Algorithm.

WEEK -12 **DATE:**

Aim: To to implement all the functions of a dictionary (ADT)

Source code:

```
#include<stdlib.h>
#include<iostream.h>
class node
{
public: int key;
        int value;
        node*next;
};
class dictionary:public node
{       int k,data;
        node *head;
public: dictionary();
        void insert_d( );
        void delete_d( );
        void display_d( );
};
dictionary::dictionary( )
{       head=NULL;
}
//code to push an val into dictionary;
void dictionary::insert_d( )
{
        node *p,*curr,*prev;
        cout<<"Enter an key and value to be inserted:";
        cin>>k;
        cin>>data;
        p=new node;
        p->key=k;
        p->value=data;
        p->next=NULL;
        if(head==NULL)
        head=p;
        else
        {
                curr=head;
                while((curr->key<p->key)&&(curr->next!=NULL))
                {
                        prev=curr;
                        curr=curr->next;
```

```
                }
                if(curr->next==NULL)
                {
                        if(curr->key<p->key)
                        {
                                curr->next=p;
                                prev=curr;
                        }
                        else
                        {
                                 p->next=prev->next;
                                prev->next=p;
                        }
                }
                else
                {
                        p->next=prev->next;
                        prev->next=p;
                }
                cout<<"\nInserted into dictionary Sucesfully....\n";
        }
}
void dictionary::delete_d( )
{
node*curr,*prev;
        cout<<"Enter key value that you want to delete...";
        cin>>k;
        if(head==NULL)
                cout<<"\ndictionary is Underflow";
        else
          {       curr=head;
                  while(curr!=NULL)
                  {
                  if(curr->key==k)
                          break;
                  prev=curr;
                  curr=curr->next;
                  }
         }
        if(curr==NULL)
                cout<<"Node not found...";
        else
         {
                  if(curr==head)
```

```
                        head=curr->next;
                else
                        prev->next=curr->next;
        delete curr;
        cout<<"Item deleted from dictionary...";
        }
 }
void dictionary::display_d( )
{
node*t;
        if(head==NULL)
                cout<<"\ndictionary Under Flow";
        else
        {
                cout<<"\nElements in the dictionary are....\n";
                t=head;
           while(t!=NULL)
                {
                 cout<<"<"<<t->key<<","<<t->value<<">";
                 t=t->next;
                }
        }
}

int main( )
{
int choice;
dictionary d1;
        while(1)
        {
        cout<<"\n\n***Menu for Dictrionay operations***\n\n";
        cout<<"1.Insert\n2.Delete\n3.DISPLAY\n4.EXIT\n";
        cout<<"Enter Choice:";
        cin>>choice;
        switch(choice)
        {
        case 1:  d1.insert_d();
                        break;
        case 2:  d1.delete_d( );
                        break;
        case 3:  d1.display_d( );
                        break;
        case 4:  exit(0);
        default:cout<<"Invalid choice...Try again...\n";
```

```
        }
    }
    }
```

Output (minimum three outputs)

Signature of the Faculty

EXERCISE:

1.Implement Breath First Search algorithm.
2.Implement Hash Table.