

```
#include <iostream>

#include <queue>

using namespace std;

int adj_mat[50][50] = {0, 0};

int visited[50] = {0};

void dfs(int s, int n, string arr[])
{
    visited[s] = 1;

    cout << arr[s] << " ";

    for (int i = 0; i < n; i++)
    {
        if (adj_mat[s][i] && !visited[i])
            dfs(i, n, arr);
    }
}

void bfs(int s, int n, string arr[])
{
    bool visited[n];

    for (int i = 0; i < n; i++)
        visited[i] = false;

    int v;

    queue<int> bfsq;

    if (!visited[s])
    {
        cout << arr[s] << " ";

        bfsq.push(s);

        visited[s] = true;

        while (!bfsq.empty())
        {
            v = bfsq.front();

            for (int i = 0; i < n; i++)
            {
                if (adj_mat[v][i] && !visited[i])
```

```

cout << arr[i] << " ";

visited[i] = true;

bfsq.push(i);

}

}

bfsq.pop();

}

}

}

int main()

{

cout << "Enter no. of cities: ";

int n, u;

cin >> n;

string cities[n];

for (int i = 0; i < n; i++)

{

cout << "Enter city name for city no." << i+1 << " : ";

cin >> cities[i];

}

cout << "\nYour cities are: " << endl;

for (int i = 0; i < n; i++)

cout << "city :" << i << ": " << cities[i] << endl;

for (int i = 0; i < n; i++)

{

for (int j = i + 1; j < n; j++)

{

cout << "Enter distance between " << cities[i] << " and " << cities[j] << " : ";

cin >> adj_mat[i][j];

adj_mat[j][i] = adj_mat[i][j];

}

}

cout << endl;

for (int i = 0; i < n; i++)

cout << "\t" << cities[i] << "\t";

for (int i = 0; i < n; i++)

```

```

{
    cout << "\n"
    << cities[i];
    for (int j = 0; j < n; j++)
        cout << "\t" << adj_mat[i][j] << "\t";
    cout << endl;
}

cout << "Enter Starting Vertex: ";

cin >> u;

cout << "DFS: ";
dfs(u, n, cities);

cout << endl;

cout << "BFS: ";
bfs(u, n, cities);

return 0;
}

```

```

Enter no. of cities: 4
Enter city name for city no.1 : Mumbai
Enter city name for city no.2 : Nagpur
Enter city name for city no.3 : Nashik
Enter city name for city no.4 : Pune

Your cities are:
city :0: Mumbai
city :1: Nagpur
city :2: Nashik
city :3: Pune
Enter distance between Mumbai and Nagpur : 20
Enter distance between Mumbai and Nashik : 30
Enter distance between Mumbai and Pune : 10
Enter distance between Nagpur and Nashik : 25
Enter distance between Nagpur and Pune : 40
Enter distance between Nashik and Pune : 28


```

	Mumbai	Nagpur	Nashik	Pune
Mumbai	0	20	30	10
Nagpur	20	0	25	40
Nashik	30	25	0	28
Pune	10	40	28	0

```

Enter Starting Vertex: Pune
DFS: Mumbai Nagpur Nashik Pune
BFS: Mumbai Nagpur Nashik Pune

```

```
#include <iostream>

#include <stdlib.h>

using namespace std;

int cost[10][10], i, j, k, n, qu[10], front, rear, v, visit[10], visited[10];

int stk[10], top, visit1[10], visited1[10];

int main()
{
    int m;

    cout << "Enter number of vertices : ";

    cin >> n;

    cout << "Enter number of edges : ";

    cin >> m;

    cout << "\nEDGES :\n";

    for (k = 1; k <= m; k++)
    {
        cin >> i >> j;

        cost[i][j] = 1;

        cost[j][i] = 1;
    }

    //display function

    cout << "The adjacency matrix of the graph is : " << endl;

    for (i = 0; i < n; i++)
    {
        for (j = 0; j < n; j++)
        {
            cout << " " << cost[i][j];

        }

        cout << endl;
    }

    cout << "Enter initial vertex : ";

    cin >> v;

    cout << "The BFS of the Graph is\n";

    cout << v<<endl;

    visited[v] = 1;

    k = 1;
```

```

while (k < n)

{

for (j = 1; j <= n; j++)

if (cost[v][j] != 0 && visited[j] != 1 && visit[j] != 1)

{

visit[j] = 1;

qu[rear++] = j;

}

v = qu[front++];

cout << v << " ";

k++;

visit[v] = 0;

visited[v] = 1;

}

cout << endl << "Enter initial vertex : ";

cin >> v;

cout << "The DFS of the Graph is\n";

cout << v << endl;

visited[v] = 1;

k = 1;

while (k < n)

{

for (j = n; j >= 1; j--)

if (cost[v][j] != 0 && visited1[j] != 1 && visit1[j] != 1)

{

visit1[j] = 1;

stk[top] = j;

top++;

}

v = stk[--top];

cout << v << " ";

k++;

visit1[v] = 0;

visited1[v] = 1;

}

return 0;

}

```

Enter number of vertices : 5

Enter number of edges : 6

EDGES :

0 1

1 2

2 3

3 4

4 0

4 1

The adjacency matrix of the graph is :

0 1 0 0 1

1 0 1 0 1

0 1 0 1 0

0 0 1 0 1

1 1 0 1 0

Enter initial vertex : 0

The BFS of the Graph is

0

1 4 2 3

Enter initial vertex : 1

The DFS of the Graph is

1

2 1 3 4

```
#include <iostream>

#include <cstring>

using namespace std;

struct hash
{
    string word;

    string meaning;

    int chain;
} obj[10];

void hash_initialization()
{
    for (int i = 0; i < 10; i++)
    {
        obj[i].word = "-";

        obj[i].meaning = "-";

        obj[i].chain = -1;
    }
}

void display()
{
    for (int i = 0; i < 10; i++)
    {
        cout << obj[i].word << "-->" << obj[i].meaning << "-->" << obj[i].chain << endl;
    }
}

int calculate(string word)
{
    int key = 0;

    for (int i = 0; i < word.length(); i++)
    {
        key = key + word[i];
    }

    return key % 10;
}

void collision(int key, string word, string meaning)
{
    int i = 1;
```

```
while (((key + i) % 10) < 10)

{

if (obj[(key + i) % 10].word == "-")

{

obj[(key + i) % 10].word = word;

obj[(key + i) % 10].meaning = meaning;

obj[(key + i - 1) % 10].chain = (key + i) % 10;

break;

}

else

{

i++;

}

}

}

void insert()

{

string wd, mg;

cout << "Enter the word => ";

cin >> wd;

cout << "Enter the meaning => ";

cin >> mg;

int hash_key = calculate(wd);

if (obj[hash_key].word == "-")

{

obj[hash_key].word = wd;

obj[hash_key].meaning = mg;

}

else

{

collision(hash_key, wd, mg);

}

}

void find(string wd)

{

int hash_key = calculate(wd);

if (obj[hash_key].word == wd)
```



```
{

cout << "found" << endl;

cout << obj[hash_key].word << "-->" << obj[hash_key].meaning << endl;

}

else if (obj[hash_key].chain != -1)

{

int temp = obj[hash_key].chain;

while (true)

{

if (obj[temp].word == wd)

{

cout << "found" << endl;

cout << obj[temp].word << "-->" << obj[temp].meaning << endl;

break;

}

temp = obj[temp].chain;

}

}

else

{

cout << "Not Found" << endl;

}

}

void Del(string wd)

{

int hash_key = calculate(wd);

if (obj[hash_key].word == wd)

{

obj[hash_key].word = "-";

obj[hash_key].meaning = "-";

obj[hash_key].chain = -1;

}

else if (obj[hash_key].chain != -1)

{

int temp = obj[hash_key].chain;

while (true)

{
```

```

if (obj[temp].word == wd)
{
    obj[temp].word = "-";
    obj[temp].meaning = "-";
    obj[temp].chain = -1;
    break;
}

temp = obj[temp].chain;
}
}

else
{
    cout << "Word Not Found" << endl;
}
}

int main()
{
    int choice, n;
    string wd_find, wd_Del;
    hash_initialization();

    do
    {
        cout << "=====Enter your choice===== " << endl;

        cout << "1) Insert" << endl;
        cout << "2) Find" << endl;
        cout << "3) Delete" << endl;
        cout << "4) Print" << endl;
        cout << "5) Exit" << endl;

        cin >> choice;

        switch (choice)
        {
            case 1:
                cout << "Enter how entries you want to make ";

                cin >> n;

                for (int i = 0; i < n; i++)
                {
                    insert();

```



```
=====Enter your choice=====
1) Insert
2) Find
3) Delete
4) Print
5) Exit
2
Enter the word to found => a
found
a-->a
=====Enter your choice=====
1) Insert
2) Find
3) Delete
4) Print
5) Exit
3
Enter the word to be deleted =>b
```

```
=====Enter your choice=====
1) Insert
2) Find
3) Delete
4) Print
5) Exit
4
c-->c-->-1
--->--->-1
--->--->-1
--->--->-1
--->--->-1
--->--->-1
--->--->-1
--->--->-1
a-->a-->-1
--->--->-1
a-->c-->0
```

```

import java.io.*;

import java.util.*;

public class heapsort {

    public int[] heap;

    public int count;

    public void downadjust(int i) {

        int j, temp, n;

        n = heap[0];

        if (2 * i <= n) {

            j = 2 * i; // j on left child of i

            if (j + 1 <= n && heap[j + 1] > heap[j]) // j points to larger of left and right child

                j = j + 1;

            if (heap[i] < heap[j]) {

                temp = heap[i];

                heap[i] = heap[j];

                heap[j] = temp;

                downadjust(j);

            }

        }

    }

    public void upadjust(int i) {

        int temp;

        while (i > 1 && heap[i] > heap[i / 2]) {

            temp = heap[i];

            heap[i] = heap[i / 2];

            heap[i / 2] = temp;

            i = i / 2;

        }

    }

    public void insert(int x) {

        heap[++heap[0]] = x;

        upadjust(heap[0]);

    }

    public void create() {

        int i, x, n;

        heap = new int[30];

        heap[0] = 0;

    }

}

```

```

Scanner reader = new Scanner(System.in);

System.out.println("\nEnter No. of elements : ");

n = reader.nextInt();

count = n;

System.out.println("\nEnter heap data : ");

for (i = 0; i < n; i++) {

    x = reader.nextInt();

    insert(x);

}

}

public void sort() {

    int last, temp;

    while (heap[0] > 1) {

        last = heap[0];

        temp = heap[1];

        heap[1] = heap[last];

        heap[last] = temp;

        heap[0]--;

        downadjust(1);

    }

}

public void print() {

    int n, i;

    n = count;

    System.out.println("\nsorted data : ");

    for (i = 1; i <= n; i++)

        System.out.print(" " + heap[i]);

}

public static void main(String[] args) {

    int x;

    heapsort myobject = new heapsort();

    myobject.create();

    myobject.sort();

    myobject.print();

}

}

```

Enter No. of elements :

5

Enter heap data :

84

45

99

12

10

sorted data :

10 12 45 84 99

Process finished with exit code 0

```

#include <iostream>

#include<string>

using namespace std;

class dictionary;

class node
{
    string word,meaning;

    node *left,*right;

public:
    friend class dictionary;

    node()
    {
        left=NULL;

        right=NULL;
    }

    node(string word, string meaning)
    {
        this->word=word;

        this->meaning=meaning;

        left=NULL;

        right=NULL;
    }

};

class dictionary
{
    node *root;

public:
    dictionary()
    {
        root=NULL;
    }

    void create();

    void inorder_rec(node *rnode);

    void postorder_rec(node *rnode);

    void inorder()
    {

```



```

    inorder_rec(root);

}

void postorder();

bool insert(string word,string meaning);

int search(string key);

};

int dictionary::search(string key)

{

    node *tmp=root;

    int count;

    if(tmp==NULL)

    {

        return -1;

    }

    if(root->word==key)

        return 1;

    while(tmp!=NULL)

    {

        if((tmp->word)>key)

        {

            tmp=tmp->left;

            count++;

        }

        else if((tmp->word)<key)

        {

            tmp=tmp->right;

            count++;

        }

        else if(tmp->word==key)

        {

            return ++count;

        }

    }

    return -1;

}

void dictionary::postorder()

{

```

```

    postorder_rec(root);
}

void dictionary::postorder_rec(node *rnode)
{
    if(rnode)
    {
        postorder_rec(rnode->right);
        cout<<" "<<rnode->word<<" : "<<rnode->meaning<<endl;
        postorder_rec(rnode->left);
    }
}

void dictionary::create()
{
    int n;

    string wordl,meaningl;

    cout<<"\nHow many Word to insert?:\n";

    cin>>n;

    for(int i=0;i<n;i++)
    {
        cout<<"\nEnter Word: ";

        cin>>wordl;

        cout<<"\nEnter Meaning: ";

        cin>>meaningl;

        insert(wordl,meaningl);
    }
}

void dictionary::inorder_rec(node *rnode)
{
    if(rnode)
    {
        inorder_rec(rnode->left);

        cout<<" "<<rnode->word<<" : "<<rnode->meaning<<endl;

        inorder_rec(rnode->right);
    }
}

bool dictionary::insert(string word, string meaning)
{

```

```
node *p=new node(word, meaning);

if(root==NULL)

{

    root=p;

    return true;

}

node *cur=root;

node *par=root;

while(cur!=NULL) //traversal

{

    if(word>cur->word)

    {par=cur;

    cur=cur->right;

    }

    else if(word<cur->word)

    {

        par=cur;

        cur=cur->left;

    }

    else

    {

        cout<<"\nWord is already in the dictionary.";

        return false;

    }

}

if(word>par->word) //insertion of node

{

    par->right=p;

    return true;

}

else

{

    par->left=p;

}

return true;

}
```

```

int main() {
    string word;
    dictionary months;
    months.create();

    cout<<"Ascending order\n";

    months.inorder();


    cout<<"\nDescending order:\n";

    months.postorder();


    cout<<"\nEnter word to search: ";

    cin>>word;

    int comparisons=months.search(word);

    if(comparisons==-1)
    {
        cout<<"\nNot found word";
    }

    else

    {
        cout<<"\n "<<word<<" found in "<<comparisons<<" comparisons";
    }

    return 0;}

```

```

How many Word to insert?:
2

Enter Word: Apple

Enter Meaning: Fruit

Enter Word: Cauliflower

Enter Meaning: Vegetable
Ascending order
    Apple : Fruit
    Cauliflower : Vegetable

Descending order:
    Cauliflower : Vegetable
    Apple : Fruit

Enter word to search: Apple

    Apple found in 1 comparisons

```

```

#include <iostream>

using namespace std;

#define SIZE 10

class OBST
{
    int p[SIZE];      // Probabilities with which we search for an element
    int q[SIZE];      // Probabilities that an element is not found
    int a[SIZE];      // Elements from which OBST is to be built
    int w[SIZE][SIZE]; // Weight 'w[i][j]' of a tree having root
                        // 'r[i][j]'
    int c[SIZE][SIZE]; // Cost 'c[i][j]' of a tree having root 'r[i][j]'
    int r[SIZE][SIZE]; // represents root
    int n;             // number of nodes

public:
    /* This function accepts the input data */
    void get_data()
    {
        int i;

        cout << "\n Optimal Binary Search Tree \n";
        cout << "\n Enter the number of nodes";

        cin >> n;

        cout << "\n Enter the data as...\n";
        for (i = 1; i <= n; i++)
        {
            cout << "\n a[" << i << "]";

            cin >> a[i];
        }

        for (i = 1; i <= n; i++)
        {
            cout << "\n p[" << i << "]";

            cin >> p[i];
        }

        for (i = 0; i <= n; i++)
        {
            cout << "\n q[" << i << "]";

            cin >> q[i];
        }
    }
};

```

```

    }
}

/* This function returns a value in the range 'r[i][j-1]' to 'r[i+1][j]' so
that the cost 'c[i][k-1]+c[k][j]' is minimum */
int Min_Value(int i, int j)
{
    int m, k;
    int minimum = 32000;
    for (m = r[i][j - 1]; m <= r[i + 1][j]; m++)
    {
        if ((c[i][m - 1] + c[m][j]) < minimum)
        {
            minimum = c[i][m - 1] + c[m][j];
            k = m;
        }
    }
    return k;
}

/* This function builds the table from all the given probabilities It
basically computes C,r,W values */
void build_OBST()
{
    int i, j, k, l, m;
    for (i = 0; i < n; i++)
    {
        // initialize
        w[i][i] = q[i];
        r[i][i] = c[i][i] = 0;
        // Optimal trees with one node
        w[i][i + 1] = q[i] + q[i + 1] + p[i + 1];
        r[i][i + 1] = i + 1;
        c[i][i + 1] = q[i] + q[i + 1] + p[i + 1];
    }
    w[n][n] = q[n];
    r[n][n] = c[n][n] = 0;
    // Find optimal trees with 'm' nodes
    for (m = 2; m <= n; m++)

```

```

{
    for (i = 0; i <= n - m; i++)
    {
        j = i + m;
        w[i][j] = w[i][j - 1] + p[j] + q[j];
        k = Min_Value(i, j);
        c[i][j] = w[i][j] + c[i][k - 1] + c[k][j];
        r[i][j] = k;
    }
}

/* This function builds the tree from the tables made by the OBST function */
void build_tree()
{
    int i, j, k;
    int queue[20], front = -1, rear = -1;
    cout << "The Optimal Binary Search Tree For the Given Node Is...\n";
    cout << "\n The Root of this OBST is ::" << r[0][n];
    cout << "\nThe Cost of this OBST is::" << c[0][n];
    cout << "\n\n\t NODE \t LEFT CHILD \t RIGHT CHILD ";
    cout << "\n";
    queue[++rear] = 0;
    queue[++rear] = n;
    while (front != rear)
    {
        i = queue[++front];
        j = queue[++front];
        k = r[i][j];
        cout << "\n\t" << k;
        if (r[i][k - 1] != 0)
        {
            cout << "\t\t" << r[i][k - 1];
            queue[++rear] = i;
            queue[++rear] = k - 1;
        }
        else
            cout << "\t\t";
    }
}

```

```

        if (r[k][j] != 0)
        {
            cout << "\t" << r[k][j];

            queue[++rear] = k;
            queue[++rear] = j;
        }
        else
            cout < "\t";
    } // end of while
    cout << "\n";
}

}; // end of the class

/*This is the main function */

int main()
{
    OBST obj;
    obj.get_data();
    obj.build_OBST();
    obj.build_tree();
    return 0;
}

```

```

Optimal Binary Search Tree
Enter the number of nodes:- 4
Enter the data as...
a[1]1
a[2]2
a[3]3
a[4]4
p[1]3
p[2]3
p[3]1
p[4]1
q[0]2
q[1]3
q[2]1
q[3]1

```



```
q[4]1
```

```
The Optimal Binary Search Tree For the Given Node Is...
```

```
The Root of this OBST is ::2
```

```
The Cost of this OBST is::32
```

NODE	LEFT CHILD	RIGHT CHILD
2	1	3
1		
3		4
4		

```

#include<iostream>

#include<fstream>

#include<stdio.h>

using namespace std;

class Employee{

    private:

        int code;

        char name[20];

        float salary;

    public:

        void read();

        void display();

        int getEmpCode()      { return code;}

        int getSalary()      { return salary;}

        void updateSalary(float s) { salary=s;}

};


void Employee::read(){

    cout<<"Enter employee code: ";

    cin>>code;

    cout<<"Enter name: ";

    cin.ignore(1);

    cin.getline(name,20);

    cout<<"Enter salary: ";

    cin>>salary;

}

void Employee::display()

{

    cout<<code<<" "<<name<<"\t"<<salary<<endl;

}

fstream file;

void deleteExistingFile(){

    remove("EMPLOYEE.DAT");

}

void appendToFille(){

    Employee  x;

```

```

        x.read();

file.open("EMPLOYEE.DAT",ios::binary|ios::app);

if(!file){

    cout<<"ERROR IN CREATING FILE\n";

    return;

}

file.write((char*)&x,sizeof(x));

file.close();

cout<<"Record added sucessfully.\n";

}

void displayAll(){

    Employee  x;

file.open("EMPLOYEE.DAT",ios::binary|ios::in);

if(!file){

    cout<<"ERROR IN OPENING FILE \n";

    return;

}

while(file){

if(file.read((char*)&x,sizeof(x)))

    if(x.getSalary()>=10000 && x.getSalary()<=20000)

        x.display();

}

file.close();

}

void searchForRecord(){

    //read employee id

    Employee  x;

    int c;

    int isFound=0;

    cout<<"Enter employee code: ";

    cin>>c;

file.open("EMPLOYEE.DAT",ios::binary|ios::in);

if(!file){

    cout<<"ERROR IN OPENING FILE \n";

    return;

}

while(file){

```

```

        if(file.read((char*)&x,sizeof(x))){
            if(x.getEmpCode()==c){
                cout<<"RECORD FOUND\n";
                x.display();
                isFound=1;
                break;
            }
        }
    }
    if(isFound==0){
        cout<<"Record not found!!!\n";
    }
    file.close();
}

void increaseSalary(){
    //read employee id
    Employee  x;
    int c;
    int isFound=0;
    float sal;
    cout<<"enter employee code \n";
    cin>>c;
    file.open("EMPLOYEE.DAT",ios::binary|ios::in);
    if(!file){
        cout<<"ERROR IN OPENING FILE \n";
        return;
    }
    while(file){
        if(file.read((char*)&x,sizeof(x))){
            if(x.getEmpCode()==c){
                cout<<"Salary hike? ";
                cin>>sal;
                x.updateSalary(x.getSalary()+sal);
                isFound=1;
                break;
            }
        }
    }
}

```

```

}

if(isFound==0){

    cout<<"Record not found!!!\n";

}

file.close();

cout<<"Salary updated successfully."<<endl;

}

void insertRecord(){

    //read employee record

    Employee  x;

    Employee newEmp;

    newEmp.read();

    fstream fin;

    file.open("EMPLOYEE.DAT",ios::binary|ios::in);

    //open file in write mode

    fin.open("TEMP.DAT",ios::binary|ios::out);


    if(!file){

        cout<<"Error in opening EMPLOYEE.DAT file!!!\n";

        return;

    }

    if(!fin){

        cout<<"Error in opening TEMP.DAT file!!!\n";

        return;

    }

    while(file){

        if(file.read((char*)&x,sizeof(x))){

            if(x.getEmpCode()>newEmp.getEmpCode()){

                fin.write((char*)&newEmp, sizeof(newEmp));

            }

            //no need to use else

            fin.write((char*)&x, sizeof(x));

        }

    }

    fin.close();

    file.close();

    rename("TEMP.DAT","EMPLOYEE.DAT");

```

```

remove("TEMP.DAT");

cout<<"Record inserted successfully."<<endl;
}

int main()
{
    char ch;

    //if required then only remove the file
    deleteExistingFile();

    do{
        int n;

        cout<<"ENTER CHOICE\n"<<"1.ADD AN EMPLOYEE\n"<<"2.DISPLAY\n"<<"3.SEARCH\n"<<"4.INCREASE
SALARY\n"<<"5.INSERT RECORD\n";

        cout<<"Make a choice: ";

        cin>>n;

        switch(n){
            case 1:
                appendToFille();

                break;

            case 2 :
                displayAll();

                break;

            case 3:
                searchForRecord();

                break;

            case 4:
                increaseSalary();

                break;

            case 5:
                insertRecord();

                break;

            default :

                cout<<"Invalid Choice\n";

        }

        cout<<"Do you want to continue ? : ";

        cin>>ch;

    }while(ch=='Y' || ch=='y');

    return 0;}

```

```
ENTER CHOICE
1.ADD AN EMPLOYEE
2.DISPLAY
3.SEARCH
4.INCREASE SALARY
5.INSERT RECORD
Make a choice: 1
Enter employee code: 52
Enter name: Ram
Enter salary: 50000
Record added sucessfully.
Do you want to continue ? : y
ENTER CHOICE
1.ADD AN EMPLOYEE
2.DISPLAY
3.SEARCH
4.INCREASE SALARY
5.INSERT RECORD
Make a choice: 1
Enter employee code: 65
Enter name: Sam
Enter salary: 65000
Record added sucessfully.
Do you want to continue ? : y
ENTER CHOICE
1.ADD AN EMPLOYEE
2.DISPLAY
3.SEARCH
4.INCREASE SALARY
5.INSERT RECORD
Make a choice: 2
Do you want to continue ? : y
```

```
ENTER CHOICE
1.ADD AN EMPLOYEE
2.DISPLAY
3.SEARCH
4.INCREASE SALARY
5.INSERT RECORD
Make a choice: 3
Enter employee code: 65
RECORD FOUND
65 Sam 65000
```