SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

C/C++ Programming Language assignment 1

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1 ANALYSIS

The problem is to calculate the distance between two places by their latitude and longitude. As we all know that the radius of earth is 6371 km, assume earth is a perfect sphere, we could use latitude and longitude to calculate the angle. Firstly, compute ϕ:

$$\phi\text{=(90-latitude)}\times \pi \div 180$$

Where latitude is in angle.
And let longitude be in radian too.

$$\theta\text{=longitude}\times \pi \div 180$$

Where longitude is also in angle.
Using the following formula could compute the shortest distance between the two places.

$$c\text{=}\sin(\phi_1)\times \sin(\phi_2)\times \cos(\theta_1 - \theta_2)+\cos(\phi_1)\times \cos(\phi_2)$$

$$d\text{=R}\times \arccos(c)$$

Where R is the radius of earth that is R = 6371 km.

2 CODE

Listing 1: Assignment 1.

```
#include <iostream>
#include <cmath>
using namespace std;
int main(){
    double latitude1;
    double longitude1;
    double latitude2;
    double longitude2;
    string city1;
    string city2;
    cout<<"The first city:";
    getline(cin,city1);
```

```
    while(cin.fail()){
        cout<<"Please input the correct name"<<endl;
        cout<<"The first city:";
        cin.clear();
        cin.sync();
        while(cin.get() != '\n'){}
        cin>>city1;
    }
    cout<<"The latitude and longitude of first city,separates by a space:";
    cin>>latitude1>>longitude1;
    while(cin.fail()){
        cout<<"Please input the correct numbers"<<endl;
        cout<<"The latitude and longitude of first city,separates by a space:";
        cin.clear();
        cin.sync();
        while(cin.get() != '\n'){}
        cin>>latitude1>>longitude1;
     }
    while(latitude1>90||latitude1<-90){
        cout<<"Latitude should be between -90 to 90"<<endl;
        cout<<"The latitude and longitude of first city,separates by a space:";
        cin.clear();
        cin.sync();
        while(cin.get() != '\n'){}
        cin>>latitude1>>longitude1;
    }
    while(longitude1>180||longitude1<-180){
        cout<<"Longitude should be between -180 to 180"<<endl;
        cout<<"The latitude and longitude of first city,separates by a space:";
        cin.clear();
        cin.sync();
        while(cin.get() != '\n'){}
        cin>>latitude1>>longitude1;
    }
    cin.get();
    cout<<"The second city:";
    getline(cin,city2);
    while(cin.fail()){
        cout<<"Please input the correct name"<<endl;
        cout<<"The second city:";
        cin.clear();
        cin.sync();
        while(cin.get() != '\n'){}
        cin>>city2;
    }
    cout<<"The latitude and longitude of second city,separates by a space:";
    cin>>latitude2>>longitude2;
    while(cin.fail()){
        cout<<"Please input the correct numbers"<<endl;
        cin.clear();
```

```
63          cin.sync();
64          while(cin.get() != '\n'){}
65          cout<<"The latitude and longitude of second city,separates by a space:";
66          cin>>latitude2>>longitude2;
67      }
68      while(latitude2>90||latitude2<-90){
69          cout<<"Latitude should be between -90 to 90"<<endl;
70          cout<<"The latitude and longitude of first city,separates by a space:";
71          cin.clear();
72          cin.sync();
73          while(cin.get() != '\n'){}
74          cin>>latitude1>>longitude1;
75      }
76      while(longitude2>180||longitude2<-180){
77          cout<<"Longitude should be between -180 to 180"<<endl;
78          cout<<"The latitude and longitude of first city,separates by a space:";
79          cin.clear();
80          cin.sync();
81          while(cin.get() != '\n'){}
82          cin>>latitude1>>longitude1;
83      }
84      double phi1 = (90 - latitude1)*M_PI/180;
85      double theta1=longitude1*M_PI/180;
86      double phi2 = (90 - latitude2)*M_PI/180;
87      double theta2=longitude2*M_PI/180;
88      double c=sin(phi1)*sin(phi2)*cos(theta1-theta2)+cos(phi1)*cos(phi2);
89      double d =6371*acos(c);
90      cout<<"The distance between " <<city1<< " and "<<city2<<" is "<<d<<" km."<<endl;
91
92      return 0;
93  }
```

3 Result & Verification

Test case #1:

Listing 2: Test1.

```
The first city:Beijing
The latitude and longitude of first city,separates by a space:39.9139  116.3917
The second city:Shenzhen
The latitude and longitude of second city,separates by a space:22.55 114.1
The distance between Beijing and Shenzhen is 1942.84km.
```

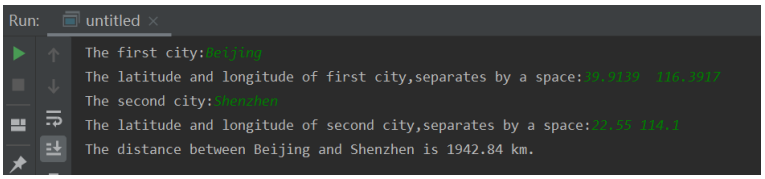

Figure 3.1: test1.

Test case #2:

Listing 3: Test2.

```
The first city:Shenzhen
The latitude and longitude of first city,separates by a space:22.55 114.1
The second city:New York
The latitude and longitude of second city,separates by a space:40.7127 -74.0059
The distance between Shenzhen and New York is 12930.8km.
```

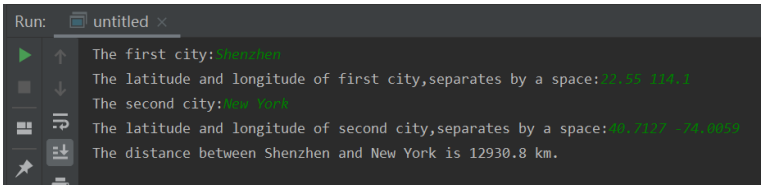

Figure 3.2: test2.

4 Difficulties & Solutions

1. To understand what the formula and model means.
2. To handle unexpected input, without reporting error and ask user to input again.
3. Some cities' names contain two or more words but store in one variable.