CS205 C/C++ Programming - Lab ASSIGNMENT

Name : 杨睦圳（Yang Muzhen）

SID： 11813010

Part 1 - Analysis

First, we need to **get the input**: two countries name, and their latitudes and longitudes. Besides, we need to **check if the user's input is legal**. When the input is illegal, give some notice and terminate the program correctly.

With the correct latitude and logitude of the two countries, we can use the formula below to computing the flying distance (adapted from mathforum.org, provided by Doctor Rob).

Assume the Earth is a perfect sphere. Let all angles be measured in signed degrees (negative latitude means South; negative longitude means West).

phi = 90 - latitude

The North Pole has phi = 0, the South Pole has phi = 180, and 0 <= phi <= 180.

theta = longitude

Greenwich, England, has theta = 0, and -180 <= theta <= 180.

Let the angles for the two points be (phi1, theta1) and (phi2, theta2). Then compute

c = sin(phi1) * sin(phi2) * cos(theta1-theta2) +cos(phi1) * cos(phi2)

Note: phi and theta should be in radians.

Then the shortest great circle distance between the two points is

d = R*arccos(c)

where R is the radius of the earth in kilometers, and the arccosine is taken between 0 and 180 degrees, inclusive. Earth radius: 6,371 km

Part 2 - Code

The program is worked on cygwin

```
#include <iostream>
#include <string>
#include <math.h>


using namespace std;

void calculate(char*, double, double, char*, double, double);
bool getCity(char*);
bool isNum(char);
bool getData(double*, double*);

int main(){
    char city1[1024];
    char city2[1024];
    double latitude1;
```

```
    double latitude2;
    double longitude1;
    double longitude2;

    cout << "The first city: ";
    if(!getCity(city1)){
        cout << "Please enter a correct city name" << endl;
        return 0;
    }

    cout << "The latitude and longitude of first city: ";
    if(!getData(&latitude1, &longitude1)){
        cout << "Please input the right latitude and longitude in the format
\"num1 num2\"" << endl;
        return 0;
    }

    cout << "The second city: ";
    if(!getCity(city2)){
        cout << "Please enter a correct city name" << endl;
        return 0;
    }

    cout << "The latitude and longitude of second city: ";
    if(!getData(&latitude2, &longitude2)){
        cout << "Please input the right latitude and longitude in the format
\"num1 num2\"" << endl;
        return 0;
    }

    calculate(city1,latitude1,longitude1,city2,latitude2,longitude2);
    return 0;
}

bool isNum(char a){
    if(a < '0' || a > '9')
        return false;
    else
        return true;
}

bool getData(double* a, double* b){
    char* arr;
    cin.get(arr, 1024).get();
    //printf("*%s*", arr);
    if(!isNum(*arr) && *arr != '-')
        return false;

    if(*arr == '-'){
        if(!isNum(*(arr + 1)))
            return false;
    }

    *a = atof (arr);
    arr++;

    bool dot = false;
    do{
```

```
        if(isNum(*arr))
            continue;
        else{
            if(*arr == ' '){
                arr++;
                break;
            }else if(*arr == '.' && !dot){
                dot = true;
                arr++;
                if(!isNum(*arr))
                    return false;
            } else
                return false;
        }
    }while(*(++arr));

    if(!*arr)
        return false;
    else{

        if(*arr == '-'){
            if(!isNum(*(arr + 1)))
                return false;
        }

        *b = atof(arr);
        arr++;

        if(!*arr)
            return true;

        bool dot = false;
        do{
            if(isNum(*arr))
                continue;
            else if(*arr == '.' && !dot){
                dot = true;
                arr++;
                if(!isNum(*arr))
                    return false;
            } else
                return false;

        }while(*(++arr));
    }

    if(*a < -90 ||*a > 90)
        return false;
    else if (*b < -180 || *b > 180)
        return false;
    else
        return true;
}

bool getCity(char* city){
    cin.get(city, 1024).get();

    do{
```

```
        if((*city >= 'a' && *city <= 'z') || (*city >= 'A' && *city <= 'Z')
            ||*city == ' ' || *city == ',')
            continue;
        return false;
    }while(*(++city));
    return true;
}

void calculate(char* city1, double latitude1, double longitude1,
               char* city2, double latitude2, double longitude2){
    const int R = 6371;
    const double PI = M_PI / 180;
    double phi1 = (90 - latitude1) * M_PI / 180;
    double phi2 = (90 - latitude2) * M_PI / 180;
    double theta1 = (longitude1) * M_PI / 180;
    double theta2 = (longitude2) * M_PI / 180;
    double c = sin(phi1) * sin(phi2) * cos(theta1 - theta2)
               + cos(phi1) * cos(phi2);
    double d = R * acos(c);

    //printf("%.2f %.2f %.2f %.2f\n", latitude1, longitude1, latitude2,
longitude2);
    printf("The distance between %s and %s is %.2f km",
           city1,  city2,  d);

}
```

Part 3 - Result & Verification

Compile:

```
sdmms@DESKTOP-09CJ9E6 /cygdrive/c/Users/sdmms/Desktop/cs/c/assignment1
$ g++ -c assignment1.cpp

sdmms@DESKTOP-09CJ9E6 /cygdrive/c/Users/sdmms/Desktop/cs/c/assignment1
$ ls
a1.md                    assignment1.cpp  Assignment1_v2.pdf
AssigmentTemplate_v2.pdf  assignment1.o

sdmms@DESKTOP-09CJ9E6 /cygdrive/c/Users/sdmms/Desktop/cs/c/assignment1
$ g++ assignment1.o -o assignment1

sdmms@DESKTOP-09CJ9E6 /cygdrive/c/Users/sdmms/Desktop/cs/c/assignment1
$ ls
a1.md                    assignment1.cpp  assignment1.o
AssigmentTemplate_v2.pdf  assignment1.exe  Assignment1_v2.pdf
```

Test case #1:

```
input: Shenzhen
       22.55 114.1
       Beijing
       39.9139 116.3917
output:The distance between Shenzhen and Beijing is 1942.84 km
```

```
sdmms@DESKTOP-09CJ9E6 /cygdrive/c/Users/sdmms/Desktop/cs/c/assignment1
$ ./assignment1
The first city: Shenzhen
The latitude and longitude of first city: 22.55 114.1
The second city: Beijing
The latitude and longitude of second city: 39.9139 116.3917
The distance between Shenzhen and Beijing is 1942.84 km
```

Test case #2:

```
input: New York, USA
       40.7127 -74.0059
       London
       51.5072 -0.1275
output:The distance between Shenzhen and Beijing is 5570.25 km
```

```
sdmms@DESKTOP-09CJ9E6 /cygdrive/c/Users/sdmms/Desktop/cs/c/assignment1
$ ./assignment1
The first city: New York, USA
The latitude and longitude of first city: 40.7127 -74.0059
The second city: London
The latitude and longitude of second city: 51.5072 -0.1275
The distance between New York, USA and London is 5570.25 km
```

Test case #3:

```
input:Shenzhen
      22.55 114.1
      @New York$
output:Please enter a correct city name
```

```
sdmms@DESKTOP-09CJ9E6 /cygdrive/c/Users/sdmms/Desktop/cs/c/assignment1
$ ./assignment1
The first city: Shenzhen
The latitude and longitude of first city: 22.55 114.1
The second city: @New York$
Please enter a correct city name
```

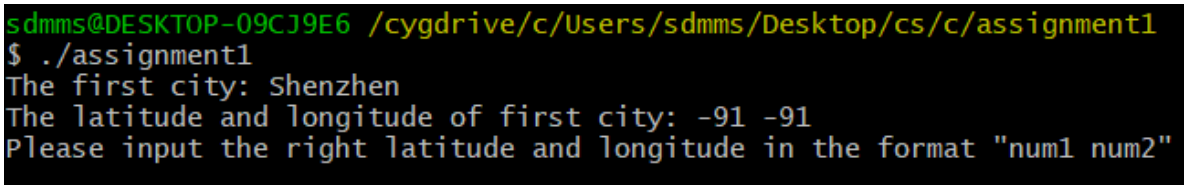
Test case #4:

```
input: Shenzhen
       avc 114.1
output:Please input the right latitude and longitude in the format "num1 num2"
```

```
sdmms@DESKTOP-09CJ9E6 /cygdrive/c/Users/sdmms/Desktop/cs/c/assignment1
$ ./assignment1
The first city: Shenzhen
The latitude and longitude of first city: avc 114.1
Please input the right latitude and longitude in the format "num1 num2"
```

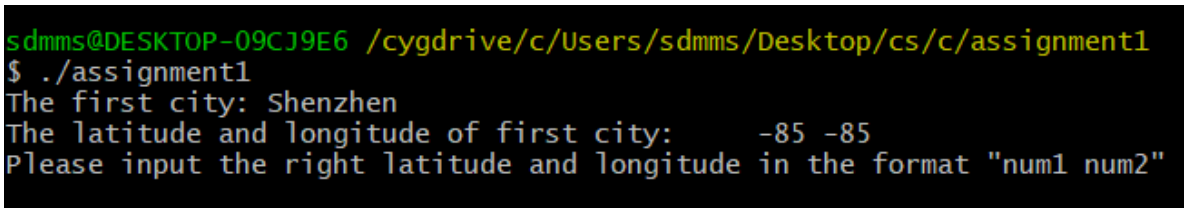
Test case #5:

```
input: Shenzhen
       -91 -91
output:Please input the right latitude and longitude in the format "num1 num2"
```



Test case #6:

```
input: Shenzhen
           -85 -85
output: Please input the right latitude and longitude in the format "num1 num2"
```



Part 4 - Difficulties & Solutions

Since the users can input anything they want, it will be disastrous if we directly use the input to calculate. So two function `getCity` and `getData` is defined to get and check the inputs. They will return 'false' if the input is illegal and then the program will show a message and terminate correctly.