CS205 C/ C++ Programming - Lab Assignment 1

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Part 1 - Analysis

The problem is to calculate the distance between two cities. We have to read the name, latitude and longitude of two's cities. Then calculate the distance and output. Because the angle, which is described in the statement, is measured with degree, we need to first convert degree to radian.

$$phi = 90 - Latitude$$
$$theta = Longitude$$
$$c = \sin(phi_1) * \sin(phi_2) * \cos(theta_1 - theta_2) + \cos(phi_1) * \cos(phi_2)$$
$$d = R * \arccos(c)$$

Part 2 - Code

```cpp
#include <cmath>
#include <cstdio>
#include <iostream>
#include <string>
using namespace std;

const int maxn = 1e3 + 10;
const double PI = acos(-1);

char s1[maxn];
char s2[maxn];

double phi1, phi2;
double theta1, theta2;
char buffer[maxn];

double get_arc(double x) { return x * PI / 180; }

void get_double(double& x) {
    cin >> x;
    while (cin.fail()) {
        cout << "wrong format, please try again" << endl;
        cin.clear();
        cin.getline(buffer, maxn);
        cin >> x;
    }
}
```

```
28
29  int main() {
30      printf("Please input the first city: <city name>\n");
31      cin.getline(s1, maxn);
32      printf("Please input <latitude>\n");
33      get_double(phi1);
34      printf("Please input <longitude>\n");
35      get_double(theta1);
36      getchar();
37      printf("Please input the second city: <city name>\n");
38      cin.getline(s2, maxn);
39      printf("Please input <latitude>\n");
40      get_double(phi2);
41      printf("Please input <longitude>\n");
42      get_double(theta2);
43
44      phi1 = 90 - phi1, phi2 = 90 - phi2;
45      phi1 = get_arc(phi1);
46      phi2 = get_arc(phi2);
47      theta1 = get_arc(theta1);
48      theta2 = get_arc(theta2);
49
50      double c = sin(phi1) * sin(phi2) * cos(theta1 - theta2) + cos(phi1) *
    cos(phi2);
51      double d = 6371 * acos(c);
52
53      printf("The distance between %s and %s is %.2f km\n", s1, s2, d);
54      return 0;
55  }
56
```

Part 3 - Result & Verification

> The verification is combined with the result queried in the website.

Test case #1:

```
1  Input:
2  Shenzhen
3  22.55
4  114.1
5  Paris
6  48.8567
7  2.3508
8  Output: The distance between Shenzhen and Beijing is 9601.85 km
```

```
➜  Assignment1 git:(master) ✗ ./Assignment1
Please input the first city: <city name>
Shenzhen
Please input <latitude> <longitude>, divide by space
22.55 114.1
Please input the second city: <city name>
Paris
Please input <latitude> <longitude>, divide by space
48.8567 2.3508
The distance between Shenzhen and Paris is 9601.85 km
```

Test case #2:

```
Input:
Shenzhen
Paris // incorrect format
22.55
114.1
Paris
48.8567
2.3508
Output: The distance between Shenzhen and Beijing is 9601.85 km
```

```
➜  Assignment1 git:(master) ✗ ./Assignment1
Please input the first city: <city name>
Shenzhen
Please input <latitude>
Paris
wrong format, please try again
22.55
Please input <longitude>
114.1
Please input the second city: <city name>
Paris
Please input <latitude>
48.8567
Please input <longitude>
2.3508
The distance between Shenzhen and Paris is 9601.85 km
```

Test Case #3:

```
Shenzhen
22.55
114.1
San Francisco
37.7833
-122.4167
```

```
➜  Assignment1 git:(master) ✗ ./Assignment1
Please input the first city: <city name>
Shenzhen
Please input <latitude>
22.55
Please input <longitude>
114.1
Please input the second city: <city name>
San Francisco
Please input <latitude>
37.7833
Please input <longitude>
-122.4167
The distance between Shenzhen and San Francisco is 11081.23 km
```

Part 4 - Difficulties & Solutions

1. The difficulty is to convert degree to radian.

   We can multiply degree with pi/180 to get radian.

2. The second problem is how to read a line from input.

   We can use `cin.getline()` to read a line.