CS205 C/C++ Programming - Lab ASSIGNMENT 2

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Part 1 - Analysis

In the first part, we need to read all the data into the program. In this process, we should separate the strings by commas and get a string array. Check if the input is correct and **ignore the data which violate the input format**, such as those with the name of the city or the name of the country **exceeding the length boundary**. When the amount of data input is larger than the set quantity, **ignore the rest of the data**.

In the second part, we should focus on several main questions:

- How to make the query case-insensitive?

  We will use a string array to store the uppercase of all the city name. We will also change the user's input to uppercase before matching.

- How to ignore all whitespaces on both ends?

  We will define a function `trim` to delete the whitespaces on both ends of the input.

- How to find the cities that the input matches?

  Create an vector to store all the cities that the input matches. After all the cities checked, get the size of the vector. If the size larger than 1, print out all the cities in it and ask for the input again. If the size is 1, select the only city in it. If the size is 0, tell the user there is no such city and ask for the input again.

We can use the formula below to compute 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

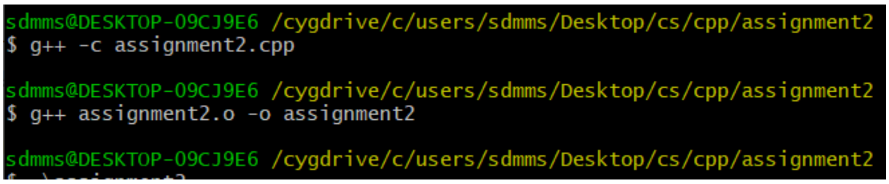
Part 2 - Code

The program is worked on cygwin

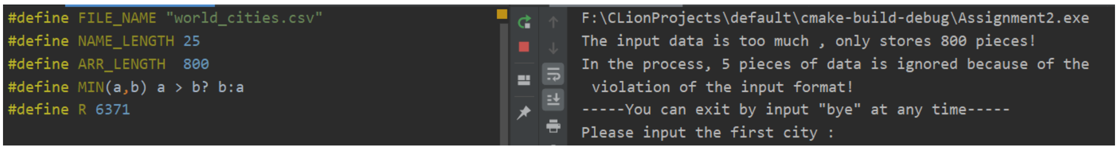
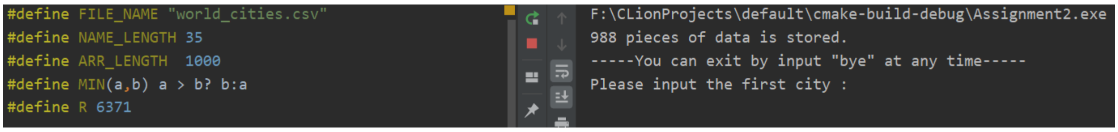
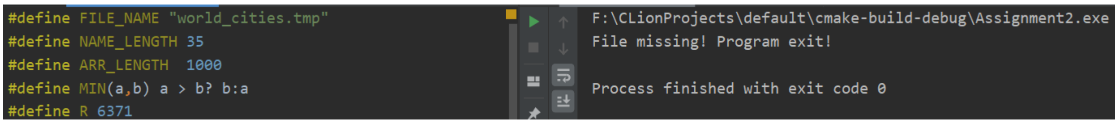
```cpp
#define FILE_NAME "world_cities.csv"
#define NAME_LENGTH 35
#define ARR_LENGTH  1000
#define MIN(a,b) a > b? b:a
#define R 6371

#include <iostream>
#include <sstream>
#include <fstream>
#include <vector>
#include <string>
#include <cmath>
#include <algorithm>

using namespace std;

struct city{
    string name;
    string country;
    double latitude{};
    double longitude{};
};

void trim(string &s){
     s.erase(0,s.find_first_not_of(' '));
     s.erase(s.find_last_not_of(' ') + 1);
}

vector<struct city*> arr;
void getCity(city cities[], string upper_name[], int len, city** city, bool*
exit){
    string in;
    while(getline(cin,in)){
        arr.clear();

        trim(in);
        transform(in.begin(), in.end(), in.begin(), ::toupper);

        if(in == "BYE"){
            *exit = true;
            return;
        }

        if(in.size() < 3){
            cout << "Please input a string with length >= 3 :" << endl;
            continue;
        }

        int i;
        for(i = 0; i < len; i++){
            if(upper_name[i] == in){
                arr.clear();
                arr.push_back(&cities[i]);
                break;
            }
            if(upper_name[i].find(in) == string :: npos)
                continue;
            arr.push_back(&cities[i]);
        }

        if(arr.empty())
            cout << "There is no such city, please input a correct name again :
" <<  endl;
        else if (arr.size() == 1){
            *city = arr[0];
            cout << "The city is " << arr[0]->name << ", " << arr[0]->country <<
endl;
            break;
        }else{
            cout << "Find several city as below : " << endl;
            for(i = 0; i < arr.size(); i++){
                cout << arr[i]->name << ", " << arr[i]->country << endl;
            }
            cout << "Please input the one you want : " << endl;
        }
    }
}

double calculate( double latitude1, double longitude1,
                    double latitude2, double longitude2){
    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);
    return d;
}

int main(){

    ifstream fin(FILE_NAME);
    if(!fin.good()){    //if file miss
        cout << "File missing! Program exit!"<< endl;
        return 0;
    }

    city cities[ARR_LENGTH];
    string upper_name[ARR_LENGTH];
    int cnt = 0;
    int ignore = 0;
    string in;
    vector<string> arr;

    while(getline(fin,in)){

        arr.clear();

        if(cnt >= ARR_LENGTH)
            break;

        istringstream sin(in);
        string temp;
        while (getline(sin, temp, ',')){
            arr.push_back(temp);
        }

        if(arr.size() > 5 || arr[0].size() > NAME_LENGTH || arr[2].size() >
NAME_LENGTH){
            ++ignore;
            continue;
        }

        cities[cnt].name = arr[0].substr(0,MIN(NAME_LENGTH,arr[0].length()));
        cities[cnt].country = arr[2].substr(0,MIN(NAME_LENGTH,arr[2].length()));
        cities[cnt].latitude = atof(arr[3].c_str());
        cities[cnt].longitude = atof(arr[4].c_str());

        upper_name[cnt] = cities[cnt].name;

 transform(upper_name[cnt].begin(),upper_name[cnt].end(),upper_name[cnt].begin()
, ::toupper);

        ++cnt;
    }

    if(cnt >= ARR_LENGTH)
        cout << "The input data is too much "  << ", only stores " << ARR_LENGTH
<< " pieces!"<< endl;
    else{
        cout << cnt << " pieces of data is stored."<< endl;
    }

    if(ignore > 0)
        cout << "In the process, " << ignore << " pieces of data is ignored
because of the violation of the input format!" << endl;

    string u;
    city* first;
    city* second;
    bool exit = false;

    while(!exit){
        cout << "-----You can exit by input \"bye\" at any time-----" << endl;

        cout << "Please input the first city : " << endl;
        getCity(cities,upper_name, cnt, &first, &exit);

        if(exit)
            break;

        cout << "Please input the second city : " << endl;
        getCity(cities,upper_name, cnt, &second, &exit);

        if(exit)
            break;

        double d = calculate(first->latitude, first->longitude, second-
>latitude, second->longitude);
        cout << "The distance between " << first->name << " and " << second-
>name << " is " << d << "km." << endl;
    }
    cout << "SUCCESSFULLY EXIT" << endl;
    return EXIT_SUCCESS;
}
```

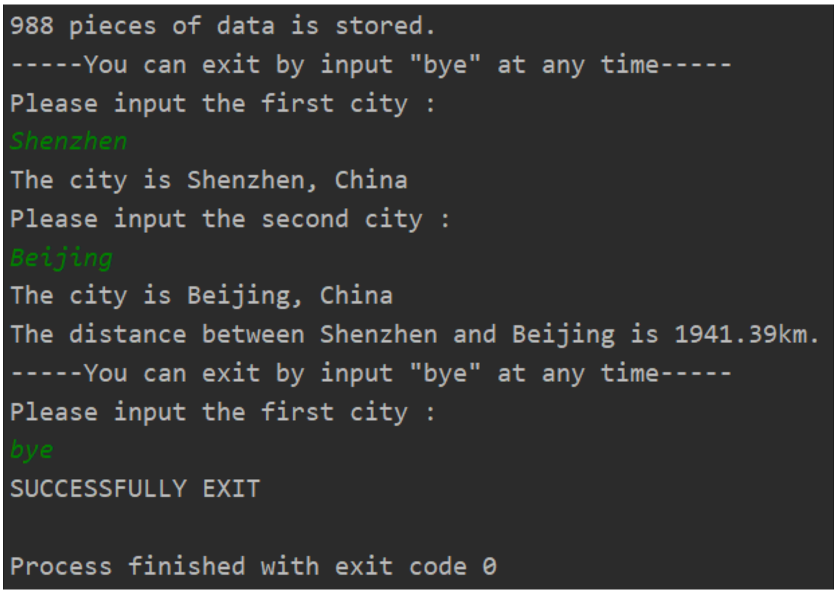
Part 3 - Result & Verification

Compile:

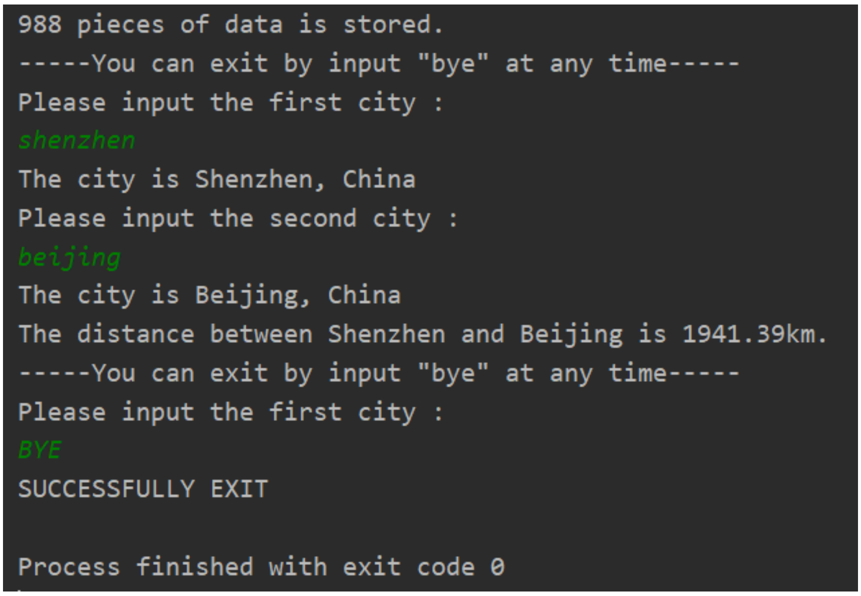


```
sdmms@DESKTOP-09CJ9E6 /cygdrive/c/users/sdmms/Desktop/cs/cpp/assignment2
$ g++ -c assignment2.cpp

sdmms@DESKTOP-09CJ9E6 /cygdrive/c/users/sdmms/Desktop/cs/cpp/assignment2
$ g++ assignment2.o -o assignment2

sdmms@DESKTOP-09CJ9E6 /cygdrive/c/users/sdmms/Desktop/cs/cpp/assignment2
```

> Part 1:
>
> 1. Initial set
>
> 
>
> ```
> #define FILE_NAME "world_cities.csv"
> #define NAME_LENGTH 25
> #define ARR_LENGTH  800
> #define MIN(a,b) a > b? b:a
> #define R 6371
> ```
>
> ```
> F:\CLionProjects\default\cmake-build-debug\Assignment2.exe
> The input data is too much , only stores 800 pieces!
> In the process, 5 pieces of data is ignored because of the
>  violation of the input format!
> -----You can exit by input "bye" at any time-----
> Please input the first city :
> ```
>
> 2. change the length of name and array
>
> 
>
> ```
> #define FILE_NAME "world_cities.csv"
> #define NAME_LENGTH 35
> #define ARR_LENGTH  1000
> #define MIN(a,b) a > b? b:a
> #define R 6371
> ```
>
> ```
> F:\CLionProjects\default\cmake-build-debug\Assignment2.exe
> 988 pieces of data is stored.
> -----You can exit by input "bye" at any time-----
> Please input the first city :
> ```
>
> 3. change the file name
>
> 
>
> ```
> #define FILE_NAME "world_cities.tmp"
> #define NAME_LENGTH 35
> #define ARR_LENGTH  1000
> #define MIN(a,b) a > b? b:a
> #define R 6371
> ```
>
> ```
> F:\CLionProjects\default\cmake-build-debug\Assignment2.exe
> File missing! Program exit!
>
> Process finished with exit code 0
> ```

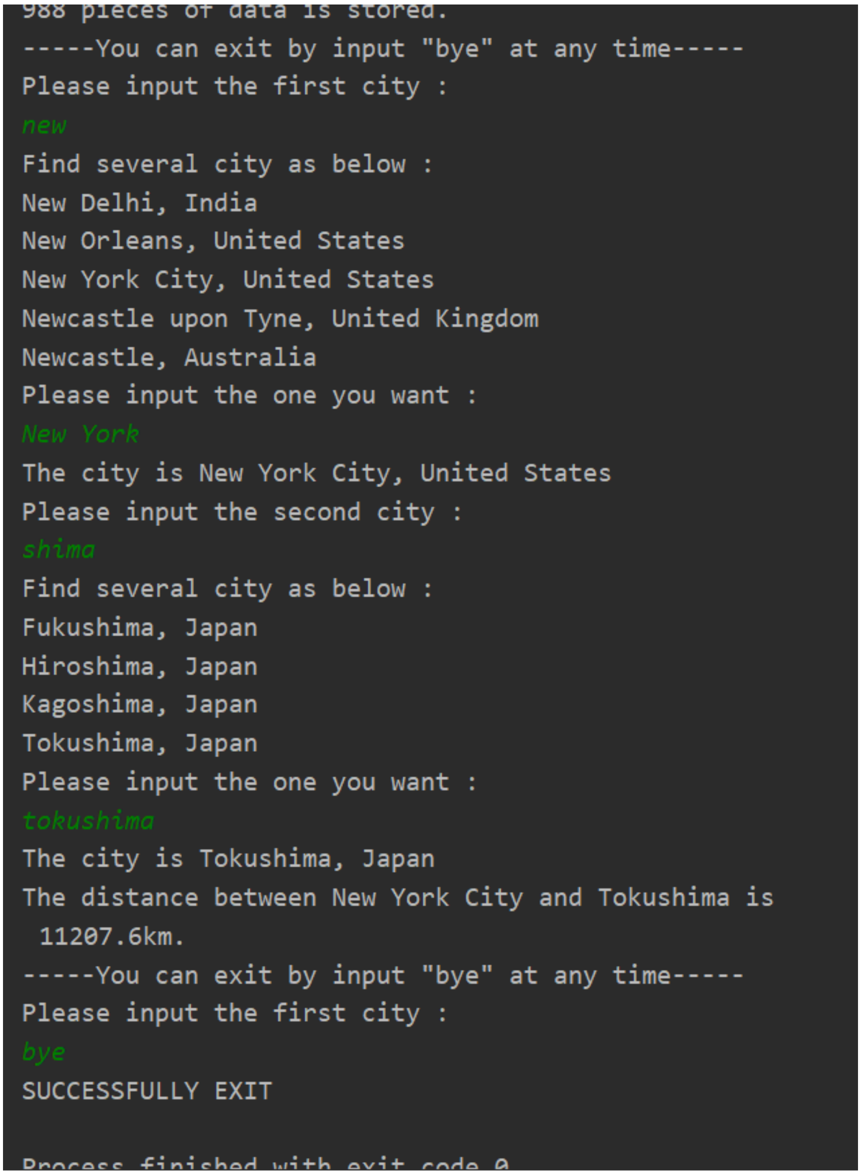
> Part 2:
>
> 1.
>
> 
>
> ```
> 988 pieces of data is stored.
> -----You can exit by input "bye" at any time-----
> Please input the first city :
> Shenzhen
> The city is Shenzhen, China
> Please input the second city :
> Beijing
> The city is Beijing, China
> The distance between Shenzhen and Beijing is 1941.39km.
> -----You can exit by input "bye" at any time-----
> Please input the first city :
> bye
> SUCCESSFULLY EXIT
>
> Process finished with exit code 0
> ```

2. test case-insensitive



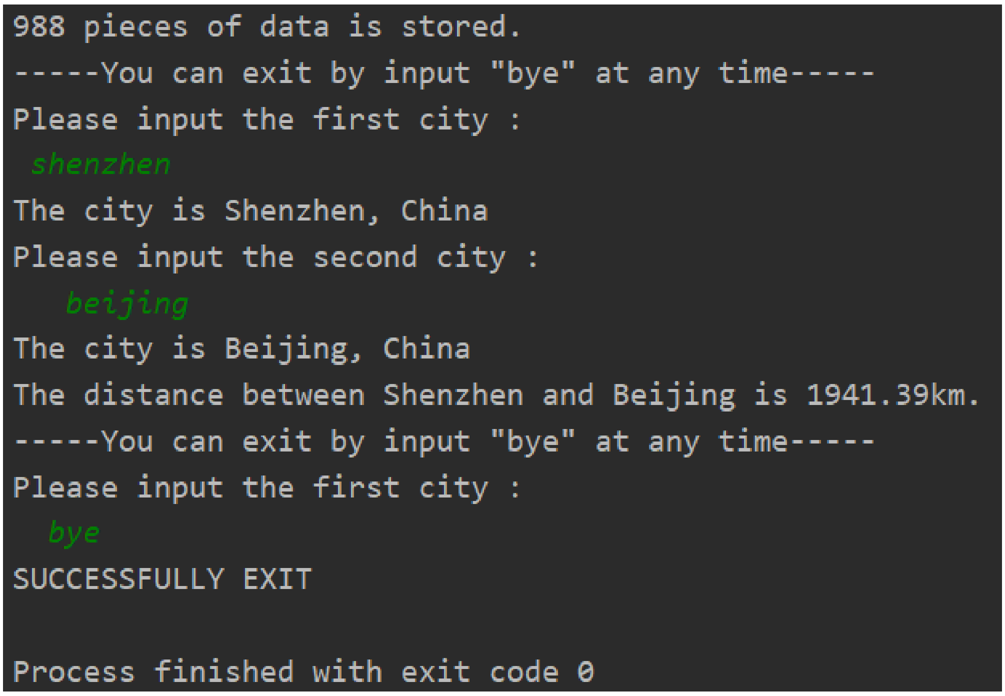
```
988 pieces of data is stored.
-----You can exit by input "bye" at any time-----
Please input the first city :
shenzhen
The city is Shenzhen, China
Please input the second city :
beijing
The city is Beijing, China
The distance between Shenzhen and Beijing is 1941.39km.
-----You can exit by input "bye" at any time-----
Please input the first city :
BYE
SUCCESSFULLY EXIT

Process finished with exit code 0
```

3. test multiple cities match



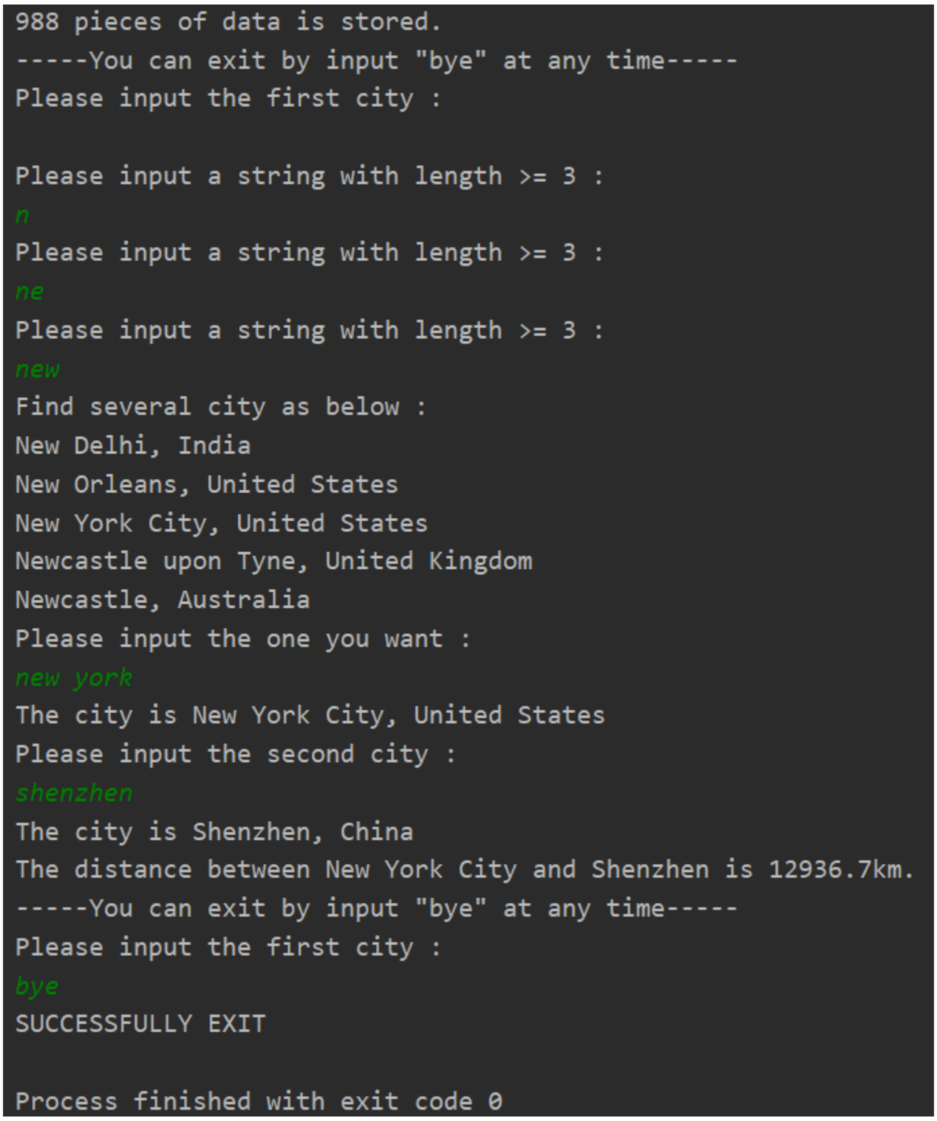
```
988 pieces of data is stored.
-----You can exit by input "bye" at any time-----
Please input the first city :
new
Find several city as below :
New Delhi, India
New Orleans, United States
New York City, United States
Newcastle upon Tyne, United Kingdom
Newcastle, Australia
Please input the one you want :
New York
The city is New York City, United States
Please input the second city :
shima
Find several city as below :
Fukushima, Japan
Hiroshima, Japan
Kagoshima, Japan
Tokushima, Japan
Please input the one you want :
tokushima
The city is Tokushima, Japan
The distance between New York City and Tokushima is
 11207.6km.
-----You can exit by input "bye" at any time-----
Please input the first city :
bye
SUCCESSFULLY EXIT

Process finished with exit code 0
```

4. Test whitespaces on both ends



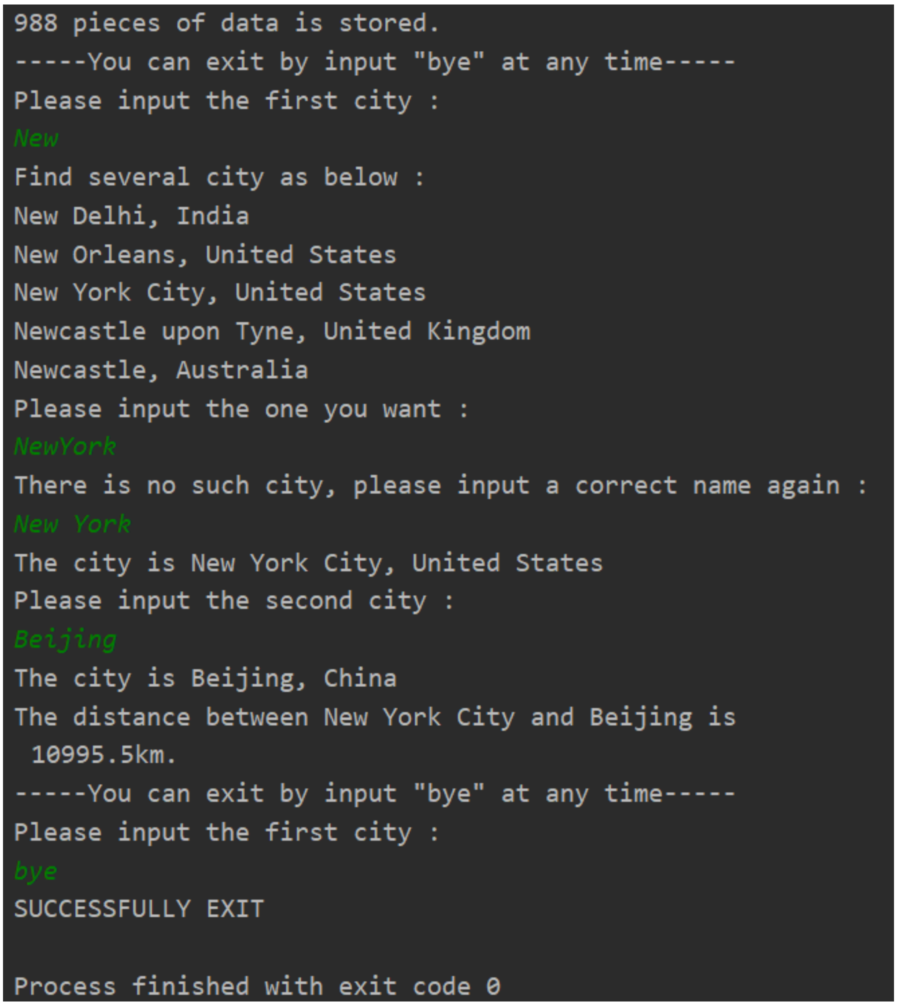
```
988 pieces of data is stored.
-----You can exit by input "bye" at any time-----
Please input the first city :
 shenzhen
The city is Shenzhen, China
Please input the second city :
   beijing
The city is Beijing, China
The distance between Shenzhen and Beijing is 1941.39km.
-----You can exit by input "bye" at any time-----
Please input the first city :
  bye
SUCCESSFULLY EXIT

Process finished with exit code 0
```

5. test the input with size less then 3



```
988 pieces of data is stored.
-----You can exit by input "bye" at any time-----
Please input the first city :

Please input a string with length >= 3 :
n
Please input a string with length >= 3 :
ne
Please input a string with length >= 3 :
new
Find several city as below :
New Delhi, India
New Orleans, United States
New York City, United States
Newcastle upon Tyne, United Kingdom
Newcastle, Australia
Please input the one you want :
new york
The city is New York City, United States
Please input the second city :
shenzhen
The city is Shenzhen, China
The distance between New York City and Shenzhen is 12936.7km.
-----You can exit by input "bye" at any time-----
Please input the first city :
bye
SUCCESSFULLY EXIT

Process finished with exit code 0
```

6. test no city matched



```
988 pieces of data is stored.
-----You can exit by input "bye" at any time-----
Please input the first city :
New
Find several city as below :
New Delhi, India
New Orleans, United States
New York City, United States
Newcastle upon Tyne, United Kingdom
Newcastle, Australia
Please input the one you want :
NewYork
There is no such city, please input a correct name again :
New York
The city is New York City, United States
Please input the second city :
Beijing
The city is Beijing, China
The distance between New York City and Beijing is
 10995.5km.
-----You can exit by input "bye" at any time-----
Please input the first city :
bye
SUCCESSFULLY EXIT

Process finished with exit code 0
```

Part 4 - Difficulties & Solutions

At first, I try to finish all the function by myself. For example, realize the function `trim` by using char array. However, I found that this would take a number of time. There are a lot of useful functions in the standard libary and it is wise to take use of them.