CSC3002: Introduction to Computer Science

Assignment 2

Assignment description:

You should write your code for each question in several .cpp and .h file. Please pack your **whole project into a single .zip file**, name it using your **student ID** (e.g. if your student ID is 123456, then the file should be named as 123456.zip), and then submit the .zip file via BB. For this assignment, **you don't have to** use the sample project. You can create an empty project with QT Creater to start programming. Please note that, the teaching assistant may ask you to explain the meaning of your program, to ensure that the codes are indeed written by yourself. Please also note that we may check whether your program is **too similar** to your fellow students' code using BB. **Please refer to the BB system for the assignment deadline.** For each day of late submission, you will obtain late penalty in the assignment marks. If you submit more than three days later than the deadline, you will receive zero in this assignment. **Detailed description on assignment requirement is stated in the last few pages.**

Exercise 1: Remove Comments

200 P192 No.8

Even though comments are essential for human readers, the compiler simply ignores them. If you are writing a compiler, you therefore need to be able to recognize and eliminate comments that occur in a source file. Write a function

```
void removeComments(istream & is, ostream & os);
```

that copies characters from the input stream `is` to the output stream `os`, except for characters that appear inside C++ comments. Your implementation should recognize both comment conventions:

- Any text beginning with /* and ending with */, possibly many lines later.
- Any text beginning with //and extending through the end of the line.

The real C++ compiler needs to check to make sure that these characters are not contained inside quoted strings, but you should feel free to ignore that detail. The problem is tricky enough as it stands.

Requirement

The function prototypes and main program has shown below. You need to write the `removeComments(istream $ is, ostream & os)` function.

```
/*
 * File: RemoveComments.cpp
 * ------------------------
 * Prints out a file after removing comments.
 */
#include <iostream>
```

```
#include <fstream>
#include "filelib.h"     // promptUserForFile
using namespace std;

/* Function prototypes */
void removeComments(istream & is, ostream & os);

/* Main program */
int main() {
   ifstream infile;
   promptUserForFile(infile, "Input file: ");
   removeComments(infile, cout);
   infile.close();
   return 0;
}

/*
 * Function: removeComments
 * Usage: removeComments(is, os);
 * ------------------------------
 * Copies characters from the input stream is to the output stream os,
 * removing any comments it finds.  This program eliminates both the
 * /* and // comment forms but does not check to see if those characters
 * are embedded within strings.
 */

void removeComments(istream & is, ostream & os) {
   // TODO
}
```

The file should be renamed as ***RemoveComments.cpp***.

Exercise 2: Area Codes

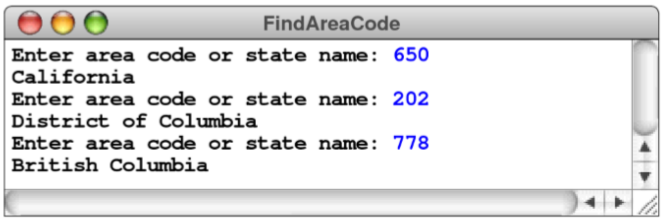
266 P258 No.19

Telephone numbers in the United States and Canada are organized into various three-digit ***area codes***. A single state or province will often have many area codes, but a single area code will not cross a state boundary. This rule makes it possible to list the geographical locations of each area code in a data file. For this problem, assume that you have access to the file **AreaCodes.txt**, which lists all the area codes paired with their locations as illustrated by the first few lines of that file:

AreaCodes.txt

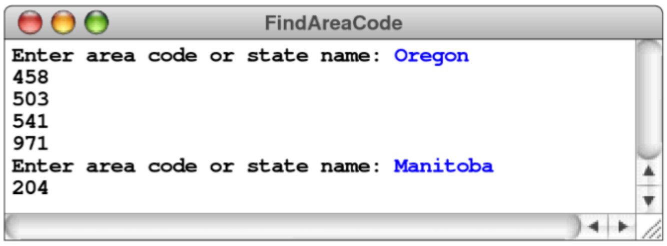
```
201-New Jersey
202-District of Columbia
203-Connecticut
204-Manitoba
205-Alabama
206-Washington
```

Using the `AirportCodes` program as a model, write the code necessary to read this file into a `Map<int,string>`, where the key is the area code and the value is the location. Once you've read in the data, write a main program that repeatedly asks the user for an area code and then looks up the corresponding location, as illustrated in the following sample run:



```
Enter area code or state name: 650
California
Enter area code or state name: 202
District of Columbia
Enter area code or state name: 778
British Columbia
```

As the prompt suggests, however, your program should also allow users to enter the name of a state or province and have the program list all the area codes that serve that area, as illustrated by the following sample run:



```
Enter area code or state name: Oregon
458
503
541
971
Enter area code or state name: Manitoba
204
```

Requirement:

```
/*
 * File: FindAreaCode.cpp
 * ----------------------
 * This program looks up a numeric area codes for the United States
 * and Canada.  The program works in both directions.  If the user
 * enters a number, the program prints out the state or province to
 * which that code is assigned.  If the user enters a name, it prints
 * out all the area codes assigned to that name.
 */
#include <iostream>
#include <fstream>
#include <string>
#include "error.h"
#include "map.h"
#include "simpio.h"
#include "strlib.h"
// TODO
using namespace std;

/* Function prototypes */
void readCodeFile(string filename, Map<int,string> & map);

/* Main program */
int main() {
   Map<int,string> areaCodeToState;
   readCodeFile("AreaCodes.txt", areaCodeToState);
   // TODO
   return 0;
}

/*
 * Function: readCodeFile
 * Usage: readCodeFile(filename, map);
 * -----------------------------------
 * Reads a data file representing area codes and locations into the map,
 * which must be declared by the client.  Each line must consist of the
 * area code, a hyphen, and the name of the state/province.
 */
void readCodeFile(string filename, Map<int,string> & map) {
   // TODO
}
```

The **AreaCode.txt** file is given. Please fill in the TODO and rename the file as **FindAreaCode.cpp**

Exercise 3: IntArray

573 P565 No.4

Design and implement a class called `IntArray` that implements the following methods:

- A constructor `IntArray(n)` that creates an `IntArray` object with n elements, each of which is initialized to 0.
- A destructor that frees any heap storage allocated by the `IntArray`.
- A method `size()` that returns the number of elements in the `IntArray`.
- A method `get(k)` that returns the element at position `k`. If `k` is outside the vector bounds, `get` should call `error` with an appropriate message.
- A method `put(k, value)` that assigns value to the element at position `k`. As with `get`, the `put` method should call `error` if `k` is out of bounds.

Your solution should be split into separate interface and implementation files in a manner similar to the `CharStack` example from the chapter. In the initial version of the code, you should add the necessary definitions to the `intarray.h` file to prevent clients from copying `IntArray` objects. Design and implement a unit test to check the methods exported by the class.

By keeping track of the array size and checking that index values are inside the array bounds, this simple `IntArray` class already fixes two of the most serious shortcomings of the built-in array type.

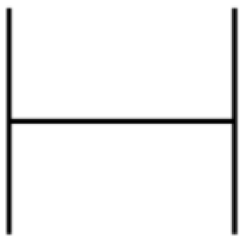
Requirement:

The **TestIntArray.cpp** file is given. Please write your **intarray.h** file and **intarray.cpp** file.

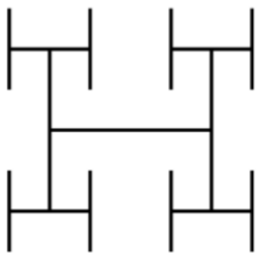
Exercise 4: H-Fractal

393 P385 No.16

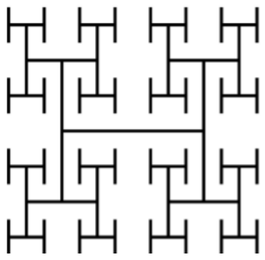
If you search the web for fractal designs, you will find many intricate wonders beyond the Koch snowflake illustrated in this chapter. H-fractal, in which the repeated pattern is shaped like an elongated letter H in which the horizontal bar and vertical lines on the sides have the same length. Thus, the order-0 Hfractal looks like this:



To create the order-1 fractal, all you do is add four new H-fractals—each one half of the original size—at each open end of the order-0 fractal, like this:



To create the order-2 fractal, all you have to do is add even smaller H-fractals (again half the size of the fractal to which they connect) to each of the open endpoints. This process gives rise to the following order-2 fractal:



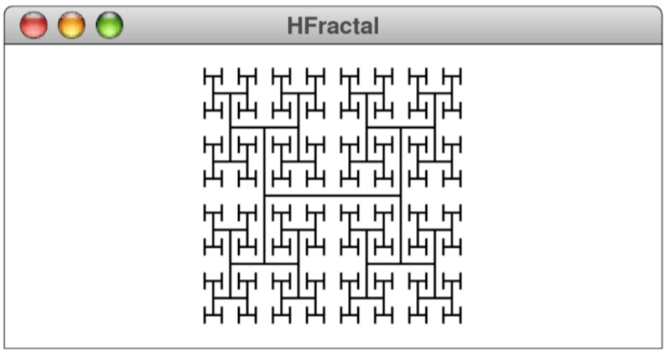
Write a recursive function

```
drawHFractal(GWindow & gw, double x, double y,                              double size, int order);
```

where x and y are the coordinates of the center of the H-fractal, size specifies the width and the height, and order indicates the order of the fractal. As an example, the main program

```
int main() {
    GWindow gw;
    double xc = gw.getWidth() / 2;
    double yc = gw.getHeight() / 2;
    drawHFractal(gw, xc, yc, 100, 3);
    return 0;
}
```

would draw an order-3 H-fractal at the center of the graphics window, like this:



Requirement

```
/*
 * File: HFractal.cpp
 * ------------------
 * This program draws an H-fractal on the graphics window.int main() {
 */
#include "gwindow.h"

/* Function prototypes */
void drawHFractal(GWindow & gw, double x, double y, double size, int order);

/* Main program */
int main() {
   GWindow gw;
   double xc = gw.getWidth() / 2;
   double yc = gw.getHeight() / 2;
   drawHFractal(gw, xc, yc, 100, 3);
   return 0;
}

/*
 * Function: drawHFractal
 * Usage: drawHFractal(gw, x, y, size, order);
 * -------------------------------------------
 * Draws a fractal diagram consisting of an H in which each additional
 * fractal layer draws half-size fractals at the four endpoints of each H.
 */
void drawHFractal(GWindow & gw, double x, double y, double size, int order) {
    //TODO
}
```

Please fill the TODO and rename the file as **HFractal.cpp**.