

CSCI 2270

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Assignment 3: Due Sunday 7/01 11:59pm

Communication between towers

Read the entire assignment carefully before beginning. This write-up contains both the details of what your program needs to do as well as implementation requirements for how the functionality needs to be implemented.

Goals:

- Use command line arguments appropriately
- Structure your code using classes
- Implement attributes and methods
- Thorough understanding of Linked lists

What should your program do:

- Read in the file *messageIn.txt*
- Your code should be separated into three files *CommunicationNetwork.h*, *CommunicationNetwork.cpp*, and *Assignment4.cpp*.
- Separate definition and implementation in respectively *.h* and *.cpp* files
- Define a class called *City* and follow *.h* to implement it
- Have the following functionalities:
 - Menu (5pts)
 - Build Network (5pts)
 - Print Network Path (5pts)
 - Transmit Message Coast-to-Coast-to-Coast (10pts)
 - Add City (10pts)
 - Delete City (35pts)
 - Clear Network (30pts)

Description

In the Lord of the Rings trilogy, there is a scene where the first beacon is lit in the towers of Minas Tirith. The second beacon then sees the fire, and knows to light its fire to send a signal to the third beacon, and so forth. This was a means of communicating in the days before telegraphs were invented as it was much faster than sending a human rider to

deliver a message. Communication towers were equipped with signaling mechanisms, such as mirrors, that could spell out messages using the positions of the mirrors.

Today, there are several examples of communication networks that are conceptually similar, but much more technically advanced, that route messages through multiple hubs between the sender and the receiver. For example, when you type a URL into a web browser, a request is sent through a network of service providers to the destination, and then packets of information are sent back to your machine. If I type `www.google.com` from my home in Boulder, my request follows this path:

1. **192.168.2.1 (192.168.2.1)**
2. **c-24-9-60-1.hsd1.co.comcast.net (24.9.60.1)**
3. **te-9-7-ur02.boulder.co.denver.comcast.net**
4. **xe-13-3-1-0-ar01.aurora.co.denver.comcast.net**
5. **he-3-10-0-0-cr01.denver.co.ibone.comcast.net (68.86.92.25)**
6. **te-1-1-0-4-cr01.chicago.il.ibone.comcast.net (68.86.95.205)**
7. **xe-2-0-0-0-pe01.910fifteenth.co.ibone.comcast.net (68.86.82.2)**
8. **as15169-1-c.910fifteenth.co.ibone.comcast.net (23.30.206.106)**
9. **72.14.234.57 (72.14.234.57)**
10. **209.85.251.111 (209.85.251.111)**
11. **den03s06-in-f16.1e100.net (74.125.225.208)**

Each IP address is a hop in the network for my request, which is received at each service provider and then forwarded to the next service provider in the network, depending on the final destination of the message.

(Note: I got this path by typing `tracert www.google.com` in a terminal window. From campus, you will see a different path.)

Build your own communications network

In this assignment, you're going to simulate a communications network using a linked list. Each node in your linked list will represent a city and you need to be able to send a message between nodes from one side of the country to the other. Your program also needs to provide the capability to update the network by adding cities and still be able to transmit the message. The linked list to be built will be the network among the cities.

Include the following cities in your network:

Los Angeles
Phoenix
Denver
Dallas
St. Louis

Chicago
Atlanta
Washington, D.C.
New York
Boston

Implement each city as a struct with a name, a pointer connecting it to the next city in the network and the previous city in the network, and a place to store the message being sent. (You can assume the message is a string.) When you initially build your network, the order of the cities should be the same as the order listed above. After the network is built, you will provide the option of adding additional cities.

When your program starts, you should display a menu that presents the user with options for how to run your program. The menu needs to look like the one shown here:

```
=====Main Menu=====
1. Build Network
2. Print Network Path
3. Transmit Message Coast-To-Coast-To-Coast
4. Add City
5. Delete City
6. Clear Network
7. Quit
```

The user will select the number for the menu option and your program should respond accordingly to that number. Your menu options need to have the following functionality:

- 1) Build Network
- 2) Print Network Path
- 3) Transmit Message Coast-to-Coast-to-Coast
- 4) Add City
- 5) Delete City
- 6) Clear Network
- 7) Quit

Build Network

This option builds the linked list using the cities listed above in the order they are listed. Each city needs to have a name, a pointer to the next city, a pointer to the previous city, and a message value, which will initially be an empty string. This option should be selected first to build the network, and can be selected anytime the user wants to rebuild the starting network after adding cities. As part of the Build Network functionality, you should print the name of each city in the network once the network is built in the following format:

```
NULL <- Los Angeles <-> Phoenix <-> Denver <-> Dallas <-> St. Louis <-> Chicago <->
Atlanta <-> Washington, D.C. <-> New York <-> Boston -> NULL
```

An example output could be the following:

```
===CURRENT PATH===
NULL <- Los Angeles <-> Phoenix <-> Denver <-> Dallas <-> St. Louis <-> Chicago
<-> Atlanta <-> Washington, D.C. <-> New York <-> Boston -> NULL
=====
```

Print Network Path

This option prints out the linked list in order from the head to the tail by following the next pointer for each city. You should print the name of each city. The function could be very useful to you when debugging your code. The format should be the same as the format in Build Network.

Transmit Message Coast-to-Coast-to-Coast

This option reads word by word from the messageIn.txt file and transmits the message starting at the beginning of the network and ending at the end of the network, and then sends the message back again to the beginning of the network. Using the cities in this write-up, the message would go from Los Angeles to Boston, passing through each city along the way, and then back to Los Angeles, passing through each city along the way. When a city receives the message, you should print

<city name> received <word>

where <city name> is the name of the city and <word> is the word received. When a city receives a word, the word should be deleted from the sender city, i.e set the message for the sender city to an empty string. Here is a screenshot of the output I get after transmitting the first two words in the file:

```
Los Angeles received A
Phoenix received A
Denver received A
Dallas received A
St. Louis received A
Chicago received A
Atlanta received A
Washington, D.C. received A
New York received A
Boston received A
New York received A
Washington, D.C. received A
Atlanta received A
Chicago received A
St. Louis received A
Dallas received A
Denver received A
Phoenix received A
Los Angeles received A
Los Angeles received liger
```

Note: The name of the file that contains the message should be a command line argument to your program.

Add City

This option allows the user to add a new city to the network. If the user selects this option, then they should be prompted for the name of the city and the city that the new city should follow in the network. For example, if the user wants to add Tucson after Phoenix in the network, then the first four cities in the network would be:

Los Angeles <-> Phoenix <-> Tucson <-> Denver...

You don't need to print anything when you add a new city, just call the Print Network function again from the menu if you want to verify that the city has been added.

If the user wants to add a new city to the head of the network, e.g. replace Los Angeles as the starting city, then they should type "First" when prompted for the previous city and your code should handle this special case.

If the user wants to add a new city to the tail of the network, e.g. replace Boston as the tail city, then they should type "" when prompted for the previous city or the tail's city name and your code should handle this special case.

Here is a screenshot showing the expected output for the add city functionality when the user selects Add City from the menu.

```
Enter a city name:
Tucson
Enter a previous city name:
Phoenix
=====Main Menu=====
1. Build Network
2. Print Network Path
3. Transmit Message Coast-To-Coast-To-Coast
4. Add City
5. Delete City
6. Clear Network
7. Quit
```

Delete City

This option allows the user to delete a city from the network. When the user selects this option, they should be prompted for the name of the city to delete. Your code should then update the next and previous pointers for the surrounding cities and free the memory for the deleted city.

```
5
Enter a city name:
Phoenix
```

Clear Network

This option allows the user to delete all cities in the network starting at the head city. After this functionality executes, the head of the list should be NULL and all cities should be deleted from the network. When a city is deleted, print the name of the city just before freeing the memory. Your clear network method should be called in the destructor of CommunicationNetwork, in addition to being a menu option.

```
6
deleting Los Angeles
deleting Phoenix
deleting Denver
deleting Dallas
deleting St. Louis
deleting Chicago
deleting Atlanta
deleting Washington, D.C.
deleting New York
deleting Boston
```

Quit

This option allows the user to exit the program.

For each of the options presented, after the user makes their choice and your code runs for that option, you should re-display the menu to allow the user to select another option.

How to code the Assignment and Tips

The functionality for your network will be implemented in a class called `CommunicationNetwork`. A suggested header file called `CommunicationNetwork.h` is provided for you on Moodle. Each of the menu options needs to be handled by calling methods in your `CommunicationNetwork` instance. You are welcome to write additional helper functions or methods (outside of the class) to support those provided. However do not modify the given `.h` file. Your code needs to be readable, efficient, and accomplish the task provided.

```
/*Insert a new city into the linked list after the previousCityName. The name of the new city is in the
argument newCityName.
*/
void CommunicationNetwork::addCity(string newCityName, string previousCityName)

/*Open the file and transmit the message between all cities in the network word by word. A word needs to be
received at the beginning of the network after being sent to the end of the network before sending the
next word (coast to coast to coast). Only one city can hold the message at a time; as soon as it is
passed to the next city, it needs to be deleted from the sender city.
*/
void CommunicationNetwork::transmitMsg(char * filename)

/*Start at the head of the linked list and print the name of each city in order to the end of the list.
*/
void CommunicationNetwork::printNetwork()

/*Build the initial network from the cities given in this writeup. The cities can be fixed in the function,
you do not need to write the function to work with any list of cities.
*/
void CommunicationNetwork::buildNetwork()

/*Find the city in the network where city name matches removeCity. Change the next and previous pointers for
the surrounding cities and free the memory.
*/
void CommunicationNetwork::deleteCity(std::string removeCity)

/*Delete all cities in the network, starting at the head city. */
void CommunicationNetwork::deleteNetwork()
```

Tips:

- 1) Follow the implementation points, start with the Menu and then code the functionalities;
- 2) Always test each new part implemented;
- 3) Read the examples in Chapter 5
- 4) Use the code runner questions posted for the lecture sprints to test your code
- 5) You need to write both the `CommunicationNetwork.cpp` and the `Assignment4.cpp` files. You can compile your code on the command-line using `g++`

`$ g++ -std=c++11 CommunicationNetwork.cpp Assignment4.cpp -o Assignment4`

and then run your program on the command-line using

`./Assignment4 messageIn.txt`