In this exercise you’ll write a C# program to read a list of people and relationships such as friend, parent, or child and build a labeled graph to represent the information. Then the program should answer questions about people such as “Who are Aachie’s descendants?,” “List Abeltje’s second-cousins-once-removed,” or “Find a chain of relationships connecting Adalind and Adaluuidis” using a syntax described below. The latter is called “Dutch Bingo.”

This assignment requires that the graph be directed (if Aachie is a parent of Aalberts, it doesn’t follow that Aalberts is a parent of Aachie) and labeled (Aafke may be a friend of Aaltie but not a parent). Using a nice graph library that supports labeled directed graphs would make the program easier, but I was unable to find one, so I wrote a simple one. You will add capabilities for the program below.

I have provided starter code that reads a file of relationships and build a directed, labeled graph and implements some basic commands such as printing the relationships a person participates in and printing a representation of the whole graph. For simplicity it’s a console application. You should add support for the following commands. Each is worth 10 points. The total possible score is 110, with 10 points of extra credit available.

1. **Friends.** Given a command line like “friends Adalrada,” the program should print all of Adalrada’s friends.

2. **Orphans.** This command, which takes no arguments, should list all the people with no parents.

3. **Bingo.** The command “bingo Aaf Adalmut” should find a shortest chain of relationships between Aaf and Adalmut. For example, it might report that
   - Aaf is a parent of Aardina
   - Aardina is a friend of Aagtje
   - Aagtje is a child of Adalmut

4. **Descendants.** Print all of a person’s descendents, labeled as children, grandchildren, great grandchildren, etc.

5. **Cousins n k.** This command should print all of a person’s nth-cousins k times removed where n and k are nonnegative integers. For example, “cousins Adaja 1 0” would report first cousins, “cousins Abigail 2 1” would list second cousins once removed, and “cousins Aartje 0 1” would list nieces, nephews, uncles, and aunts. (Cousin relationships are symmetric: if A is B’s zeroeth cousin once removed, then B is A’s as well.) Note that if someone is a sibling, that person is not also a cousin, second cousin, etc.

Submit your zipped project directory through moodle. Also turn in a grading sheet.
CS212 Program 4 – Grading Sheet

Name: _______________________________ Date/time: _______ Is this program late? ______

Parts of the program I didn't get to work correctly:

Comments:

____________________ [below the line for instructor use only] _______________________

Submit a program that compiles and runs (50%)

1. Friends command (10%)

2. Orphans (10%)

3. Bingo finds and prints the shortest path of relationships between two people—or says that they are unrelated (10%)

4. Descendants command, with labeled output (children, grandchildren, etc.)
   If the graph has a cycle, it should say so and abort (10%)

5. Cousins n k. Relationships don’t apply if there is a closer relationship,
   e.g. a sibling is not a cousin (10%)

Style and mechanics of submission (10%)

Total: __________