

Data Structures and Objects

CSIS 3700

Fall Semester 2017 — CRN 42034

Project 4 — Family Trees

Due date: Thursday, December 14, 2017 at noon. NO EXTENSIONS WILL BE GIVEN.

Goal

Given a set of parents and children, determine how pairs of people are related, if at all.

Details

The input to the program consists of two parts. The first line consists of two integers f and q , which are the number of nuclear families and queries that follow. The next f lines each describe one nuclear family. These lines are of the form m father mother child₁ child₂ ... child_m, where m is the number of children in the nuclear family and the remaining elements are names. The last q lines are pairs of names.

A name is any sequence of non-space characters.

Some definitions for ascertaining relationships:

- p is a 0-descendent of q if p is a child of q .
- p is a k -descendent of q if p is a child of some person r and r is a $(k - 1)$ -descendent of q .
- p is a 0-ancestor of q if p is a parent of q .
- p is a k -ancestor of q if p is a parent of some person r and r is a $(k - 1)$ -ancestor of q .

If two people p and q are related, then they are related in one of the following manners:

- child
 p is a child of q if p is a 0-descendent of q
- grandchild
 p is a grandchild of q if p is a 1-descendent of q
- great great ... great grandchild
 n times
This is when p is an $(n + 1)$ -descendent of q
- parent
 p is a child of q if p is a 0-ancestor of q
- grandparent
 p is a grandparent of q if p is a 1-ancestor of q
- great great ... great grandparent
 n times
This is when p is an $(n + 1)$ -ancestor of q

- cousins and siblings

Let r be the *closest common ancestor* to p and q ; that is, no descendent of r is also an ancestor of both p and q . Suppose that p is an m -descendent of r and q is an n -descendent of r . Let $s = \min(m, n)$ and let $t = |m - n|$. Then, p and q are s -cousins t times removed. 0^{th} -cousins zero times removed are *siblings*.

For each query $p\ q$, output one of the following lines as appropriate:

- child, grandchild, great great ... great grandchild
If p is a descendent of q
- parent, grandparent, great great ... great grandparent
If p is an ancestor of q
- sibling
If p and q are 0-cousins zero times removed
- m -cousin
If p and q are m -cousins zero times removed
- m -cousin removed n
If p and q are m -cousins n times removed
- No relation
If p and q are not related

►Limitations

For any query, there will be at most two closest common ancestors; these will be spouses of each other.

There will be at most 500 unique names.

What to turn in

Turn in your source code and **Makefile**. If you use Code::Blocks, turn in a tarball of your project directory.

Example Input

```
13 6
2 bill wilma brenda deb
3 bob.1 diana bob.2 kelly angela
4 mac pearl lloyd bill barb bob.1
2 kelly glenn hilary ashlee
2 bob.2 betty tony nick
1 bob.3 barb bob.4
9 joe.1 nettie ron.1 joe.2 jim.1 bob.3 carol georgia charlie mary.ellen lynette
4 jim.1 mary.ann jim.2 michael bradley brian
3 michael kris max madison mckenna
3 jim.2 connie alex kerri zack
2 ron.1 jackie ron.2 jacob
2 joe.3 helen joe.1 katherine
3 jim.3 emma joe.3 jim.4 george
alex emma
joe.3 ron.2
nick kelly
georgia charlie
deb jacob
tony ashlee
```

Sample Output

```
great great great grandchild
great grandparent
0 cousin 1 removed
sibling
no relation
1 cousin
```