School of Data and Computer Science, Sun Yat-sen University

E05 Family Problem (Prolog)

17341137 Zhenpeng Song

September 27, 2019

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1 About Cousin and Removed

What Is a First Cousin, Twice Removed?

If someone walked up to you and said, "Howdy, I'm your third cousin, twice removed," would you have any idea what they meant? Most people have a good understanding of basic relationship words such as "mother," "father," "aunt," "uncle," "brother," and "sister." But what about the relationship terms that we don't use in everyday speech? Terms like "second cousin" and "first cousin, once removed"? We don't tend to speak about our relationships in such exact terms ("cousin" seems good enough when you are introducing one person to another), so most of us aren't familiar with what these words mean.

Relationship Terms

Sometimes, especially when working on your family history, it's handy to know how to describe your family relationships more exactly. The definitions below should help you out.

Cousin (a.k.a "first cousin")

Your first cousins are the people in your family who have two of the same grandparents as you. In other words, they are the children of your aunts and uncles.

Second Cousin

Your second cousins are the people in your family who have the same great-grandparents as you., but not the same grandparents.

Third, Fourth, and Fifth Cousins

Your third cousins have the same great great grandparents, fourth cousins have the same great-great-great-grandparents, and so on.

Removed

When the word "removed" is used to describe a relationship, it indicates that the two people are from different generations. You and your first cousins are in the same generation (two generations younger than your grandparents), so the word "removed" is not used to describe your relationship.

The words "**once removed**" mean that there is a difference of one generation. For example, your mother's first cousin is your first cousin, once removed. This is because your mother's first cousin is one generation younger than your grandparents and you are two generations younger than your grandparents. This one-generation difference equals "once removed."

Twice removed means that there is a two-generation difference. You are two generations younger than a first cousin of your grandmother, so you and your grandmother's first cousin are first cousins, twice removed.

2 Problem Description

Please fulfill the following tasks by using `Prolog`:

1. Write sentences describing the predicates **Grandchild**, **Greatgrandparent**, **Ancestor**, **Brother**, **Sister**, **Daughter**, **Son**, **FirstCousin**, **BrotherInLaw**, **SisterInLaw**, **Aunt**, and **Uncle**. *Hint: you can define these predicates by choosing child, sibling, male, female, father, mother, and so on.*

2. Find out the proper definition of ***m*th cousin *n* times removed**, in other words, define the predicate `mthCousinNremoved(X,Y,M,N)`. *Hint: You'd better define the predicate* `distance(X,Y,N)` *by recursion (please refer to* `hanoi.pl`*) to show there are N generations between X and Y in advance.*

3. Write down the basic facts depicted in the family tree in Figure 2.

4. ASK it who are **Elizabeth's grandchildren**, **Diana's brothers-in-law**, **Zara's great-grandparents**, and **Eugenie's ancestors**.

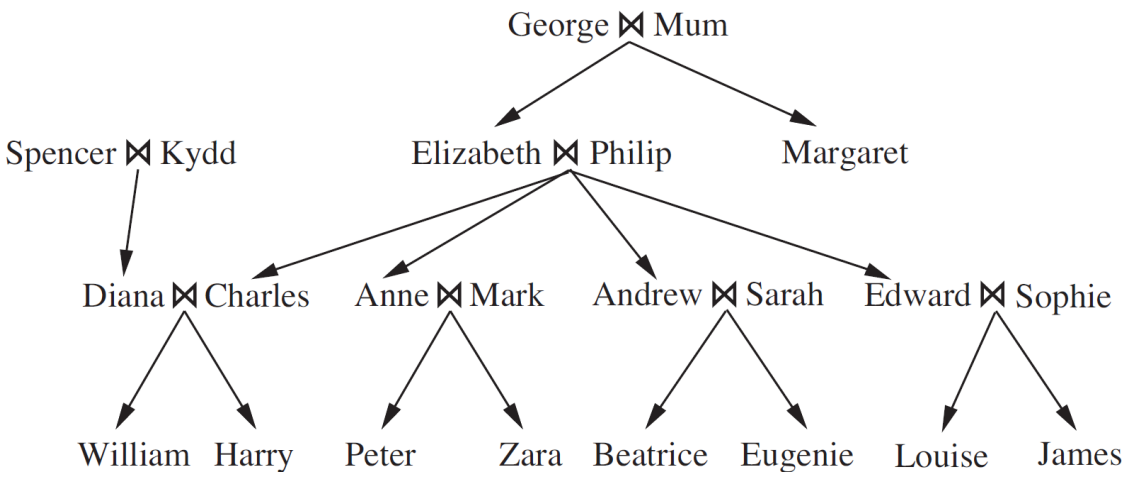

Figure 1: A typical family tree. The symbol ⋈ connects spouses and arrows point to children.

3 Tasks

1. Please complete the `Prolog` codes. There are several tutorials in the folder and I will explain the usage of Prolog in class.

2. Write the related codes and take a screenshot of the running results in the file named E05_YourNumber.pdf, and send it to ai_201901@foxmail.com.

4 Codes

```
% Family Tree
% 17341137

% 1 Predicates Description
% There are some basic predicates that will be used to help.
% child, siblings, male, female, father, mother, spouse...
grandchild(A,B):-child(A,C),child(C,B).
greatgrandparent(A,B):-child(B,C),grandchild(C,A).
ancestor(A,B):-child(B,A).
ancestor(A,B):-child(B,C),ancestor(A,C).
brother(A,B):-male(A),siblings(A,B).
sister(A,B):-female(A),siblings(A,B).
daughter(A,B):-female(A),child(A,B).
son(A,B):-male(A),child(A,B).
firstCousin(A,B):-child(A,C),child(B,D),siblings(C,D).
brotherInLaw(A,B):-brother(A,C),spouses(B,C).
sisterInLaw(A,B):-sister(A,C),spouses(B,C).
aunt(A,B):-child(B,C),sister(A,C).
aunt(A,B):-child(B,C),sisterInLaw(A,C).
uncle(A,B):-child(B,C),brother(A,C).
uncle(A,B):-child(B,C),brotherInLaw(A,C).

% 2 Define mth_Cousin_n_times_Removed
% Define:
% dis(A, B, K): A and B have a gap of K generations.
% mthCousinNTimesRemoved(X, Y, M, N):
%   X is the MthCousinNTimesRemoved of Y.
dis(A, A, 0).
dis(A, B, K):-child(C, A), dis(C, B, K1), K is K1+1.
mthCousinNTimesRemoved(X, Y, M, N) :-
    dis(C, X, M+1), dis(C, Y, M+N+1).
```

```
32
33 % 3 Facts from the Family Tree
34 % male
35 male('George').
36 male('Philip').
37 male('Charles').
38 male('Kydd').
39 male('William').
40 male('Harry').
41 male('Peter').
42 male('Andrew').
43 male('Edward').
44 male('James').
45 male('Mark').
46
47 % female
48 female('Mum').
49 female('Elizabeth').
50 female('Margaret').
51 female('Spencer').
52 female('Diana').
53 female('Zara').
54 female('Beatrice').
55 female('Eugenie').
56 female('Louise').
57 female('Sophie').
58 female('Sarah').
59 female('Anne').
60
61 % child
62 child('William','Diana').
63 child('William','Charles').
64 child('Harry','Diana').
```

```
child('Harry', 'Charles').
child('Diana', 'Spencer').
child('Diana', 'Kydd').
child('Charles', 'Elizabeth').
child('Charles', 'Philip').
child('Peter', 'Anne').
child('Peter', 'Mark').
child('Zara', 'Anne').
child('Zara', 'Mark').
child('Anne', 'Elizabeth').
child('Anne', 'Philip').
child('Beatrice', 'Andrew').
child('Beatrice', 'Sarah').
child('Eugenie', 'Andrew').
child('Eugenie', 'Sarah').
child('Andrew', 'Elizabeth').
child('Andrew', 'Philip').
child('Louise', 'Edward').
child('Louise', 'Sophie').
child('James', 'Edward').
child('James', 'Sophie').
child('Edward', 'Elizabeth').
child('Edward', 'Philip').
child('Elizabeth', 'George').
child('Elizabeth', 'Mum').
child('Margaret', 'George').
child('Margaret', 'Mum').

% sibling
sibling('William', 'Harry').
sibling('Peter', 'Zara').
sibling('Beatrice', 'Eugenie').
sibling('Louise', 'James').
```

```
98  sibling('Charles', 'Anne').
99  sibling('Charles', 'Andrew').
100 sibling('Charles', 'Edward').
101 sibling('Anne', 'Andrew').
102 sibling('Anne', 'Edward').
103 sibling('Andrew', 'Edward').
104 sibling('Elizabeth', 'Margaret').
105 siblings(A,B):-sibling(A,B).
106 siblings(A,B):-sibling(B,A).
107
108
109 % spouse
110 spouse('Spencer', 'Kydd').
111 spouse('Diana', 'Charles').
112 spouse('Anne', 'Mark').
113 spouse('Andrew', 'Sarah').
114 spouse('Edward', 'Sophie').
115 spouse('Elizabeth', 'Philip').
116 spouse('George', 'Mum').
117 spouses(A,B):-spouse(A,B).
118 spouses(A,B):-spouse(B,A).
119
120 % 4 ASK
121 % 4.1 who are Elizabeth's grandchildren?
122 % ?- grandChild(X, 'Elizabeth'), write(X), nl, fail.
123 % 4.2 who are Diana's brothers-in-law?
124 % ?- brotherInLaw(X, 'Diana'),write(X),nl,fail.
125 % 4.3 who are Zara's great-grandparents?
126 % ?- greatGrandparent(X, 'Zara'), write(X), nl, fail.
127 % 4.4 who are Eugenie's ancestors?
128 % ?- ancestor(X, 'Eugenie'),write(X),nl,fail.
```

5 Results

```
2 ?- grandchild(X, 'Elizabeth'), write(X), nl, fail.
William
Harry
Peter
Zara
Beatrice
Eugenie
Louise
James
false.
```

Figure 2: who are Elizabeth's grandchildren?

```
1 ?- brotherInLaw(X, 'Diana'), write(X), nl, fail.
Andrew
Edward
false.
```

Figure 3: who are Diana's brothers-in-law?

```
4 ?- greatgrandparent(X, 'Zara'), write(X), nl, fail.
George
Mum
false.
```

Figure 4: who are Zara's great-grandparents?

```
5 ?- ancestor(X, 'Eugenie'), write(X), nl, fail.
Andrew
Sarah
Elizabeth
Philip
George
Mum
false.
```

Figure 5: who are Eugenie's ancestors?