中山大学计算机学院

人工智能

本科生实验报告

(2022 学年春季学期)

课程名称：Artificial Intelligence

教学班级	2	专业（方向）	计算机科学与技术
学号	21307174	姓名	刘俊杰

一、 实验题目

实验 2 关系简介

实验内容本次实验只需完成一个简化版，即不再按我国方式区分堂表亲，也不区分叔舅、姑姑姨妈等，也不区分孙辈和祖辈性别，而是直接使用 cousin，uncle，aunt，grandchilds，grandparents 等替代。

Cousin，又称 "First Cousin"，是指你的堂/表兄弟姐妹。

BrotherInLaw 包括你的配偶的兄弟、自己的姐夫妹夫、配偶的姐夫妹夫；

类似地，可得 SisterInLaw

什么是 m^th cousin？

First cousin 就是 cousin，指你自己的堂/表兄弟姐妹，你们的关系是你们有相同的祖父母/外祖父母；

Second cousin ，就是有相同的曾祖父母/外曾祖父母；……

m^th cousin n times removed 是一种亲戚关系，其中 n times removed 即指两个人隔了多少辈；举个例子，小明妈妈的 first cousin 是小明的 first cousin once removed，因为差了一辈。如没有隔辈，可直接用 m^th cousin 表示。

实验要求

1. 列出家族树中显示的基本事实。

夫妻？性别？亲子？

2. 写出对应的谓词来预测以下关系：grandchild, greatgrandparent, ancestor, brother, sister, daughter, son, first_cousin, brother_in_law, sister_in_law, aunt, uncle.
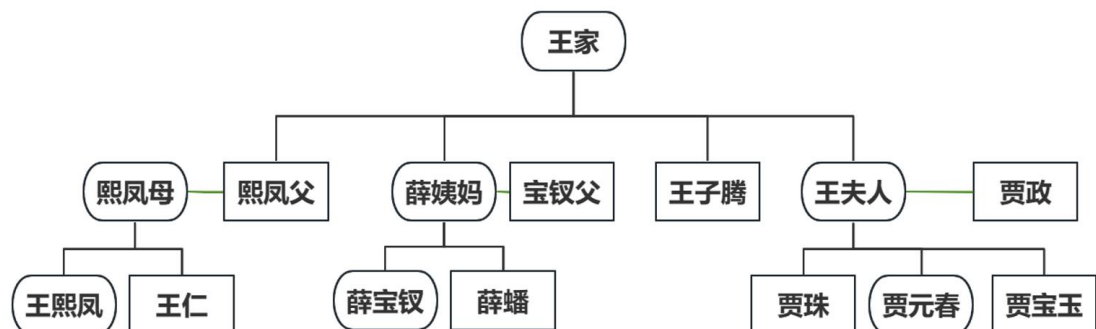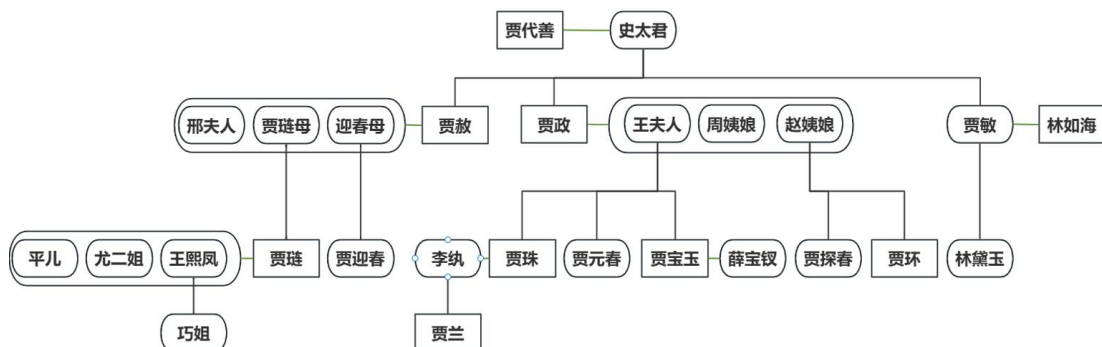
注意 ancestor 计算所有直系长辈

需要二元谓词，如可执行查询 ?- grandchild(shitaijun,jiabaoyu).

3. 定义 mth cousin n times removed 关系，即定义 mthCousinNremoved(X,Y,M,N)

4. 提问 ：(1)贾母（史太君）的孙辈，(2)林如海的大舅哥们， (3)贾兰的曾祖辈，(4) 巧姐的直系长辈（ancestor）。

二、

- 贾府

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1. 算法原理

Prolog 语言是一种以一阶谓词为基础的逻辑性语言（Programming in Logic）

Prolog 语言（或者系统）是以一阶谓词逻辑的 Horn 子句集为语法，以 Robinson 的消解原理为工具，加上深度优先的控制策略而形成的人工智能通用程序设计语言。

归结的思想是 prolog 查询的基础

策略：goal-directed, depth-first, top-down, left-right

通过三种语句：

事实 fact：谓词(项 1，…，项 n)

规则 rule：原子 :- 原子 1，…，原子 n

查询 query：?- 原子 1，…，原子 n

实现事实描述和逻辑推理

2. 关键代码展示

```
%fact
    male(jiadaishang).
male(jiashe).
male(jiazheng).
```

```
male(linruhai).
male(jialian).
male(jialan).
male(jiazhu).
male(jiabaoyu).
male(jiahuan).
male(xifengfu).
male(baochaifu).
male(wangziteng).
male(wangren).
male(xuepan).
male(wangfu).
female(wangmu).
female(shitaijun).
female(xingfuren).
female(jialianmu).
female(yingchunmu).
female(wangfuren).
female(zhouyiniang).
female(zhaoyiniang).
female(jiamin).
female(lindaiyu).
female(pinger).
female(youerjie).
female(wangxifeng).
female(qiaojie).
female(jiayingchun).
female(liwan).
female(jiayuanchun).
female(xuebaochai).
female(jiatanchun).
female(lindaiyu).
female(xifengmu).
female(xueyima).
female(wangxifeng).
parent(wangfu,xifengfu).
parent(wangmu,xifengfu).
parent(wangfu,xueyima).
parent(wangmu,xueyima).
parent(wangfu,wangziteng).
parent(wangmu,wangziteng).
parent(wangfu,wangfuren).
parent(wangmu,wangfuren).
```

parent(jiadaishang,jiashe).

parent(jiadaishang,jiazheng).

parent(jiadaishang,jiamin).

parent(shitaijun,jiashe).

parent(shitaijun,jiazheng).

parent(shitaijun,jiamin).

parent(jiashe,jialian).

parent(jiashe,jiayingchun).

parent(jialianmu,jialian).

parent(yingchunmu,jiayingchun).

parent(jiazheng,jiazhu).

parent(jiazheng,jiayuanchun).

parent(jiazheng,jiabaoyu).

parent(jiazheng,jiatanchun).

parent(jiazheng,jiahuan).

parent(wangfuren,jiazhu).

parent(wangfuren,jiayuanchun).

parent(wangfuren,jiabaoyu).

parent(zhaoyiniang,jiatanchun).

parent(zhaoyiniang,jiahuan).

parent(jiamin,lindaiyu).

parent(linruhai,lindaiyu).

parent(wangxifeng,qiaojie).

parent(jialian,qiaojie).

parent(liwan,jialan).

parent(jiazhu,jialan).

parent(jiazhu,liwan).

parent(xifengmu,wangxifeng).

parent(xifengfu,wangxifeng).

parent(xifengmu,wangren).

parent(xifengfu,wangren).

parent(xueyima,xuebaochai).

parent(baochaifu,xuebaochai).

parent(xueyima,xuepan).

parent(baochaifeng,xuepan).

spouse(shidaishang,shitaijun).

spouse(jiashe,yingchunmu).

spouse(jiashe,jialianmu).

spouse(jiashe,xinfuren).

spouse(jiazheng,wangfuren).

spouse(jiazheng,zhouyiniang).

spouse(jiazheng,zhaoyiniang).

spouse(jiamin,linruhai).

```prolog
spouse(jialian,wangxifeng).
spouse(jialian,youerjie).
spouse(lialian,pinger).
spouse(liwan,jiazhu).
spouse(jiabaoyu,xuebaochai).
spouse(xifengmu,xifengfu).
spouse(xueyima,baochaifu).
spouse(wangfu,wangmu).
```

```prolog
father(X,Y):-parent(X,Y),male(X).
mother(X,Y):-parent(X,Y),female(X).
grandchild(X,Y):-parent(Y,Z),parent(Z,X).
grandparent(X,Y):-grandchild(Y,X).
son(X,Y):-parent(Y,X),male(X).
daughter(X,Y):-parent(Y,X),female(X).
sibling(X,Y):-parent(Z,X),parent(Z,Y),X\=Y.
brother(X,Y):-sibling(X,Y),male(X).
sister(X,Y):-sibling(X,Y),female(X).
brother_in_law(X,Y):-(spouse(Z,Y)|spouse(Y,Z)),brother(X,Z).
```
%本人的姐夫妹夫，配偶的姐夫妹夫以及配偶的兄弟，sister_in_law 类似
```prolog
sister_in_law(X,Y):-(spouse(Z,Y)|spouse(Y,Z)),sister(X,Z).
firstcousin(X,Y):parent(Z,X),aunt(Z,Y)|uncle(Z,Y).
greatparent(X,Y):-grandparent(X,Z),parent(Z,Y).
aunt(X,Y):-parent(Z,Y),(sister(X,Z)|sister_in_law(X,Z)).
uncle(X,Y):-parent(Z,Y),(brother(X,Z)|brother_in_law(X,Z)).
ancestor(X,Y):-parent(X,Y).
```
%规则 通过递归实现的遍历所有的直系祖先
```prolog
ancestor(X,Y):-parent(X,Z),ancestor(Z,Y).
```
%以下输入要求 X 的辈分不能小于 Y
```prolog
distance(X,Y,N):-(X=Y,N=0);(parent(Z,Y),parent(Z,X),N=0);(grandparent(Z,Y),grandparent(Z,X),N=0);(greatparent(Z,Y),greatparent(Z,X),N=0);(ancestor(X,Y),parent(Z,Y),distance(X,Z,N1),N is N1+1);(\+ancestor(X,Y),ancestor(Z,X),ancestor(Z,Y),distance(Z,Y,N1),distance(Z,X,N2),N is N1-N2). %X must >=Y
mthcousin(X,Y,M) :-(parent(Z,Y),parent(Z,X),M=0);(grandparent(Z,Y),grandparent(Z,X),M=1);(greatparent(Z,X),greatparent(Z,Y),M=2);(parent(Z1,Y),parent(Z2,X),mthcousin(Z1,Z2,M1),M is M1+1).
mthCousinNremoved(X,Y,M,N) :-distance(X,Y,N),distance(Z,X,0),mthcousin(Z,X,M).
```
%X>=Y

三、 实验结果及分析

1. 实验结果展示示例（可图可表可文字，尽量可视化）

(1)史太君的孙辈

```
% c:/Users/刘俊杰/Desktop/code/prolog/e2.pl compiled 0.00 sec, -3 clau
?- grandchild(X,shitaijun).
X = jialian ;
X = jiayingchun ;
X = jiazhu ;
X = jiayuanchun ;
X = jiabaoyu ;
X = jiatanchun ;
X = jiahuan ;
X = lindaiyu.

?-
```

(2) 林如海的舅哥

```
?- brother_in_law(X,linruhai).
X = jiashe ;
X = jiazheng ;
X = jiashe ;
X = jiazheng ;
false.
```

(3) 贾兰的曾祖辈

```
?- greatgrandparent(X,jialan).
X = jiadaishan ;
X = shitaijun ;
X = wangfu ;
X = wangmu ;
false.
```

(4)巧姐的直系亲属

```
?- ancestor(X,qiaojie).
X = wangxifeng ;
X = jialian ;
X = wangfu ;
X = wangmu ;
X = jiadaishang ;
X = shitaijun ;
X = jiashe ;
X = jialianmu ;
X = xifengmu ;
X = xifengfu ;
false.
```