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Professor Lu

CSC 135

PL Assignment 3

1. **(4 %) Complete the following sentences:**

   a. Logic programming systems are also called _____ databases.
   Deductive

   b. The process of pattern matching to make statements identical is called _____.
   Pattern Matching

2. **(12%) Give a concise answer to each questions below:**

   a. What are the differences between procedural programming and logic programming?

   Procedural Programming
   - Architecture: Von Neumann machine
   - Syntax: Sequence of statements
   - Computation: Sequential statements execution
   - Control: Logic and control are mixed together

   Logical Programming
   - Abstract Model
   - Logic Formulas (Horn Clauses)
   - Deduction of the clauses
   - Logic and control can be separated

   b. What are the deficiencies of Prolog?

   Resolution order control: Ordering of pattern matching during resolution
   Closed world assumption: It only has the knowledge of its DB, making it a (true/fail) system instead of a (true/false) system
   The negation problem: Prolog NOT operator != logical NOT operator due to Horn Clause

   c. What are the motivations for Logic programming?

   Logic is used to represent program. Deductions are used as computation. A higher level language does more automatically – we can concentrate more on what is to be done and less on how to do it. Ideal is to only specify logic and let system take care of control.

3. **(9%) Use the set notation to describe resolution as a refutation system.**

   Given a set of clauses S & a goal of G,
   {S} U {¬G}
   Existence of contradiction => derivation of empty clause
   Based on {S} U {¬G} is inconsistent if {S} U {G} is consistent

4. **(25%) Give deduction trees of resolution** (a) using (1) and (5); (b) using (2) and (5) for the following set of clauses. Show each level of unification with instantiation (for example {m|Y}).

(1) anc (X, Y) ∨ ~par (X, Y)

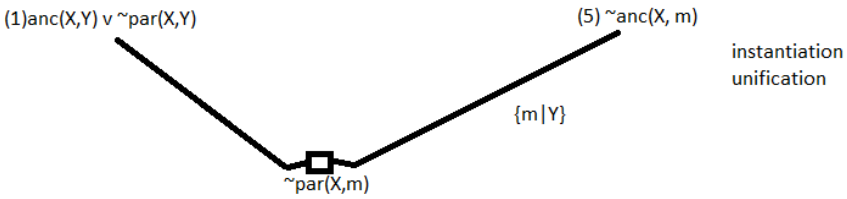
(2) anc(X, Y) ∨ ~par (X, Z) ∨ ~anc (Z, Y)

(3) par (d, b)

(4) par (b, m)

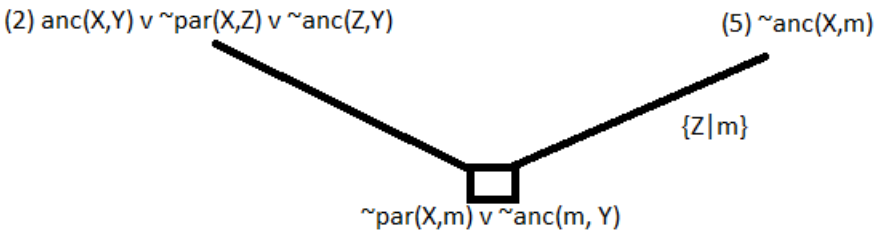
(5) ~anc (X, m)

a.



No contradiction

b.



No contradiction

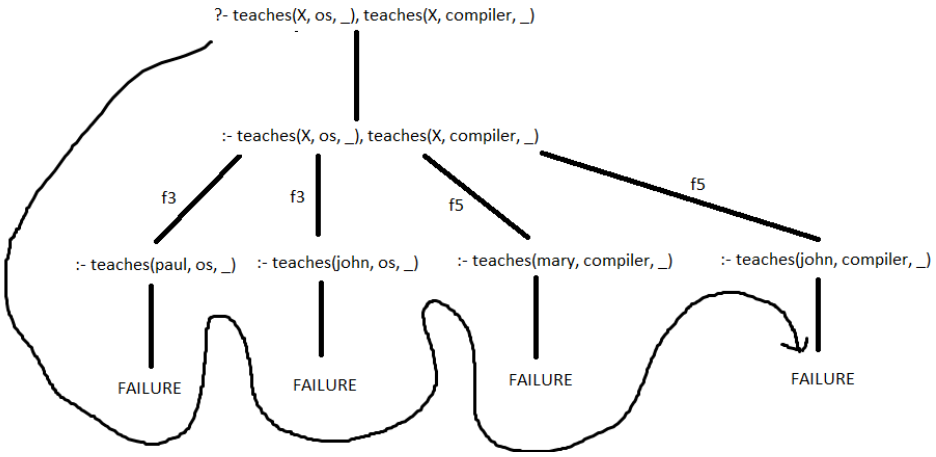
5. **(20%) Conjunctions and Backtracking**. Using the example of "Who teaches what" (see LogicProglecture page 19 in Canvas),

f1: teaches(john, database, s1).
f2: teaches(john, ai, s1).
f3: teaches(mary, os, s1).
f4: teaches(mary, ai, s2).
f5: teaches(paul, compiler, s1).

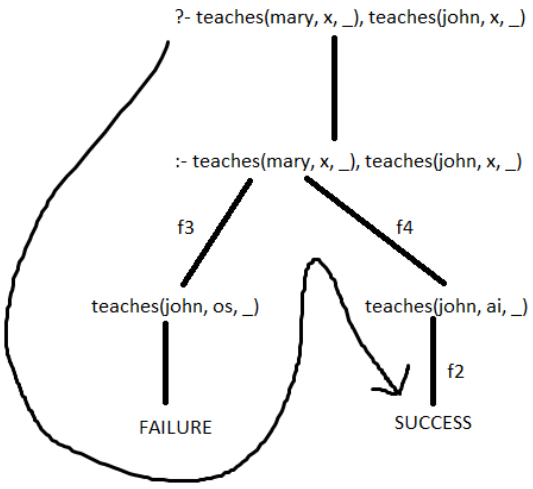
Query 1: What's the course taught by John and Mary?
?- teaches(john, X, _), teaches(mary, X, _).

Query 2: Who teaches both os and compiler?
?- teaches(X, os, _), teaches(X, compiler, _).

a. try to trace through search process for Query 2;



b. try to trace through Query 1, but with sub-goals reversed.



6. **(30%) Exam problem contribution.** Using the Example "Every scientist is logician" (see Canvas ExecofProlog example) as a guide, to create a problem with following 4 parts and then give solution to your own problem. **Post** your **problem** ((a) - (c)) and **solution** ((d) - (e)) **at your website** to share with your classmates. (Note: You may scan/take a picture of hand drawn deduction tree or draw it with a tool digitally)

6.

a. (5%) Write a PROLOG representation of the following facts: (your at least 5 facts in English);

```
%facts

cars('Maserati', gas, hers).

cars('Tesla Model S', electric, his).

cars('Honda Leaf', electric, noone).

cars('Toyota Avalon', gas, his).

cars('Ford Fiesta', gas, noone).
```

b. (6%) Write a PROLOG representation of the following rule: (your at least 3 rules in English);

```
%rules

cool(X) :- cars(X, electric, his).

cool(X) :- cars(X, gas, hers).

isGas(X) :- cars(X, gas, _).

isElectric(X) :- cars(X, electric, _).
```

c. (c) (4%) Write two PROLOG goal statements to search for answers: (also give 2 W questions in English), and at least one of your goal statements should be a conjunction of two subgoals;

```
%queries

%?- cars(X, gas, _).

%?- isElectric(X).

%?- isElectric(X), cool(X).
```

d. (10%) Run each given query in (c) using Prolog and then **post the interactive sessions as part of your solution at your website**;

```
?- cars(X, gas, _).
X = 'Maserati' ;
X = 'Toyota Avalon' ;
X = 'Ford Fiesta'.

?- isElectric(X).
X = 'Tesla Model S' ;
X = 'Honda Leaf'.

?- isElectric(X), cool(X).
X = 'Tesla Model S' ;
false.
```

e. (e) (5%) Show deduction tree that deducing the answer for one of the W questions above according to Prolog search strategy (**a picture to post**).