CSCE-420-HW4

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1 Question 1

1.1 Write rules in Prolog to infer various kinship relationships in terms of basic predicates like parent(X,Y) and female(X) and male(Y).

1. ?- brother(rod,X).
   X = tod ? ;
2. ?- sister(marge,X).
   X = patty ? ;
   X = selma
3. ?- aunt(X,patty).
   X = bart ? ;

   X = lisa ? ;

   X = maggie ? ;
4. ?- uncle(bart,X).
   X = herb ? ;
5. ?- grandfather(maggie,X).
   X = abraham ? ;
6. ?- granddaughter(jackie,D).
   D = lisa ? ;

   D = maggie ? ;
7. ?- ancestor(bart,X).
   X = homer ? ;

   X = marge ? ;

   X = abraham ? ;

X = jackie ? ;

2 Question 2

2.1 Using the following database, write Prolog queries for:

1. query2a: find all lawyers.
   $is\_lawyer(X)$.

2. query2b: find all surgeons who live in California.
   $is\_surgeon(X), address(X, los\_angeles)$.

3. query2c: find all the surgeons who live in Texas and make over $100,000/yr.
   $is\_surgeon(X), in\_texas(X), salary(X, Salary), Salary > 100000$.

3 Question 3

3.1 Write a predicate canTeach(X,Y) that defines which persons X can teach a class Y a given subject, which requires that they have a phd in the relevant field Z. For example, Susan can teach calculus because she has a phd in math. Note that, since Z is not mentioned in the head of the clause, it will effectively be treated like an existentially quantified variable in the antecedents, which be matched to any academic field during the back-chaining.

1. query: canTeach(X,Y).
   X = bill
   Y = organic ? ;

   X = bill
   Y = inorganic ? ;

   X = susan
   Y = algebra ? ;

   X = susan
   Y = calculus ? ;

3.2 Modify the canTeach rule (call it canTeach2(X,Y)) to exclude people who are retired. (hint: this requires negation).

1. query: canTeach(X,Y).
   X = susan
   Y = algebra ? ;

   X = susan
   Y = calculus ? ;

3.3 Modify the canTeach2 rule (call it canTeach3(X,Y)) to allow persons with a PhD or an MS degree who are not retired to teach a class related to their degree.

1. query: canTeach(X,Y).
   X = susan
   Y = algebra ? ;

   X = susan
   Y = calculus ? ;

   X = chuck
   Y = dynamics ? ;

   X = chuck
   Y = electromagnetism ? ;

   X = chuck
   Y = nuclear ? ;

4 Question 4

4.1 Define the 3-argument predicate for '$octal_code(A, B, C)'$ as a sentence in FOL.

For all A, B, and C, '$octal_code(A, B, C)'$ is true if and only if A, B, and C are bits, where a bit is either 0 or 1.

4.2 Express this as a rule in Prolog (along with facts defining bits).

1. query: octal_code(A,B,C).
   000

A = 0
B = 0
C = 0 ? ;
001

A = 0
B = 0
C = 1 ? ;
010

A = 0
B = 1
C = 0 ? ;
011

A = 0
B = 1
C = 1 ? ;
100

A = 1
B = 0
C = 0 ? ;
101

A = 1
B = 0
C = 1 ? ;
110

A = 1
B = 1
C = 0 ? ;
111

A = 1
B = 1
C = 1

4.3 Use back-chaining to explain why the solutions are generated in the order they are.

With the query '$octal_code(A, B, C)$', Prolog first tries to satisfy bit(A) by searching through the facts. The first fact that fits is bit(0), so A is assigned as 0, Prolog then moves to bit(B). For bit(B) the first fact is bit(0), so B is assigned as 0, Prolog then moves to bit(C). For bit(C) the first fact is bit(0), so C is

assigned as 0, the format is then printed. After typing a semicolon, Prolog backtracks to find the next possible solution for bit(C), so C is then assigned as bit(1) and the format prints. Prolog continues to backtrack until all possibilities for C have been tried, and then continues by moving onto B changing it to bit(1) and iterating through the possibilities for C. Once all possibilities for B and C have been attempted, Prolog backtracks for A, changing it to bit(1) and goes through all the combinations of B and C again. The process is completed once all combinations of A, B, and C have been attempted.

5 Question 5

5.1 Write a rule to solve the color of the 7 states of Australia. Use a "generate and test" approach, where the initial antecedents bind each of the variables to one of the 3 possible colors, and the remaining antecedents enforce the adjacency constraints (states sharing a border cannot be same color). Hint: if you want to say that Western Australia is not the same color as Northern Territories, you can use the inequality operator 'WT=NT'.

1. query: mapcolor(WA,NT,SA,Q,NSW,V,T).
   NSW = green
   NT = green
   Q = blue
   SA = red
   T = red
   V = blue
   WA = blue ? ;

2. query: WA=green, mapcolor(WA,NT,SA,Q,NSW,V,T).
   NSW = red
   NT = red
   Q = green
   SA = blue
   T = red
   V = green
   WA = green ? ;

3. query: WA=red, Q=green, mapcolor(WA,NT,SA,Q,NSW,V,T).
   no