

Homework #4: Chapters 9 and 10

Problem 1: [10 pts., 2 pts. each]

a) $\text{UNIFY}(P(A, B, B), P(x, y, z)) = \{x/A, y/B, z/B\}$

b) $\text{UNIFY}(P(x, y), Q(A, B)) = \text{fail}$

c) $\text{UNIFY}(\text{Knows}(\text{Father}(y), y), \text{Knows}(x, x)) = \text{fail}$

d) $\text{UNIFY}(Q(y, G(A, B)), Q(G(x, z), y)) = \{x/A, z/B, y/G(A, B)\}$

e) $\text{UNIFY}(P(f(x), y, g(B)), P(f(y), A, g(y))) = \text{fail}$

Problem 2:

Standardizing apart the FOL sentences:

S1: $\forall x, y P(x_1, y_1) \Rightarrow T(x_1, y_1)$

S2: $\forall x, y P(x_2, y_2) \Rightarrow T(y_2, x_2)$

S3: $\forall x, y, z T(x_3, y_3) \wedge Q(y_3, z_3) \wedge S(z_3, x_3) \Rightarrow R(x_3, y_3, z_3)$

S4: $P(\text{Red}, \text{Blue})$

S5: $P(\text{Green}, \text{Red})$

S6: $P(\text{Blue}, \text{Green})$

S7: $Q(\text{Blue}, \text{Green})$

S8: $Q(\text{Green}, \text{Blue})$

S9: $Q(\text{Red}, \text{Green})$

S10: $Q(\text{Blue}, \text{Red})$

S11: $Q(\text{Green}, \text{Red})$

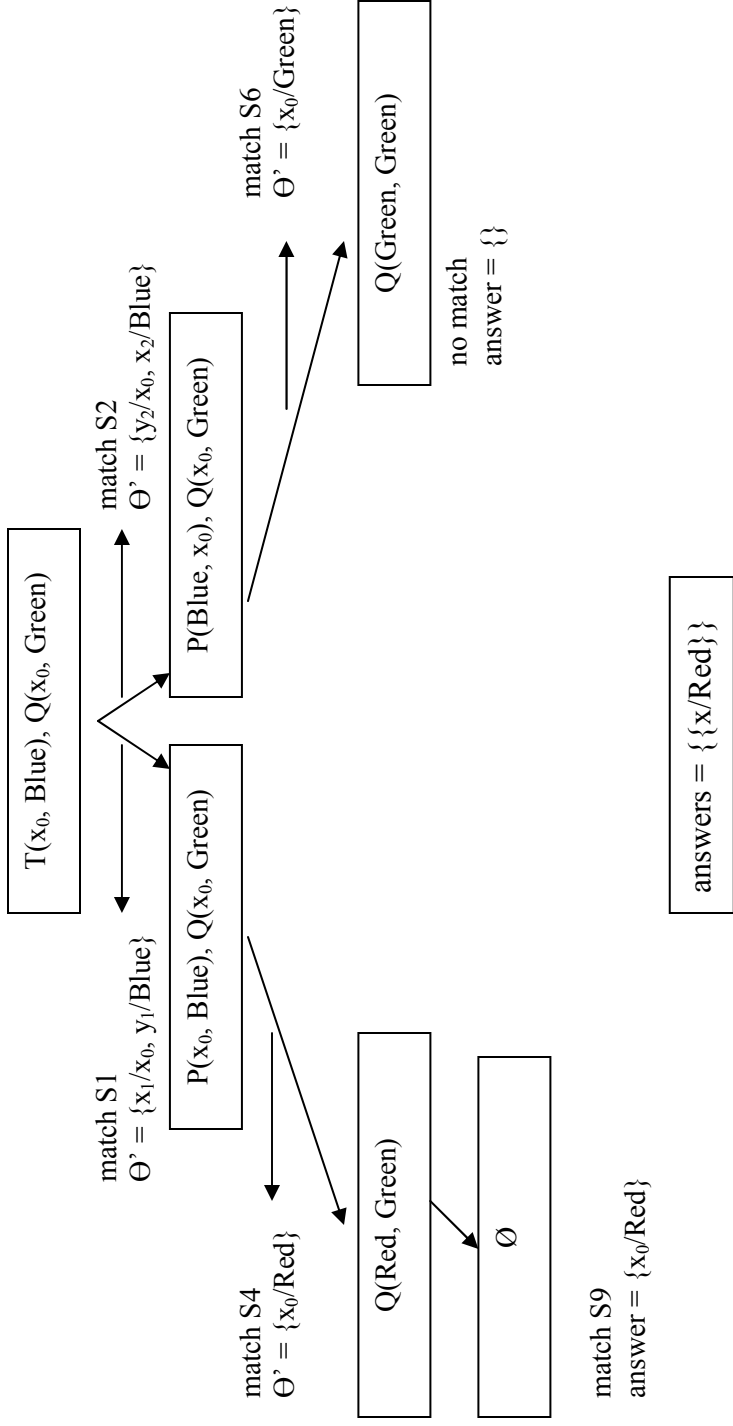
S12: $S(\text{Blue}, \text{Red})$

S13: $S(\text{Green}, \text{Red})$

S14: $S(\text{Green}, \text{Green})$

S15: $S(\text{Green}, \text{Blue})$

2a) [10 pts.]



Problem 3:

a) [30 pts.]

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/* Homework#4 Problem3 key

This program creates a knowledge base about animals.
*/

% All Animals breathe oxygen.
breathe(X, oxygen)
    :- animal(X).

% There are three types of Animal: Bird, Fish and Mammal.
animal(X)
    :- bird(X).
animal(X)
    :- fish(X).
animal(X)
    :- mammal(X).

% Birds are covered in feathers, have two legs, and move by flying.
coveredIn(X, feathers)
    :- bird(X).
haveNumberOfLegs(X, 2)
    :- bird(X).
moveBy(X, flying)
    :- bird(X).

% There are two kinds of Birds: Robins and Hawks.
bird(X)
    :- robin(X).
bird(X)
    :- hawk(X).

% Robins eat worms and Hawks eat rodents.
eat(X, worm)
    :- robin(X).

eat(X, rodent)
    :- hawk(X).

% Fish are covered in scales and move by swimming.
coveredIn(X, scales)
    :- fish(X).
moveBy(X, swimming)
    :- fish(X).

% Mammals are covered in fur and move by walking.
coveredIn(X, fur)
    :- mammal(X).
moveBy(X, walking)
    :- mammal(X).

% There are three kinds of Mammals: Apes, Cows, and Lions.
mammal(X)
    :- ape(X).
mammal(X)
    :- cow(X).
mammal(X)
    :- lion(X).

% Apes have two legs.
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haveNumberOfLegs(X, 2)
    :- ape(X).

% Cows have four legs and eat grass.
haveNumberOfLegs(X, 4)
    :- cow(X).
eat(X, grass)
    :- cow(X).

% Lions have four legs and eat meat.
haveNumberOfLegs(X, 4)
    :- lion(X).
eat(X, meat)
    :- lion(X).

% Nemo is a Fish, Lee is a Hawk, Rob is a Robin, Kong is an Ape, Elsa is a Lion, and
Bessie is a Cow.
fish(nemo).
hawk(lee).
robin(rob).
ape(kong).
lion(elsa).
cow(bessie).

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b) [15 pts., 2pts each except for last one, which is 3 pts.]

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1 ?- coveredIn(lee, feathers).

Yes      (or True)
2 ?- haveNumberOfLegs(elsa, X).

X = 4 ;

No
3 ?- moveBy(nemo, X).

X = swimming ;

No
4 ?- breathe(rob, oxygen).

Yes      (or True)
5 ?- eat(bessie, X), eat(elsa, X).

No      (or False)
6 ?- haveNumberOfLegs(kong, X), haveNumberOfLegs(rob, X).

X = 2 ;

No
7 ?- mammal(X).

X = kong ;

X = bessie ;

X = elsa ;

No

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Problem 4: [15 pts.]

There are many possible answers. One is given below.

