Mary Catherine Scott
HW 9
9.4 a,b,c,d, 9.13, 9.23

9.4 For each pair of atomic sentences, give the most general unifier if it exists:

a. $P(A,B,B), P(x,y,z)$.

{x/A, y/B, z/B}

b. $Q(y,G(A,B)), Q(G(x,x),y)$

Does not exist, x cannot be both A and B, while y has to be G(A,B).

c. $Older(Father(y),y), Older(Father(x),John)$

{y/John, x/John}

d. $Knows(Father(y),y), Knows(x,x)$

Does not exist, x cannot be both y and Father(y).

//Not assigned, but needed for next problem.

9.6 Write down the logical representations for the following sentences, suitable for use with Generalized Modus Ponens:

a. Horses, cows and pigs are mammals.

$(\forall x) Horse(x) \vee Cow(x) \vee Pig(x) \Rightarrow Mammal(x)$

b. An offspring of a horse is a horse.

$Offspring(x,y) \wedge Horse(y) \Rightarrow Horse(x)$

c. Bluebeard is a horse.

$Horse(Bluebeard)$

d. Bluebeard is Charlie's parent.

$Parent(Bluebeard, Charlie)$

e. Offspring and parent are inverse relations.

$Parent(x,y) \Rightarrow Offspring(y,x)$

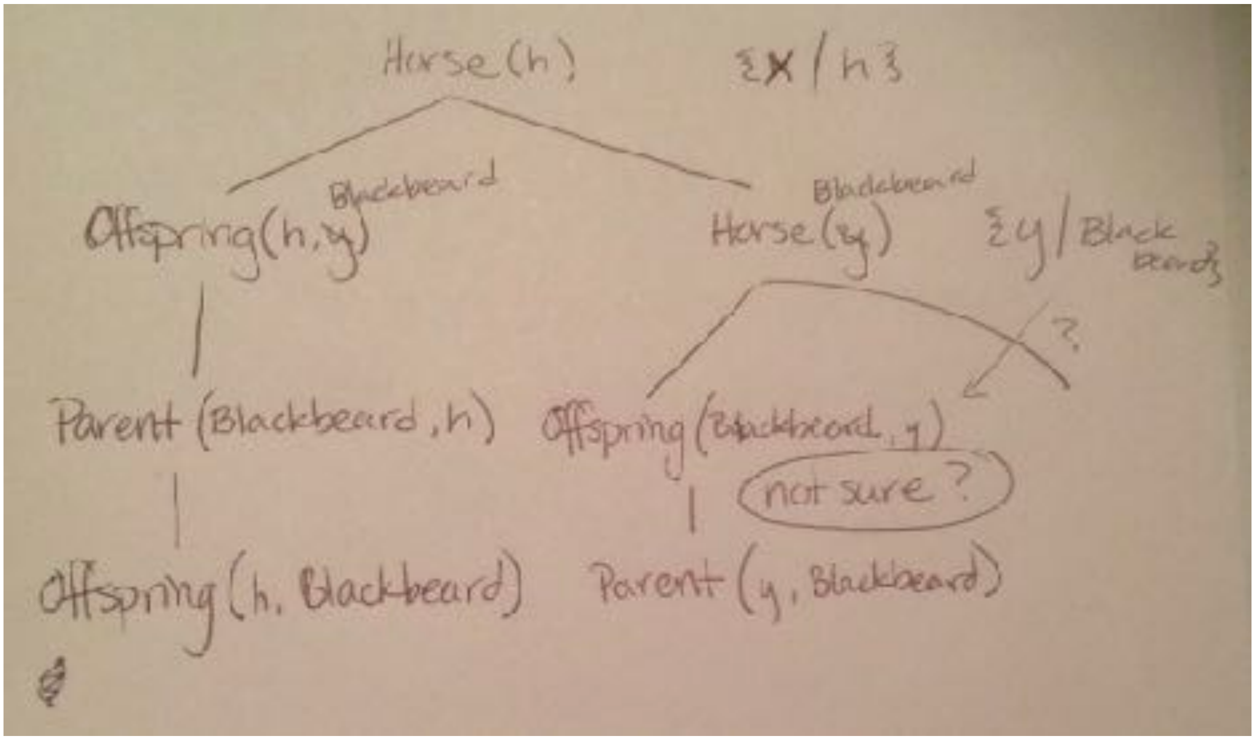
$Offspring(x,y) \Rightarrow Parent(y,x)$

f. Every mammal has a parent.

$Mammal(x) \Rightarrow Parent(G(x),x)$

9.13 In this exercise, use the sentences you wrote in Exercise 9.6 to answer a question by using a backward-chaining algorithm.

a. Draw the proof tree generated by an exhaustive backward-chainring algorithm for the query $(\exists h) Horse(h)$, where clauses are matched in the order given.



b. What do you notice about this domain?

We end up in some weird loops such that it looks like we will never find an answer.

c. How many solutions for h actually follow from your sentences?

Looks like it can be proved that Blackbeard and Charlie are horses.

d. Can you think of a way to find all of them?(Hint: See Smith el al (1986).)

9.23 From “Horses are animals” it follows that “The head of a horse is the head of an animal.” Demonstrate that this inference is valid by carrying out the following steps:

a. Translate the premise and the conclusion into the language of first-order logic. Use three predicates: HeadOf(h,x) (meaning “h is the head of x”), Horse(x), and Animal(x).

$$Horse(x) \Rightarrow Animal(x)$$

$$HeadOf(h, x) \land Horse(x) \Rightarrow HeadOf(h, x) \land Animal(x)$$

b. Negate the conclusion, and convert the premise and the negated conclusion into conjunctive normal form.

$$\neg [HeadOf(h,x) \land Horse(x) \Rightarrow HeadOf(h,x) \land Animal(x)]$$

$$\neg [\neg (HeadOf(h,x) \land Horse(x)) \lor (HeadOf(h,x) \land Animal(x))]$$

$$\neg [\neg HeadOf(h,x) \lor \neg Horse(x) \lor (HeadOf(h,x) \land Animal(x))]$$

$$HeadOf(h,x) \land Horse(x) \land \neg (HeadOf(h,x) \land Animal(x))$$

1. $HeadOf(h,x)$ $\qquad \neg HeadOf(h,x) \lor \neg Animal(x)$
2. $Horse(x)$
3. $\neg HeadOf(h,x) \lor \neg Animal(x)$

$$Horse(x) \Rightarrow Animal(x)$$

4. $\neg Horse(x) \lor Animal(x)$

c. Use resolution to show that the conclusion follows from the premise.

Resolve equation 1 with equation 3 to get $\neg Animal(x)$ as equation 5

Resolve equation 5 with equation 4 to get $\neg Horse(x)$ as equation 6

Resolve equation 6 with equation 2 to get an empty set, a contradiction.