

CSC 244/444 Assignment 5, Part A Non-Monotonic Logics

Due: December 7, no late assignments accepted as we will be discussing solutions in class. Note also that a Part B of this assignment, on probabilistic reasoning will be handed out after thanksgiving, so don't leave this to the end because we are covering a lot of material in these last few weeks, and you will have trouble completing the assignment on time.

Readings: The following readings form the basis for these questions (and questions on final)

Chapter 8: Sections 8.1 and 8.2

Chapter 9: Sections 9.1 through 9.5

Chapter 10: Sections 10.1 and 10.2

Chapter 16: 444 students

1. (5 points) State a generalization for the unique names assumption that would work for knowledge bases that do allow some equality assertions, say the $KB = \{P(a), P(b), a=c, R(d)\}$. Under your new technique, what can you infer about whether P is true of d?
2. (20 points, 5 each section) Consider the following KB:

$$\forall x \forall y. Q(x) \vee R(y) \vee P(x)$$

$$\neg Q(A) \vee \neg R(A)$$

$$R(B) \vee P(B)$$

$$P(C)$$

$$R(C) \vee \neg P(C)$$

- a) What is the predicate completion formula for P?
- b) Once you have the completion formula, can you prove or disprove $P(A)$, or is it still undetermined. Sketch the proof one way or the other, or give an argument why it could be either.
- c) Starting with a three element domain where A, B, and C are distinct objects, show all possible models of this KB, and identify which ones are minimal.
- d) Demonstrate the correspondence between predicate completion and minimal models by finding all the possible models for the KB+the completion formula, and showing that it is the same set as the minimal models in (c).

3. (10 points, 5 each section) Consider each of the following KBs in the context of having two default rules:

$$P : \neg A / B$$

$$P : \neg B / C$$

$$KB1 = \{P\}$$

$$KB2 = \{P, \neg B \vee \neg C\}$$

$$KB3 = \{\neg P, A\}$$

KB4={P, A, B}

- a) For each KB, list all the possible extensions based on the rules. Which ones have a unique extension and which do not.
- b) Are there some situations that could produce an inconsistent extension (either from the above KBs or one you construct yourself). Show an example or give an argument why this couldn't happen *with these particular default rules*.

4. (20 points, 5 each section) (*derived from question 1 in 11.8 of text*)

Consider the following KB:

Canadians are typically not francophones

All Quebecois are Canadians

Quebecois are typically francophones

Robert is a Quebecois

- a) Represent these assertions in an inheritance network, and argue that it unambiguously supports the conclusion that Robert is a francophone.
- b) Represent these assertions in FOL using two abnormality predicates, one for Canadians and one for Quebecois. Argue that, given just the literal translation of these assertions, that minimizing abnormality is not sufficient to prove that Robert is a francophone.
- c) Show that minimizing abnormality will work if we also add

All Quebecois are abnormal Canadians

but will *not* work if we only add

Quebecois are typically abnormal Canadians.

- d) Repeat the exercise using default logic and show that the original assertions end up with two possible extensions. Can you eliminate the ambiguity by adding further normal default rules. If not, how about with a non-normal default rule? Justify your answers.

5. (15 points, 5 each section) Description Logic. Answer question 1 in Section 9.8.

6. (20 points) (444 students only) Read chapter 16 and answer question 1 in section 16.7.