

CSC 244/444 Final Assignment

Due: Dec 7th

1. Consider the following knowledge base.

$$\{P(A) \vee P(B), P(B) \vee P(C), A \neq B \neq C\}$$

a) Can we use predicate completion to minimize P? If so, what is the completion formula. If not, why not?

b) Given a domain of interpretation $\{a, b, c\}$ where $I(A)=a$, $I(B)=b$, and $I(C)=c$. Draw all the possible models of the KB in a lattice format showing the ordering between models relative to the predicate P. What are the minimal models of P? (Note: there is more than one!)

c) Define a predicate P' that completes P (i.e., is true in just the minimal models).

d) Use the circumscription theorem to prove that P' is the completion of P.

2. 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*.

3. Consider the following KB:

Canadians are typically not francophones

All Quebecois are Candians

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.

4. Consider

Ann spends 60% of her time in her office. When in the office, she has her light only half the time. When she is not in the office, her light is on only 5% of the time. 80% of the time she is in the office, she is logged on her computer. 10% of the time when she is not in the office, she is also logged on the computer (from home).

a) Express these facts in a belief network and state the probability distributions necessary to encode the above situation. Give an example of an independence assumption that is implicit in this network.

b) Write a formula for the full joint probability distribution over the variables. What is the probability that the light is on in Ann's office.

d) Suppose a student checks Ann's login status and finds that she is logged on. How does this change the probability that the light is on in her office. Show your work.

5. Assume we have a set of mutually exclusive hypotheses H , consisting of grades in this course, namely A, B, C and F, in the Dempster-Shafer framework.

a) You see the final grades in this course for 90% of the students in the class who passed the midterm. Of these, 95% got a grade of C or higher, 5% failed, and 20% got a grade of A. Express this knowledge as a bpa called m_1 .

b) Let's say a friend tells you that they saw your final grade for this year and that you failed, but it's only 25% likely that your friend actually saw the right grade. Express this as a bpa called m_2 .

c) What is your belief (expressed as a possibility interval) that you failed the course given that you passed the midterm but your friend says that you failed? Make sure you show all your calculations.

d) How much uncertainty is there in your belief computed in (c). Did your uncertainty go up or down based on your friend's information?