

CS 2502/486 2008 Assignment 3

Due: Nov. 28

1. **[25 pts]** In class we saw that with the closed world assumption, complex queries can be broken down to queries about their parts. In particular, restricting ourselves to the propositional case, for any formulas α and β , we have that $\text{KB} \models_{\text{c}} (\alpha \vee \beta)$ iff $\text{KB} \models_{\text{c}} \alpha$ or $\text{KB} \models_{\text{c}} \beta$. This way of handling disjunction clearly does not work for regular entailment since, for instance, $(p \vee q) \models (p \vee q)$ but $(p \vee q) \not\models p$ and $(p \vee q) \not\models q$.
 - (a) Prove that this way of handling disjunction *does* work for regular entailment when the KB happens to be a complete set of literals (that is, containing every atom or its negation).
 - (b) Show that the completeness of the KB matters here by finding a set of literals S and formulas α and β such that $S \models (\alpha \vee \beta)$, $S \not\models \alpha$, $S \not\models \beta$, and $S \not\models (\alpha \vee \beta)$.
 - (c) Prove that when a KB is a set of literals (not necessarily complete) and also α and β have no atoms in common, then $\text{KB} \models (\alpha \vee \beta)$ iff $\text{KB} \models \alpha$ or $\text{KB} \models \beta$.
2. **[40 pts]** Although inheritance networks are, in a sense, much weaker than the other formalisms considered in class for default reasoning, they use the default assertions more fully.

Consider the following variant of the network from the previous assignment:

Henry is a university person.
A university person is typically a student.
A university person is typically an adult.
A student is typically not an adult.

Given just these assertions, it seems reasonable to conclude by default that Henry is an adult.

- (a) Explain how this network unambiguously supports the desired conclusion.
 - (b) Represent the assertions in first-order logic using three abnormality predicates, and argue that minimizing abnormality would not be sufficient to get the desired conclusion.
 - (c) Repeat the exercise in default logic: Represent the assertions as one fact and three normal default rules, and show that there is an extension where Henry is not an adult. Show that this extension can be eliminated by using a non-normal default rule. (You may use a variable-free version of the problem where the letters u , s , and a stand for the propositions that Henry is a university person, a student, and an adult respectively, and where defaults are considered only with respect to Henry.)
 - (d) Write a variable-free version of the assertions in autoepistemic logic, and use the procedure described in class to generate a stable expansion where again Henry is not an adult.
3. **[30 pts]** Exercise 3 of Chapter 12.
 4. **[25 pts]** Exercise 2 of Chapter 13.
 5. **[30 pts]** Exercise 3 of Chapter 13.