CS 2502/486 2007 Assignment 2

Due: November 9

Note that Question 5 below requires programming. Further instructions will be provided in a tutorial.

1. **[30 pts]** In this question, we generalize the entailment procedure for Horn clauses to handle *negation as failure*. In Exercise 1 of Chapter 6, the forward chaining procedure for Horn clauses is considered. In this question, we consider back-chaining. For this question, assume that a KB consists of a list of rules of the form $(q \leftarrow a_1, \ldots, a_n)$ where $n \geq 0$, q is an atom, and each a_i is either of the form p or **not**(p), where p is an atom. The q in this case is called the conclusion of the rule, and the a_i make up the antecedent of the rule.

   (a) Adapt the recursive back-chaining SOLVE procedure on Slide 87 (or page 92 of the book) to deal with the case where the q_i may also be of the form **not**(p). Note that like SOLVE, your procedure can go into an infinite loop.

   (b) Explain what your procedure does on KB $\models g$ with the KB from Exercise 1a) of Chapter 6.

   (c) Argue informally that if your procedure terminates, it does the right thing. (We can't *prove* that it does the right thing since we have not considered a formal specification for negation as failure.)

   (d) Consider the definition of a strongly stratified KB in Exercise 1c) of Chapter 6. Either prove that your procedure always terminates when the KB is strongly stratified or present a counterexample where it does not.

2. **[30 pts]** Chapter 7, Exercise 3.

3. **[25 pts]** Chapter 8, Exercise 2 for the Classroom Scheduler.

4. **[25 pts]** Chapter 9, Exercise 2.

5. **[50 pts]** Chapter 9, Exercise 5.

6. **[25 pts]** Chapter 10, Exercises 1, 2, 3, 4, 5 for Polly.

7. **[15 pts]** The GCWA presented in class is an attempt to restrict the CWA so as to preserve consistency in the presence of disjunctions. For example, with a KB that contains $(a \vee b)$, we do not consider it safe to assume that a is false, since if we do the same for b, we will end up with a contradiction.

   (a) The definition of the GCWA says that we should use the entailments of KB together with

   $$\{\neg p \mid \text{ for all atoms } q_1, \ldots, q_n, \text{ if KB} \models (p \vee q_1 \vee \ldots \vee q_n), \text{ then KB} \models (q_1 \vee \ldots \vee q_n)\}.$$

   Explain how with a KB that contains $(a \vee b)$ but no other sentence mentioning a, b, or c, this definition does the right thing for a, b, and c.

   (b) Now we wish to consider disjunctions in a KB like $(a \vee \neg b)$ that involve negated literals. First, explain why the GCWA definition would not work properly if we allowed the q_i to range over all literals, not just the positive ones.

   (c) Now suppose a KB $\models (a \vee \neg b)$ but KB $\not\models a$ and KB $\not\models \neg b$. Explain why it would be safe to assume that a is false in this case despite this disjunction.