CSE 571 – Artificial Intelligence

Take Home TEST — II a

Due Date: Dec 7th, beginning of the class.

(1) Show the equivalence of McCarthy's formulation of circumscription, given by

$\forall \Phi[[A(\Phi) \wedge \forall \bar{x}.(\Phi(\bar{x}) \supset P(\bar{x}))] \supset (P(\bar{x}) \supset \Phi(\bar{x}))]$

and Lifschitz's simplification given by:

$\neg \exists \Phi(A(\Phi) \wedge \Phi < P)$ (10 pts)

(2) Consider the following first-order theory. List a few of its models. (Note: The theory is not a universal theory. So you basically have to follow the definition of what a model is and give a model of this theory.)

$(\exists x.\ student(x) \wedge teaches(x)) \wedge (\forall x.\ (faculty(x) \supset teaches(x)))$ (10 pts)

(3) Explain in *detail* how we can not make the intended conclusion if we use the formulation of the Yale Shooting problem in Slide 20, of Handout 3 (version 0.3). (Explain what the minimal models are and how there is an unwanted minimal which prevents us from making the appropriate conclusion. When you claim something to be a minimal model, do give explanation about why it indeed is a minimal model.) (15 pts)

(4) Consider the following action description.

$a\ causes\ f$
$executable\ a\ if\ g$
$b\ causes\ g$
$executable\ b\ if\ h$
$initially\ h, \neg g, \neg f$

Using the above description, write a propositional theory whose models are plans that achieve the goal f. Compute the models of this propositional theory. (15 pts)

(5) Formally prove that the ancestor relation can not be expressed in first-order logic. (Hint: A proof of a more general result is available in one of the references mentioned in the web site. It may be present in some logic books. If you find a source where this answer is located **do not** tell your classmates, as the intention of this question is to make you at least flip through the suggested references.) (15 pts)