

Take-Home Exam on Knowledge Representation and Automatic Reasoning

Hint: Examine the slide sets in readings #9 and #11 and refresh your understanding of our discussions in the class.

Problem 1. Consider the following knowledge base KB_1 regarding six facts in terms of propositions a, l, m, p, q :

$$\begin{aligned} a \wedge q &\Rightarrow m \\ l \wedge m &\Rightarrow q \\ m &\Rightarrow l \\ q &\Rightarrow p \\ a &\Rightarrow m \\ a \end{aligned}$$

(i) Explain how you can use model checking to prove that $KB_1 \models p$ (in other words, KB_1 entails p , or equivalently KB_1 implies p).

Problem 2. Consider problem #1 again: (i) Is KB_1 in Horn form? Why or why not? (ii) Explain how you can use forward chaining to prove that $KB_1 \models p$ (in other words, KB_1 entails p , or equivalently KB_1 implies p).

Problem 3. Consider the following knowledge base KB_2 regarding six facts in terms of propositions a, b, c, d, e, f :

$$\begin{aligned} a \vee \neg b \vee \neg c \\ b \\ c \vee \neg d \vee \neg e \\ e \vee f \\ d \\ \neg f \end{aligned}$$

(i) Is KB_2 in Horn form? Why or why not? Could we use forward chaining to prove that $KB_2 \models a$? (ii) Show how you can use resolution to prove that $KB_2 \models a$ (in other words, show $KB_2 \wedge \neg a$ is a contradiction that is always false). Draw a resolution proof diagram to show the steps of the resolution involved in this case.

Problem 4. Encode the following imagined knowledge description by CDC (the Center of Disease Control) into logic sentences in first-order logic. (You

can devise whatever predicates, variables, and constants you need for this purpose.) *Knowledge description:* A person is of critical disease-control concern to CDC if that person is an American entering the US territory from a SARS inflicted area. Tland, is a southeastern Asian island nation. All southeastern Asian nations are inflicted by SARS. Johnny is an American entering the US territory from Tland.

Problem 5. Continue with Problem #4 above. Draw a resolution proof diagram to show how you can use unification and resolution to prove that Johnny is of critical disease-control concern to CDC.