CSci 4511 Spring 2018

Final Exam

Tuesday May 8
120 minutes – Open book and notes

1. *15 points*
   You are given the following English sentence: "People who own a bird do not own a cat" and these translations into predicate calculus:

   1. $\forall x \forall y \forall z\ [[Owns(x,y) \wedge Bird(y) \wedge Owns(x,z)] \rightarrow \neg Cat(z)]$
   2. $\exists x \exists y \exists z\ [[Owns(x,y) \wedge Bird(y) \wedge Cat(z)] \wedge \neg Owns(x,z)]$
   3. $\forall x \forall y\ [[Owns(x,y) \wedge Bird(y)] \rightarrow [\exists z Cat(z) \wedge \neg Owns(x,z)]]$

   1. Is there a statement that represents well the English sentence? If yes, specify which one it is. If no, please write the correct logical sentence.
   2. For each of the logical sentences above write in English what the logical sentence is actually saying.

2. *15 points*
   Convert the following set of propositional clauses to CNF.

   1. $\neg(A \wedge \neg B) \vee \neg(\neg C \wedge \neg D)$
   2. $\neg(D \vee B)$
   3. $E \rightarrow (\neg D \rightarrow (\neg C \wedge A))$

   Use resolution with refutation to prove: $\neg E$.

3. *5 points*
   Show that the sentences:

   $\forall x\ [\forall y\ Loves(x,y)] \Rightarrow Happy(x)$

   $\forall x\ \exists y\ [[Loves(x,y)] \Rightarrow Happy(x)]$

   are logically equivalent by converting them to CNF.

4. *15 points*
   You have a tray with a glass on it. The tray is in the kitchen. You want to take the glass to the living room and bring the tray back to the kitchen.

   1. Specify the initial state and the goal state, using appropriate predicates.
   2. Define two action schemas using predicate calculus, one for moving the tray and its contents from a location to another, and another for taking an object off the tray.

Turn to the next page for more questions

5. *20 points*
   You are given the following problem and operator schemas:

   Initial State: $Garbage \wedge Cleanhands$
   Goal: $Dinner \wedge \neg Garbage$
   Op(ACTION:$Cook$,
   PRECOND: $Cleanhands$
   EFFECT: $Dinner$
   Op(ACTION:$Carry$,
   PRECOND: $Garbage$
   EFFECT: $\neg Garbage \wedge \neg Cleanhands$

   1. Draw the planning graph. Mark all the mutexes and their type.
   2. Is the problem solved at level $S1$? If not, is it solved at level $S2$? How?

6. *15 points*
   Use a semantic network to represent the following: "Tomorrow Bill will cut down a dead tree with a saw. Cutting the tree will take two hours. Bill will plant a new tree. The new tree will be smaller than the dead tree."

7. *15 points*
   Answer these questions explaining your reasoning briefly but precisely.

   1. A* does not test a node to see if it is a goal until the node is selected for expansion. This test could be performed instead when new nodes are generated. What effect would doing so have on the efficiency and admissibility of the algorithm?
   2. What are the main differences between using predicate calculus and using propositional calculus for planning? Provide one positive and one negative reason for using predicate calculus and one positive and one negative reason for using propositional calculus.
   3. Explain why a literal that does not appear in the final level of the planning graph cannot be achieved.

8. Extra Credit *10 points*
   An exhaustive decomposition is defined as

   $ExhaustiveDecomposition(s, c) \Leftrightarrow (\forall\ i\ i \in c \Leftrightarrow \exists\ c2\ c2 \in s \wedge i \in c2)$

   1. Explain with your own words the definition of exhaustive decomposition.
   2. Why in an ontology it is important to specify if two or more categories are an exhaustive decomposition?

YOU REACHED THE END OF THE EXAM