Assignment 2 Comprehension

B351 / Q351

Comprehension Questions Due:
(This assignment)
Tuesday, January 22nd, 2019 @ 11:59PM

Initial Due, Programming Component:
Tuesday, January 29th, 2019 @ 11:59PM

Revision Due, Programming Component:
Tuesday, February 5th, 2019 @ 11:59PM

Please submit to canvas as ONE PDF file. You may type your work using LaTeX or TeX or you may handwrite them neatly. Please make sure you check your file after you submit it. If you cant read it, neither can we. The material covered in this HW can be found in Sections 2.1-2.4 and Sections 3.1-3.5 of our textbook.

1 Problems

1. Convert the following formulas to CNF
   (a) $(A \Rightarrow B) \Rightarrow C$
   (b) $(A \Leftrightarrow B) \Rightarrow (\neg A \wedge C)$
   (c) $(A \Rightarrow (D \Rightarrow C)) \Rightarrow (A \Rightarrow (C \Rightarrow D))$
2. Using resolution, prove that $\neg A \vee D, \neg C \Rightarrow \neg D \models A \Rightarrow C$
3. Consider the following assumptions:
   (a) If Zeus were able and willing to prevent evil, then he would so.
   (b) If Zeus were unable to prevent evil, then he would be impotent.
   (c) If he were unwilling to prevent evil, then he would be malevolent.
   (d) Zeus does not prevent evil.
   (e) If Zeus exists, he is neither impotent nor malevolent.

   Let the variables:

   - P: "Zeus is able to prevent evil,"
   - Q: "Zeus is willing to prevent evil,"
   - R: "Zeus prevents evil,"
   - S: "Zeus is impotent,"
   - T: "Zeus is malevolent," and
   - U: "Zeus exists."

First translate each of the sentences into logic notation, and then prove that Zeus does not exist using resolution.

4. Using the following predicates, write each of the sentences below utilizing first order logic: $Animal(x)$: x is an animal, $Eats(x, y)$: x eats y, $Vegetarian(x)$: x is vegetarian. Assume the domain is the set of all beings.

   (a) Some animals are not vegetarians.

   (b) All vegetarians eat something that is not an animal.

   (c) Vegetarians don't eat animals.

   (d) Whoever eats an animal cannot be vegetarian.

5. Consider the following predicates: $Younger(x, y)$: x is younger than y, $Dad(x, y)$: x is ys dad, $Alive(x)$: x is alive, and $Child(x, y)$: x is ys child. Assume the following:

   (a) $Dad(Fa, So)$

   (b) $Alive(So)$

   (c) $\forall x \forall y (Dad(x, y) \Rightarrow Child(y, x))$

   (d) $\forall x \forall y (Child(x, y)) \wedge Alive(x)) \Rightarrow Younger(x, y))$

   Use resolution to prove that $Younger(So, Fa)$. [Hint: The process to convert first-order logic statements into CNF is on page 40 of our book and in Worksheet 3. In this case, Step 2 of that process can be ignored since we dont have any existential quantifier.]

2 Bonus Problem (10%)

Prove using resolution that if

$KB = (p \Rightarrow q) \wedge (r \vee s) \wedge (\neg s) \wedge (\neg s \Rightarrow \neg t) \wedge (\neg q \vee s) \wedge (\neg p \wedge r \Rightarrow u) \wedge (w \vee t)$,

then $KB \models (u \wedge w)$