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NICTA and ANU
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COMP6463
Assignment "Automated Reasoning in First-Order Logic"

Due date: September 30, 2010, 5pm.

Marking scheme: Full marks for a formulation that correctly answers the question and clearly shows the steps to obtain the solution.

Solutions to be submitted electronically by Email to Peter.Baumgartner@nicta.com.au or on paper to a lecturer of this course.

Question 1 (3 pts). Determine which of the following propositional formulas are valid/satisable/unsatisable. Use equivalence preserving transformations to transform the formulas into a CNF and argue with the resulting CNF.

1. $P \wedge Q \rightarrow P \vee Q$
2. $P \vee Q \rightarrow P \wedge Q$
3. $P \rightarrow \neg P$

Question 2 (4 pts). Convert this formula into Prenex normal form, then Skolemize

$$\forall x\ ((\forall x\ P(x)) \rightarrow \exists y\ Q(x, y))$$

Question 3 (4 pts). Use the algorithm based on usable/worked-off sets of clauses presented in class to show that the set consisting of these clauses is unsatisfiable

1. $A \vee B \vee B$
2. $\neg A \vee B$
3. $A \vee \neg B$
4. $\neg A \vee \neg B$

Question 4 (4 pts). Apply the rule-based standard unification algorithm to these sets of equations and read off the result, i.e., either $\bot$ or the unifier (a is a constant, x and y variables):

1. $x \doteq y,\ f(f(x)) \doteq f(y)$
2. $a \doteq x,\ f(x, z) \doteq y,\ f(z, x) \doteq y$

Question 5 (5 pts). Find a Resolution derivation to show that the set consisting of these clauses is unsatisfiable; it suffices to only state the unifiers used in inference in your solution

1. $\neg P(x) \vee Q(f(x)) \vee Q(y)$
2. $\neg Q(x) \vee R(x)$
3. $P(a)$
4. $\neg R(f(a))$