Examination Automated Reasoning

Code 2IW15, August 17, 2011, 14.00 - 17.00

This examination consists of 5 problems all having the same weight. The final result for this course will be the average of the result for the practical assignment and the result for this examination, as long as both results are at least 5.

Problem 1.

Consider the CNF consisting of the following eight clauses

(1)	$p \vee \neg q$	(5)	$r \vee \neg s \vee \neg t$
(2)	$\neg r \vee \neg s$	(6)	$\neg p \vee q \vee s$
(3)	$\neg p \vee t$	(7)	$p \vee \neg r \vee t$
(4)	$q \vee r$	(8)	$s \vee \neg t$

a. Determine whether this CNF is satisfiable by using the four rules UnitPropagate, Decide, Fail and Backtrack; as the first decision literal choose p^d. Make clear at every step what is the corresponding list M of literals and which clause was used.

b. Do the same for the CNF consisting of the CNF consisting of clauses (1) to (7), so excluding (8).

Problem 2.

Compute the ROBDD of

$$((q \wedge s) \leftrightarrow p) \wedge (r \vee (p \rightarrow s))$$

with respect to the order $p < q < r < s$.

Problem 3.

Prove that

$$\forall x \exists y \forall z (\neg P(y, f(z)) \wedge Q(x, y) \wedge$$

$$\neg(\neg P(z, x) \wedge Q(x, z)))$$

is unsatisfiable using skolemization and resolution.

Problem 4.

a. Assume that $\sigma(x)$ is a variable for a unifier σ of two terms t and u in which the variable x occurs. Let τ be a most general unifier of t and u. Prove that $\tau(x)$ is a variable.

b. Explain what is meant by completeness of resolution in predicate logic.

Problem 5.

The term rewriting system R is defined to consist of the rules

$$\begin{array}{lcl} f(x, g(y)) & \rightarrow & g(f(y, x)), \\ f(h(x), y) & \rightarrow & h(f(x, y)). \end{array}$$

a. Prove that R is terminating by monotone interpretations.

b. Explain why termination of R can not be proved by the lexicographic path order.

c. Give all non-trivial critical pairs of R.

d. Determine whether R is confluent.