Examination Automated Reasoning

Code 2IW15, January 22, 2013, 14.00 - 17.00

This examination consists of 5 problems each 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. Here for the practical assignment the average of both parts is taken.

Problem 1.

Consider the CNF consisting of the following eight clauses

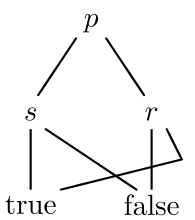
(1)	$\neg p \vee t$	(5)	$p \vee \neg r \vee s$
(2)	$\neg q \vee r$	(6)	$\neg q \vee s \vee \neg t$
(3)	$p \vee q \vee s$	(7)	$r \vee \neg s \vee \neg t$
(4)	$\neg r \vee \neg s$	(8)	$\neg p \vee q \vee s$

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.

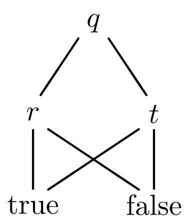
Problem 2.

Consider the ROBDDs T en U with respect to the order $p < q < r < s < t$:

T :



U :



For every node the left and right branch correspond to true and false, respectively. Compute

$$apply(T, U, \wedge).$$

Problem 3.

Show how by (the initialization part of) the simplex algorithm values for $x, y \geq 0$ are found satisfying

$$\begin{aligned} x + y &\geq 4 \\ x + 2y &\leq 8 \\ 2x - y &\geq 2. \end{aligned}$$

Problem 4.

a. Let u, v, x, y, z be variables. Compute $\sigma(x)$, where σ is the most general unifier of $f(g(x, h(y, z)), f(z, y))$ and $f(g(f(u, v), u), v)$.

b. 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 5.

Given the term rewriting system R consisting of the two rules

$$f(g(x)) \to f(h(x, x)), \quad g(f(x)) \to h(g(x), x).$$

a. Compute all normal forms of $g(f(f(x)))$.

b. Prove that R is terminating.

c. Give all critical pairs of R.

d. Determine whether R is confluent.