Examination Automated Reasoning

Code 2IMF25, November 6, 2020, 13.30 - 16.30

This examination consists of 5 problems each having the same weight. It is a closed-book-examination: no extra material may be used. 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.

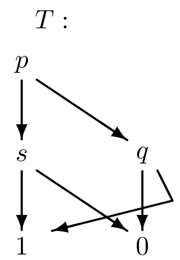
Consider the CNF consisting of the following eight clauses

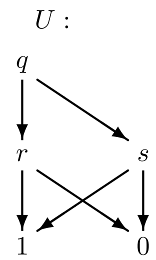
(1) $s \vee t$	(5) $p \vee \neg r$
(2) $\neg p \vee \neg s$	(6) $\neg q \vee s \vee \neg t$
(3) $q \vee s$	(7) $r \vee \neg u$
(4) $p \vee t$	(8) $q \vee u$

Use DPLL to determine whether this CNF is satisfiable; in case it is also give a satisfying assignment. Start with choice on p; in every unit resolution step indicate the number of the clause used.

Problem 2.

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





For every node the left and right branch correspond to true and false, respectively. Compute *apply*$(T, U, \vee)$, that is, the ROBDD representing the disjunction of these ROBDDS.

Problem 3.

a. Elaborate the first pivot in the simplex algorithm in order to check whether the conjunction of $x \geq 0$, $y \geq 0$, $x + 2y \leq 10$, $x - y \geq 3$ and $x - 2y \leq -2$ is satisfiable.

b. Give a transition system and a formula ϕ such that $EX(EG\phi)$ holds and $AF\phi$ does not hold.

Problem 4.

a. Let u, v, w, x, y, z be variables. Check whether $P(x, g(x, x), f(y, z))$ and $P(f(u, v), w, f(u, h(w)))$ unify, and if so, compute $\sigma(z)$ for σ being the most general unifier.

b. Find a refutation of

$$A(b, c) \wedge A(a, b) \wedge A(c, d) \wedge \neg P(b, d) \wedge$$

$$(P(x, y) \vee \neg A(x, y)) \wedge$$

$$(P(x, y) \vee \neg A(x, z) \vee \neg P(z, y))$$

using resolution, where x, y, z are variables.

Problem 5.

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

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

a. Prove that R is terminating by monotone interpretations.

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

c. Determine whether R is confluent.