Examination Automated Reasoning

Code 2IMF25, April 4, 2016, 18.00 - 21.00

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.

a. Apply DPLL to decide whether the CNF consisting of the following six clauses is satisfiable or not:

$$p \vee q, \quad \neg p \vee q, \quad \neg p \vee \neg q,$$
$$p \vee \neg r, \quad \neg p \vee r, \quad \neg q \vee \neg r.$$

b. Describe what it means that resolution is complete for deciding satisfiability of proposition logic, and indicate how this can be proven.

Problem 2.

a. Explain what it means to bring a linear optimization problem to slack form.

b. Give a set of linear inequalities that has a solution in the real numbers but not in the integers.

Problem 3.

Compute the ROBDD of the boolean expression $(p \leftrightarrow s) \vee (q \wedge r)$ with respect to the order $p < q < r < s$.

Problem 4.

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

b. Prove that

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

is unsatisfiable using skolemization and resolution.

Problem 5.

Given the term rewriting system R consisting of the two rules

$$f(g(x)) \rightarrow g(h(x, x)),$$

$$h(f(x), f(y)) \rightarrow h(g(x), x).$$

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

b. Prove that R is terminating.

c. Give all critical pairs of R.