Examination Automated Reasoning

Code 2IMF25, April 12, 2017, 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. Prove that the CNF consisting of the following clauses is unsatisfiable, 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.

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

b. Show that it is possible to remove one clause from this CNF such that the remaining CNF of seven clauses is still unsatisfiable. Which clause may be removed?

Problem 2.

Compute the ROBDD of

$$(p \wedge t) \wedge (r \leftrightarrow (s \leftrightarrow q))$$

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

Problem 3.

a. Give an example of a feasible linear program that is not feasible in ILP.

b. Explain what is meant by Skolemization.

Problem 4.

Consider the following six clauses

$$Q(A,B), \quad Q(B,C), \quad Q(C,A),$$

$$\neg P(C,C), \quad \neg Q(X,Y) \vee P(Y,X),$$

$$\neg P(X,Y) \vee \neg P(Y,Z) \vee P(X,Z),$$

in which X, Y, Z denote variables and A, B, C, P, Q denote constants and relation symbols.
Prove by resolution that the conjunction of these six clauses is unsatisfiable.

Problem 5.

Given the term rewriting system R consisting of the two rules

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

$$f(h(x,y)) \to h(f(y), f(x)).$$

a. Prove that R is terminating.

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

c. Determine whether R is confluent.