# Examination Automated Reasoning

## Code 2IMF25, January 23, 2017, 13.30 - 16.30

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. Compute the number of clauses of the Tseitin transformation of

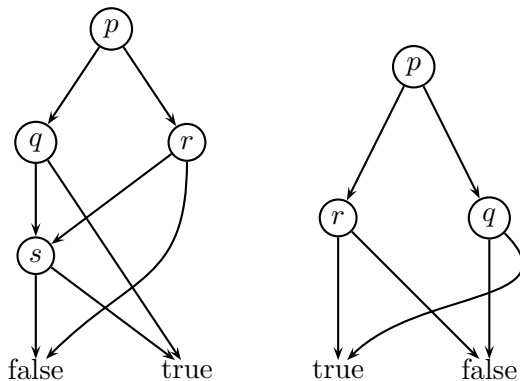$$\neg r \wedge ((p \leftrightarrow \neg q) \vee (r \rightarrow p))$$

(only the number, not the full CNF). Explain your answer.

b. For the first step of the Davis Putnam procedure applied on the following CNF the variable $p$ is chosen. Give the result of this first step.

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

## Problem 2.

Compute the ROBDD of the conjunction of the following two ROBDDs with respect to the order $p < q < r < s$.



## Problem 3.

Bring the following optimization problem to slack form and execute the first pivot of the Simplex method.
Minimize $z - x$ for the variables $x, y, z \geq 0$ satisfying

$$2x \leq 4 + y + z, \ x \geq 2z - 2, \ x \leq 3 - 2y + z.$$

## Problem 4.

a. Give an example of a unifier of two terms that is not a most general unifier.

b. Give the definition of a Horn clause.

c. Check whether resolution can be applied on the clause

$$P(x, f(x)) \vee \neg P(g(x), y)$$

with itself; if so, give the result.

## Problem 5.

Given the term rewriting system $R$ consisting of the two rules

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

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

a. Prove that $R$ is terminating.

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

c. Determine whether $R$ is confluent.