Exercise for the lecture Modeling Methods in Computer Science, Winter Semester 2007/08
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Consultation-hour: Thursday, 15:00-16:00
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Exercise Sheet 13 — Due date: **30.01.2008, 14:00**

Exercise 25: Unification

Given the constants a, b and c, the functions f and g, the variables x, y, z, x' and the predicates P and Q.

Apply the unification algorithm to each of the following sets of literals. If a set is unifiable, also give a most common unificator.

(a) $\{P(x, f(y)), P(g(y, a), f(b)), P(g(b, x'), z)\}$

(b) $\{P(f(x), f(f(a))), Q(f(x), f(f(a)), g(z, z, z))\}$

(c) $\{Q(a, x, g(a, b, c)), Q(a, f(z), g(a, b, y)), Q(a, f(f(x')), g(a, x, g(c, b, a)))\}$

6 Points

Exercise 26: Ground Resolution

Given the constant c the monadic function f and the variables x, y and z. Prove the unsatisfiability of the following formula in Skolem normal form using ground resolution:

$$F = \forall x \forall y \forall z ((\neg P(f(c)) \vee \neg P(y) \vee Q(y)) \wedge P(f(z)) \wedge (\neg P(f(f(x))) \vee \neg Q(f(x))))$$

(a) Give the set of clauses.

(b) Illustrate the ground resolution in its graphical form including the substitutions used.

(c) Which basic instances of clauses have to be composed to arrive at the empty clause?

6 Points

Exercise 27: Resolution in First Order Logic

Given the constants a, b, c, d and the variables x_i, y_i. Prove the unsatisfiability of the following set of clauses using resolution in first order logic according to Robinson:

$$\{\{B(a)\}, \{R(b)\}, \{\neg D(x_3, y_3), E(x_3, y_3)\}, \{\neg R(x_4), F(x_4)\},$$
$$\{\neg F(y_5), \neg E(x_5, y_5), F(x_5)\}, \{\neg B(x_6), \neg F(x_6)\},$$
$$\{B(c)\}, \{R(d)\}, \{D(c, d)\}\}$$

(a) Illustrate the resolution in its graphical form including the substitutions used.

(b) Which basic instances of clauses have to be composed to arrive at the empty clause?

5 Points

Exercise 28: Procedure of proof of universality

Given an arbitrary formula F in first order logic. How does one show the universality of F using resolution in first order logic (not ground resolution!)? Enumerate the necessary steps.

3 Points