



---

Uwe Waldmann

May 6, 2020

**Tutorials for “Automated Reasoning II”**  
**Exercise sheet 1**

**Exercise 1.1:**

Use the congruence closure algorithm to check whether the equational clause

$$\forall x, y \ f(f(x)) \not\approx x \vee f(x) \not\approx y \vee f(f(y)) \not\approx g(y) \vee x \approx y \vee h(x, y) \approx h(x, g(y))$$

is valid.

**Exercise 1.2:**

On page 4 of the lecture notes we have sketched a flattening operation for sets of equations. Formalize it using an appropriate transition system in such a way that any two different D-equations have always different left-hand sides.

**Exercise 1.3:**

The Fourier-Motzkin algorithm would be unsound if we omitted the non-triviality axioms from the definition of ODAGs. Where do we need non-triviality?

**Exercise 1.4:**

Describe the rules for virtual substitution for the test points in the set  $T'$  that is defined on page 13 of the lecture notes.

**Exercise 1.5:**

Use the Loos-Weispfenning algorithm to eliminate  $\exists x$  from the formula

$$\exists x \ ((2x - y > 0 \vee x \geq 2) \wedge (y - x \geq -1 \vee x < 1) \wedge \neg(x \geq 3y))$$

Simplify the result as much as possible.

Submit your solution (or solution attempt) by e-mail to [uwe@mpi-inf.mpg.de](mailto:uwe@mpi-inf.mpg.de), subject Ex 1. until May 12.