Prof. Dr. Rüdiger Ehlers Francisco Palau, M.Sc.

Applied Computational Engines 2018 – Assignment Sheet 10

Due: **Monday, 3rd July 2018, 9:30 am**

Please indicate your **name** and **email address**. You can work in **groups** of up to **three** students. Only one submission per group is necessary. However, in the tutorials every group member must be able to present the solutions to each problem solved by your group.

Please submit your solutions either

- by e-mail to `fpalau@uni-bremen.de` **and** `rehlers@uni-bremen.de`, or
- ~~on paper in **letter box 52** (Francisco Palau-Romero) on floor 6 of the MZH building.~~

Note that you will need 50% of the points on all exercise sheets in order to take the "Fachgespräch" OR the oral exam.

SAT+LP (25 pts.)

Use the SAT+LP algorithm from the lecture to solve the following SMT problem instance, where x and y are real-valued variables.

$$(x \leq 5 \vee y \geq 2) \wedge (x \geq 4 \vee y \leq 2) \wedge (x + y \geq 12) \wedge (x + y \leq 14) \wedge (3y - 4x \leq 0) \wedge (3x - 4y \leq 0)$$

You can use an LP solver to help with the calls to SOLVELP, or you can just solve the LP instances graphically on paper, as there are only two dimensions. Always branch on the leftmost ground term that has not been assigned a value of $\{\mathbf{false}, \mathbf{true}\}$ yet.

Choose any of the two SAT+LP variants presented in the lecture.

Uninterpreted Functions (25 pts.)

Check if the following set of ground terms from the theory of uninterpreted functions is consistent:

$$\begin{aligned}&(f(x) = x) \wedge (f(f(x)) = g(x, x)) \wedge (g(f(y), y) = g(f(y), f(y)))\\ \wedge\ &(f(y) = g(f(x), f(x))) \wedge (g(x, g(x, y)) = g(y, x)) \wedge (g(x, x) \neq g(f(y), y))\end{aligned}$$

In this specification, f is a unary function, g is a binary function, and x and y are constants. When applying the congruence closure algorithm, explain the steps that the algorithm performs.