Universität Koblenz-Landau

FB 4 Informatik

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Exercises for "Decision Procedures for Verification"
Exercise sheet 11

Exercise 11.1: *(4 P)*
Let $\mathcal{T}$ be the combination of $LI(\mathbb{Q})$ (linear arithmetic over $\mathbb{Q}$) and UIF_Σ, the theory of uninterpreted function symbols in the signature $\Sigma = \{\{f/1, g/2\}, \emptyset\}$.
Check the satisfiability of the following ground formulae w.r.t. $\mathcal{T}$ using the deterministic version of the Nelson-Oppen procedure (after purifying the formulae check for entailment of equalities between shared constants and propagate the entailed equalities):

(1) $\phi_1 = (c + d \approx e \wedge f(e) \approx c + d \wedge f(f(c+d)) \not\approx e)$.
(2) $\phi_2 = (g(c+d, e) \approx f(g(c,d)) \wedge c + e \approx d \wedge e \geq 0 \wedge c \geq d \wedge g(c,c) \approx e \wedge f(e) \not\approx g(c+c, 0))$

Exercise 11.2: *(2 P)*
Check the satisfiability w.r.t. $\mathcal{T} = LI(\mathbb{Q})$ of the following set of ground clauses using the "lazy" approach to SMT presented in the class.

$$(\neg(0 \leq x) \vee \neg(y \leq z)) \ \wedge \ (\neg(z \leq x+y) \vee (y \leq z)) \ \wedge \ (\neg(0 \leq y) \vee (0 \leq x)) \ \wedge \ (z \leq x+y)$$

For theory reasoning in $LI(\mathbb{Q})$ use the Fourier-Motzkin algorithm.

Supplementary exercises:

Exercise 11.3: *(5 P)*
Let $\mathcal{T}$ be a theory with signature $\Sigma = (\Omega, \Pi)$ and $\mathsf{Mod}(\mathcal{T})$ be its class of models.
Show that if $\mathsf{Mod}(\mathcal{T})$ is closed under products then $\mathcal{T}$ is Π-convex.

Exercise 11.4: *(5 P)*
We say that a theory $\mathcal{T}$ is *stably infinite* if for every quantifier-free formula ϕ, ϕ is satisfiable in $\mathcal{T}$ iff ϕ is satisfiable in a (countably) infinite model of $\mathcal{T}$.
Let $\mathcal{T}_1, \mathcal{T}_2$ be stably infinite theories with disjoint signatures. Prove that their combination $\mathcal{T}_1 \cup \mathcal{T}_2$ is stably infinite.

Please submit your solution until Monday, January 13, 2014 at 16:00. Joint solutions prepared by up to three persons are allowed. Please do not forget to write your name on your solution.

Submission possibilities:

- By e-mail to `sofronie@uni-koblenz.de` with the keyword "Homework DP" in the subject.

- Put it in the box in front of Room B 222.