Universität Koblenz-Landau

FB 4 Informatik

Prof. Dr. Viorica Sofronie-Stokkermans **February 7, 2015**

Exercises for "Decision Procedures for Verification"
Exercise sheet 12

Exercise 12.1: *(4p P)*
Let $\mathcal{T} = LI(\mathbb{Q})$, and let $Q := y \leq 1, R := x \leq y, P := y + y \leq 2, S := x \geq 1$. Use a DPLL($\mathcal{T}$) method to check the satisfiability w.r.t. $\mathcal{T}$ of the following set of clauses:

$$\begin{array}{lc} (1) & \neg R \vee P \\ (2) & \neg Q \vee \neg P \\ (3) & R \vee P \\ (4) & S \end{array}$$

For checking the satisfiability of conjunctions of inequalities in $LI(\mathbb{Q})$ use the Fourier-Motzkin method.

In what follows we consider the theory of arrays defined in the lecture. We assume that the theory of indices $\mathcal{T}_i$ is $LI(\mathbb{Z})$, and the theory of elements $\mathcal{T}_e$ is $LI(\mathbb{Q})$.

Exercise 12.2: *(2 P)*
Which of the formulae below are (equivalent to formulae) in the array property fragment and which are not?
Justify your answer. (The universally quantified variables i, j are sort index; the indices k, l which are not universally quantified are considered to be constants of sort index)

(1) $\forall i \ (a[i+1] > a[i])$
(2) $\forall i \ (i < a[k] \rightarrow a[i] = a[k])$
(3) $\forall i, j \ (l_1 \leq i \leq u_1 < l_2 \leq j \leq u_2 \rightarrow a[i] \leq a[j]$
(3) $\forall i, j \ (l_1 < i \leq u_1 < l_2 \leq j \leq u_2 \rightarrow a[i] \leq a[j]$.

Exercise 12.3: *(4 P)*
Consider the following array property formula:

$$F : \forall i \ (l \leq i \leq u \rightarrow a[i] = b[i]) \wedge \neg \forall i \ (l \leq i \leq u + 1 \rightarrow \mathsf{write}(a, u+1, b[u+1])[i] = b[i])$$

Apply to the formula F the Steps 1–6 of the transformation procedure for formulae in the array property fragment presented in the lecture from Tue, 10.02.2015.

Please submit your solution until Wednesday, February 11, 2015 at 13:00. 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.