Universität Koblenz-Landau

FB 4 Informatik

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Exercises for "Decision Procedures for Verification"
Exercise sheet 2

Exercise 2.1:
Prove Prop. 1.4: If N is a set of propositional formulas, then $N \models F$ if and only if $N \cup \{\neg F\}$ is unsatisfiable.

(A set of propositional formulas is unsatisfiable, if and only if for every valuation $\mathcal{A}$ there is a formula G in the set such that $\mathcal{A} \not\models G$.)

Exercise 2.2:
Let F be a formula, P a propositional variable not occurring in F, and F' a subformula of F.

We will write F also as $F[F']$ in order to emphasize that F' occurs in F. Let $F[P]$ be the formula obtained from F by replacing the subformula F' with the propositional variable P.

Prove:
The formula $F[P] \wedge (P \leftrightarrow F')$ is satisfiable if and only if $F[F']$ is satisfiable.

Hint: You can use structural induction.

Exercise 2.3:
Let F be the following formula:

$$\neg[((Q \wedge \neg P) \wedge \neg(Q \wedge R)) \rightarrow (Q \wedge (Q \rightarrow P) \wedge \neg P)] \wedge (P \vee R)$$

(1) Compute the negation normal form (NNF) F' of F.

(2) Convert F' to CNF using the transformation method using the distributivity of conjunctions over disjunctions described in the lecture.

Exercise 2.4:
Consider the formulae $F_n = \bigvee_{i=1}^{n} (Q_i \wedge R_i)$ for $n \in \mathbb{N}$.
As a function of n, how many clauses are in the CNF formula F' constructed using the distributivity of disjunctions over conjunctions?

Please submit your solution until Monday, October 29, 2012 at 09:00. 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 `mbender@uni-koblenz.de` with the keyword "Homework DP" in the subject.
- Put it in the box in front of Room B 222.