Universität Koblenz-Landau

FB 4 Informatik

Prof. Dr. Viorica Sofronie-Stokkermans   **October 27, 2016**

Exercises for "Formal Specification and Verification"
Exercise sheet 1

Exercise 1.1:
Determine the polarity of the following subformulae of

$$F = \neg((\neg(P \wedge \neg Q)) \vee (R \vee \neg S)) \vee (U \wedge V)$$

(1) $(P \wedge \neg Q)$ (4) Q
(2) $(R \vee \neg S)$ (5) S
(3) $((\neg(P \wedge \neg Q)) \vee (R \vee \neg S))$ (6) V

Exercise 1.2:
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 satisfiability-preserving transformation described in the lecture.

Exercise 1.3:
Use the resolution calculus to prove that the following set of clauses is unsatisfiable:

(1)	$\neg P \vee \neg Q \vee R$
(2)	$\neg P \vee \neg Q \vee S$
(3)	P
(4)	$\neg S \vee \neg R$
(5)	Q

Exercise 1.4:
Let F be a formula, P a propositional variable not occurring in F, and F' a subformula of F.

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

Supplementary exercise (to be discussed on November 3, 2016)

Exercise 1.5:
Let F be a formula containing neither $\rightarrow$ nor $\leftrightarrow$, P a propositional variable not occurring in F, and F' a subformula of F.

Prove:

- If F' has positive polarity in F then $F[F']$ is satisfiable if and only if $F[P] \wedge (P \rightarrow F')$ is satisfiable.

- If F' has negative polarity in F then $F[F']$ is satisfiable if and only if $F[P] \wedge (F' \rightarrow P)$ is satisfiable.

Please submit your solution until Wednesday, November 2, 2016 at 11:00. 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 FSW" in the subject.

- Put it in the box in Room B 222.