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16.04.2013
submit until 23.04.2013, 10:15

Tutorials for Decision Procedures Exercise sheet 1

Exercise 1: Normal form

Convert the following formulae into Negation Normal Form (NNF), into disjunctive normal form (DNF), and into conjunctive normal form (CNF).

- (a) $(P \wedge Q) \rightarrow (P \vee Q)$
- (b) $(P \vee (Q \rightarrow P)) \wedge Q$
- (c) $P \leftrightarrow (Q \leftrightarrow R)$

Exercise 2: Validity and Satisfiability

Which of the following formulae is valid, which is satisfiable? Give a satisfying and falsifying interpretation resp. prove validity resp. unsatisfiability using the methods of the lecture.

- (a) $P \rightarrow (Q \rightarrow P)$
- (b) $(P \vee Q) \wedge (P \rightarrow Q)$
- (c) $(P \wedge Q \wedge \neg R) \vee ((P \rightarrow Q) \rightarrow (P \rightarrow R))$
- (d) $(\neg P \rightarrow Q) \wedge \neg(Q \vee P)$
- (e) $(\neg P \vee \neg Q \vee R) \wedge (\neg P \vee Q) \wedge P \wedge \neg R$

Exercise 3: Equisatisfiability and DNF

We have seen that converting a formula into an equisatisfiable formula in CNF can be done efficiently. Now show that there is a polynomial algorithm to convert a formula into an equisatisfiable formula in *DNF* if and only if $P = NP$.