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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) $\neg(P \rightarrow Q) \wedge (P \vee Q)$

(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) $(P \rightarrow Q) \rightarrow (Q \rightarrow P)$

(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) $(P \vee Q \vee R) \wedge (P \vee \neg Q) \wedge (\neg Q \vee R) \wedge \neg P$

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 $P = NP$.