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**Tutorials for "Automated Reasoning"
Exercise sheet 4**

Exercise 4.1: (*4 P*)
Convert the following formulas to equivalent formulas in CNF using $\Rightarrow_{ECNF}$:

1. $[(P \rightarrow S) \land \neg Q] \leftrightarrow [R \lor (\neg S \rightarrow Q)]$
2. $[\neg(\neg P \lor (Q \land R))] \rightarrow [P \land (\neg Q \leftrightarrow \neg R)]$

Exercise 4.2: (*4 P*)
Convert the following formulas to equisatisfiable formulas in CNF using $\Rightarrow_{ECNF}$, but before applying this procedure introduce fresh variables for subformulas like in Step 2 of OCNF for given positions. (This is essentially Step 2 of OCNF without computing ν and doing subformula renaming only at given positions.)

1. $[\neg(\neg P \lor (Q \land R))] \rightarrow [P \land (\neg Q \leftrightarrow \neg R)]$ positions: $\{1, 22\}$
2. $[P \lor (\neg Q \leftrightarrow \neg R)] \rightarrow [\neg(\neg P \land (Q \lor R))]$ positions: $\{12, 212\}$

Exercise 4.3: (*3 P*)
Prove Proposition 2.10 for the case of polarity zero. You can assume that in the formula ψ only connectives $\land$, $\lor$ and $\neg$ are present.

Exercise 4.4: (*4 Bonus Points*)
Prove Proposition 2.10 for the case of positive and negative polarity. You can assume that in the formula ψ only connectives $\land$, $\lor$ and $\neg$ are present.

Submit your solution in lecture hall 001 during the lecture on May 14. Please write your name and the date of your tutorial group on your solution.

Note: Joint solutions are not permitted (work in groups is encouraged).