max planck institut informatik

Universität des Saarlandes
FR Informatik

**Evgeny Kruglov**
**Christoph Weidenbach**

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**Tutorials for "Automated Reasoning"**
**Exercise sheet 3**

**Exercise 3.1:** (*4 P*)
Prove Lemma 1.14.

**Exercise 3.2:** (*3 P*)
Let N be the following set of propositional clauses:

$$
\begin{array}{ccccccccccccccc}
\neg P & & & \vee & \neg R & & & \vee & \neg T & & & (1)\\
\neg P & & & & & & & \vee & T & \vee & \neg U & (2)\\
 & & & & \neg R & & & \vee & T & \vee & U & (3)\\
 & & \neg Q & \vee & \neg R & \vee & S & & & & & (4)\\
\neg P & & & \vee & R & \vee & \neg S & & & & & (5)\\
 & & Q & & & & & & & \vee & \neg U & (6)\\
P & & & & & & & & & \vee & U & (7)\\
P & \vee & \neg Q & & & & & & & \vee & \neg U & (8)
\end{array}
$$

Assume that during a DPLL-derivation, we have reached the configuration $P^d Q^d R^d S \neg T U \parallel N$. Give two different backjump clauses that can be used in this situation and give the successor state with respect to $\Rightarrow_{\mathsf{DPLL}}$ for each of these backjump clauses.

**Exercise 3.3:** (*3 P*)
Use the Fourier-Motzkin method to decide whether the following theory is satisfiable:

$$x + y \geq 16 \quad (1)$$
$$4x + 7y \leq 28 \quad (2)$$
$$2x - 7y \leq 20 \quad (3)$$
$$2x - 3y \geq -9 \quad (4)$$

**Challenge Problem:** (*2 Bonus Points*)
Present an unsatisfiable propositional clause set where the shortest $\Rightarrow_{DPLL}$ refutation (considering the standard backjump clause over the decision literals) is longer (counting the number of fail and backjump steps) than the shortest refutation by resolution (counting the number of generated resolvents).

Submit your solution in lecture hall 002 during the lecture on May 11. Please write your name and the date of your tutorial group (Tue, Wed, Fri) on your solution.

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