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**Tutorials for “Automated Reasoning”**  
**Exercise sheet 7**

**Exercise 7.1:** (1+1+2+1 P)

Prove the following properties of the superposition partial model construction.

1. For every  $D$  with  $(C \vee \neg P) \prec D$  we have  $\delta_D \neq \{P\}$ .
2. If  $\delta_C = \{P\}$  then  $N_C \cup \delta_C \models C$ .
3. If  $N_C \models D$  then for all  $C'$  with  $C \prec C'$  we have  $N_{C'} \models D$  and in particular  $N_{\mathcal{I}} \models D$ .
4. There is no clause  $C$  with  $P \vee P \prec C$  such that  $\delta_C = \{P\}$ .

**Exercise 7.2:** (4 P)

Consider the clause set

$$N = \{\neg P \vee \neg R, R \vee S \vee Q, \neg S \vee R, \neg Q \vee R, R \vee P \vee S\}$$

and the CDCL state  $(P^1, N, \emptyset, 1, \top)$ . Continue the application of CDCL rules to this state (don't use Forget, Restart) until a contradiction is derived or a model is found. Hint: prefer Conflict and Propagate over the other rules.

**Exercise 7.3:** (3+3+3 P)

Consider the clause set

$$N = \{P \vee Q \vee S, P \vee Q \vee \neg S, P \vee \neg Q \vee S, P \vee \neg Q \vee \neg S, \neg P \vee Q \vee S, \neg P \vee Q \vee \neg S, \neg P \vee \neg Q \vee S, \neg P \vee \neg Q \vee \neg S\}$$

and refute it by

1. Semantic Tableaux
2. Propositional Superposition with Redundancy
3. CDCL

Submit your solution in lecture hall E1.3, Room 002 during the lecture on December 09. Please write your name and the date of your tutorial group (Mon, Thu) on your solution.

Joint solutions are not permitted, please submit individually. However, I encourage you working and solving the exercises in a group.