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Tutorials for "Automated Reasoning"
Exercise sheet 5

Exercise 5.1: (*4 P*)
Demonstrate the Partial Model Construction on the following sets of clauses:

1. Set of clauses $N = \{\neg Q_0 \vee \neg P_2 \vee Q_1, \neg Q_1 \vee Q_2, P_0 \vee Q_0, \neg Q_0 \vee P_1, Q_0 \vee P_1, \neg Q_0 \vee \neg P_2 \vee Q_1\}$. Use ordering $Q_2 \succ P_2 \succ Q_1 \succ P_1 \succ Q_0 \succ P_0$ on atoms.

2. Set of clauses $N = \{\neg P \vee Q \vee P, S \vee \neg Q \vee R, \neg R \vee \neg S, Q \vee \neg S \vee S, R \vee S \vee P, S \vee Q, \neg R \vee \neg P \vee S \vee \neg Q\}$. Use ordering $P \succ Q \succ R \succ S$ on atoms.

Demonstrate here means: order the clauses in the set, show how (partial) interpretations (i.e. N_D for every $D \in N$) looks like, show how δ_D look like for every $D \in N$ and show the minimal clause which is not entailed by $N_{\mathcal{I}}$ if there is some. Don't do any inferences!

Exercise 5.2: (*4 P*)
Show some derivation of the empty clause (notation: $\bot$) from this set of clauses: $N = \{R \vee S, R \vee P \vee \neg Q, \neg Q \vee \neg S, \neg P \vee Q \vee \neg R, \neg Q \vee \neg S \vee \neg R, P \vee Q, \neg R \vee S, \neg P \vee \neg S\}$. Ordering on atoms is: $P \succ Q \succ R \succ S$. Use only Superposition Left and Factoring rules from the lecture. Show the derivation precisely, i.e. which rule you apply to which clause(s) (on which literal) and what is the output of this rule application.

Exercise 5.3: (*3 P*)
We call a set X of clauses exhausted (with respect to some rules) if the result of any inference (using these rules) with clauses from the set X is already in the set X or is subsumed by some clause in the set X. Compute the exhausted set of clauses for this set of clauses: $\{\neg P \vee Q \vee \neg S, \neg P \vee Q \vee S, P \vee S, P \vee \neg Q \vee \neg S, \neg P \vee \neg Q \vee \neg S, Q \vee \neg S \vee P\}$ with respect to rules Resolution and Factoring from the lecture.

Exercise 5.4: (*3 Bonus Points*)
Let N be any set of propositional clauses. Let $N_{\mathcal{I}}$ be the model obtained via Partial Model

Construction from the lecture. Suppose that $N_{\mathcal{I}} \models N$. Show that the set $N_{\mathcal{I}}$ is minimal with respect to inclusion, i.e. there is no $M \subsetneq N_{\mathcal{I}}$ such that $M \models N$.

Submit your solution in lecture hall 001 during the lecture on May 21. 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).