

Solved exercises must be marked and solutions (as a single PDF file) uploaded in **OLAT**. The (strict) deadline is 7 am on March 19.

Exercises

- (2) 1. Determine the satisfiability of the following Horn formulas.
- (a) $(\top \rightarrow p) \wedge (\top \rightarrow q) \wedge (s \rightarrow \perp) \wedge (p \wedge q \wedge r \rightarrow \perp) \wedge (t \rightarrow q) \wedge (\top \rightarrow u) \wedge (u \rightarrow t)$
 - (b) $(q \wedge s \rightarrow p) \wedge (p \wedge t \rightarrow \perp) \wedge (p \rightarrow t) \wedge (\top \rightarrow q) \wedge (r \rightarrow s) \wedge (\top \rightarrow r)$
- (2) 2. (a) Extend the lemma on **slide 29** with a fourth item for implication by transforming the formula

$$\varphi \leftrightarrow (\psi \rightarrow \chi)$$

into an equivalent CNF consisting of at most three clauses.

- (b) Use Tseitin's transformation to compute an equisatisfiable CNF of the formula

$$((p \rightarrow q) \wedge r) \vee \neg(p \rightarrow \neg r)$$

- (3) 3. Find the missing clauses such that the formula $a \leftrightarrow ((p \rightarrow q) \wedge (\neg p \rightarrow r))$ and the CNF

$$(a \vee p \vee \neg r) \wedge \boxed{} \wedge \boxed{} \wedge (\neg a \vee p \vee r)$$

are equivalent.

- (3) 4. Consider the map of Germany



- (a) Construct a CNF formula that is satisfiable if and only if the map of the Germany is 3-colorable.
- (b) Encode the formula of part (a) into DIMACS format and use a SAT solver to determine whether Germany is 3-colorable.