

Database Theory
Winter Term 2013/14
Prof. Dr. W. May

1. Unit: Kalkül I

Discussion by 13./14.11.2013

- Exercise 1 (FOL: Beweise)** a) Prove the equivalence of the expressions $\forall x : F(x)$ and $\neg\exists y : \neg F(y)$ by using the definition of the semantics of the formulas.
- b) Prove: if in some application, there is a causal relationship between a formula φ and another formula ψ (i.e., if for any state where φ holds, also ψ is satisfied), then also the *material implication* $\varphi \rightarrow \psi$ holds in every state that satisfies the specification.
- c) Give an example where the formula $\varphi \rightarrow \psi$ is satisfied without any causal relationship between them. sein kann, ohne dass ein kausaler Zusammenhang besteht.
- d) Give examples, where the material implication $\varphi \rightarrow \psi$ occurs in a reasonable way in a formula.

Exercise 2 (Kalkül: Sichere, Wertebereichsunabhängige Anfragen) Check for the following queries whether they are in SRNF (give $rr(G)$ for each of their subformulas).

Check also, whether the formulas are in RANF. If not, give an equivalent formula in RANF.

Give equivalent expressions in the relational algebra and in SQL (develop the SQL expressions both from the original formula and from the RANF formula).

- a) $F(X) = p(X, Y) \wedge (q(Y) \vee r(Z))$,
- b) $F(X) = p(X, Y) \wedge (q(Y) \vee r(X))$,
- c) $F(X, Y) = p(X, Y) \wedge \neg\exists Z : r(Y, Z)$,
- d) $F(X) = p(X) \wedge \exists Y : (q(Y) \wedge \neg r(X, Y))$,
- e) $F(X) = p(X) \wedge \neg\exists Y : (q(Y) \wedge \neg r(X, Y))$
- f) $F(X, Y) = \exists V : (r(V, X) \wedge \neg s(X, Y, V)) \wedge \exists W : (r(W, Y) \wedge \neg s(Y, X, W))$

Exercise 3 (Relationale Anfragen an Mondial: Schweizer Sprachen) Give expressions in the relational calculus for the following queries against the Mondial database. Compare with the same queries in the relational Algebra and in SQL.

- a) All codes of countries, in which some languages is spoken that is also spoken in Switzerland.
- b) All codes of countries, in which only languages are spoken that are not spoken in Switzerland.
- c) All codes of countries, in which only languages are spoken that are also spoken in Switzerland.
- d) All codes of countries in which all languages that are spoken in Switzerland are also spoken.