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Foundations of Query Languages
Summerterm 11
Discussion by 22.06.2011

3. First Order Queries

Exercise 1 (RA)

a) Express the join expression $R \bowtie_{A=B} S$ by a suitable combination of primitive relational operations

b) Same question for the intersection $R \cap S$.

Exercise 2 (RA)

Consider the relational schemas $R(A, B), P(C, D)$, and $Q(E, F)$ and the FO queries:

a) $S(x, y) \leftarrow R(x, z) \wedge R(z, y)$.

b) $S(x, y, z) \leftarrow R(x, y) \wedge P(x, z) \wedge Q(z, z)$.

c) $S(x, y) \leftarrow \exists z(R(x, y) \wedge (P(y, z) \vee Q(z, y)))$.

Find equivalent queries in Relational Algebra.

Exercise 3 (RA)

Assume we eliminate the difference operation (-) from the primitive operations of Relational Algebra, obtaining a sub-formalism RA^+, called Positive Relational Algebra, which consists of the operations selection, projection, cross product, rename, and union. Is $RA^+ = RA$? Explain your answer.

Exercise 4 (FO)

Say which of the Boolean queries on the Exercise slide entitled 'Exercise: FO Examples: True or False' evaluates to true.

Exercise 5 (FO, Complexity)

a) Is the combined complexity of a query language always as least as high as its query complexity?

b) Is the query complexity always as least as high as the data complexity?

In case of a yes answer explain why. In case of a no answer give a counterexample.

Exercise 6 (Logspace)

Outline how the projection and selection operations can be done in logarithmic space.

Exercise 7 (Logspace)

Show that logspace-reducibility is transitive, i.e., that whenever A can be reduced in deterministic logspace to B and B in turn to C, then A can be reduced in deterministic logspace to C. In other terms, show that deterministic logspace reductions are closed under composition. You do not need to spell out a complete formal proof. It would be sufficient, for example, to indicate why the straightforward approach to combine the two logspace transducers does not work, and to explain how the problem can be redressed.