CS633 Spring 06 — Problems 3

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16 Feb 06

These problems come from Chapter 4 of [AHV95].

1 Rule-based Conjunctive Queries with Equality

(From Exercise. 4.5)

a) Formally specify the syntax and semantics of rule-based conjunctive queries with equality.

b) Prove for each rule-based conjunctive query with equality q that either $q \equiv q^{\emptyset}$ or $q \equiv q'$ for some rule-based conjunctive query q' without equality. Give a polynomial time algorithm that decides whether $q \equiv q^{\emptyset}$, and if not, constructs an equivalent rule-based conjunctive query without equality.

c) Prove that each rule-based conjunctive query with equality but no constants is equivalent to a rule-based conjunctive query without equality.

2 SPC and Equality

(Exercise 4.16)

Consider the problem of defining a restricted version of the SPC algebra that is equivalent to rule-based conjunctive queries without equality. Find a natural restricted version, or argue why it should not exist.

3 "Or" Queries

(From Exercise 4.22)

The following queries are used in this exercise:

- (4.10) Where can I see "Annie Hall" or "Manhattan"?
- (4.11) What are the films with Woody Allen as actor or director?

- (4.12) What films with Woody Allen as actor or director are currently featured at the Concorde?
- (4.13) List all movies that were directed by Hitchcock or are currently playing at the Rex.
- (4.14) List all actors and director of the movie "Apocalypse Now."
- (4.15) Produce a binary relation that includes all tuples $\langle t, \text{excellent} \rangle$ where t is a movie directed by Woody Allen, and all tuples $\langle t, \text{superb} \rangle$ where t is a movie directed by Alfred Hitchcock.

a) Show that none of the queries (4.10-4.15) can be expressed using SPC algebra.

A *positive selection formula* for SPC algebra is a selection formula, except that disjunction can be used in addition to conjunction. Define *S+PC algebra* to be SPC algebra extended to permit arbitrary positive selection formulas.

b) Determine which of the queries (4.10-4.15) can be expressed in S+PC algebra.

Define the $SPC - 1^*$ *algebra* to be SPC algebra, except that nonsingleton unary constant relations can be used as base queries. Define the $SPC - n^*$ *algebra* to be SPC algebra, except that nonsingleton constant relations of any arity can be used as base queries.

c) Determine which of queries (4.10-4.15) can be expressed using the SPC-1^* and SPC-n^* algebras.

d) Determine the relative expressive power of the S+PC, SPC-1^*, SPC-n^* and SPCU algebras.