

3. Containment of Conjunctive Queries

Instructions: Work in groups of 2 students. You can write up your answers by hand (provided your handwriting is legible) or use a word processing system like Latex or Word. However, experience shows that Word is in general difficult to use for this kind of task. Please, include name and email address in your submission.

1. Conjunctive Queries without Self Joins

A conjunctive query has a *self join* if its body contains two relational atoms with the same relation symbol. Thus, in the body of a query without self join, any two relational atoms have distinct relation symbols.

We know that containment is NP-complete for arbitrary relational conjunctive queries and that containment is Π_2^P -complete for conjunctive queries with comparisons.

Question: How difficult is it to decide containment of conjunctive queries (possibly with comparisons) that have no self join? Can this problem be solved in polynomial time? Or is it NP-complete? Or even Π_2^P -complete? (Consider only the case that the comparisons range over the rational numbers.)

Hint 1: First, find a characterizing property of containment for this class of queries. Then assess the difficulty of checking this property.

Hint 2: Consider first the case of queries without comparisons, and then study queries with comparisons. For queries with comparisons you can assume that queries and comparison sets are *reduced* in the following sense: a set of comparisons M is *reduced*, if for all terms s, t it holds that $M \models s = t$ only if s and t are syntactically equal; a conjunctive query is *reduced* if its comparisons are reduced. Note that every satisfiable query can be equivalently rewritten as a reduced query in polynomial time.

(10 Points)

2. Conjunctive Queries with Disequalities

A disequality is an atom of the form “ $s \neq t$ ”. The class of conjunctive queries with disequalities consists of the conjunctive queries with the property that all their built-in atoms are disequalities.

Question: How difficult is to decide containment of conjunctive queries with disequalities?

Hint 1: First, find a characterizing property of containment for this class of queries. Then use this property to establish an upper complexity bound for the problem.

Hint 2: It is highly likely that you can reuse ideas from the analysis of the containment problem for conjunctive queries with comparisons in the lecture slides.

(20 Points)

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