

On the Decidability and Axiomatization of Query Finiteness in Deductive Databases*

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Abstract

A database query is *finite*¹ if its result consists of a finite set of tuples. For queries formulated as sets of pure Horn rules, the problem of determining finiteness is, in general, undecidable.

In this paper we consider *superfiniteness*—a stronger kind of finiteness, which applies to Horn queries whose function symbols are replaced by the abstraction of *infinite relations* with *finiteness constraints* (abbr., FC's). We show that superfiniteness is not only decidable but also *axiomatizable*, and the axiomatization yields an effective decision procedure. Although there are finite queries that are not superfinite, we demonstrate that superfinite queries represent an interesting and nontrivial subclass within the class of all finite queries.

Then we turn to the issue of inference of finiteness constraints—an important practical problem that is instrumental in deciding if a query is evaluable by a bottom-up algorithm. Although it is not known whether FC-entailment is decidable for function-free Horn programs, we show that *super-entailment*, a stronger form of entailment, is decidable. We also show how a decision procedure for super-entailment can be used to enhance tests for query finiteness.

Categories and Subject Descriptors: H.2.1 [Database Management]: Systems – *query processing*; I.2.3 [Computing Methodologies]: Deduction and Theorem Proving – *logic programming*.

General Terms: Algorithms, languages, theory.

Additional Keywords and Phrases: Query processing, finiteness constraints, finite queries, horizontal decompositions, partial constraints, computability, axiomatization.

1 Introduction

Query evaluation has been central to deductive database research since the inception of the field. It is known that queries specified via sets of function-free Horn clauses are evaluable in finite time.

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¹Finiteness is often called “safety”. We use the term “finiteness” since “safety” is overloaded, and finiteness seems to be a more appropriate name for the concept at hand.