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A rule-based language for Web data management*

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ABSTRACT

There is a new trend to use Datalog-style rule-based languages to specify modern distributed applications, notably on the Web. We introduce here such a language for a distributed data model where peers exchange messages (i.e. logical facts) as well as rules. The model is formally defined and its interest for distributed data management is illustrated through a variety of examples. A contribution of our work is a study of the impact on expressiveness of "delegations" (the installation of rules by a peer in some other peer) and explicit timestamps. We also validate the semantics of our model by showing that under certain natural conditions, our semantics converges to the same semantics as the centralized system with the same rules. Indeed, we show this is even true when updates are considered.

Categories and Subject Descriptors

H.2.4 [**Information Systems**]: Database Management—*Systems, Distributed databases*

General Terms

Languages, Theory

Keywords

Datalog, Delegation, Distribution, Web

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1. INTRODUCTION

The management of modern distributed information, notably on the Web, is a challenging problem. Because of its complexity, there has recently been a trend towards using high-level Datalog-style rules to specify such applications. We introduce here a model for distributed computation where peers exchange messages (i.e. logical facts) as well as rules. The model provides a novel setting with a strong emphasis on dynamicity and interactions (in a Web 2.0 style). Because the model is powerful, it provides a clean basis for the specification of complex distributed applications. Because it is simple, it provides a formal framework for studying many facets of the problem such as distribution, concurrency, and expressivity in the context of distributed autonomous peers.

In recent years, there has been renewed interest in studying languages in the Datalog family for a wide range of applications ranging from program analysis, to security and privacy protocols, to natural language processing, or multiplayer games. For references see [17] and the forthcoming proceedings of the Datalog 2.0 workshop [15]. We are concerned here with using rule-based languages for the management of data in distributed settings, as in web applications [2, 7, 13, 4], networking [21, 20, 16] or distributed systems [22]. The arguments in favor of using Datalog-style specifications for complex distributed applications are the familiar ones, cf. [17].

A main contribution of the paper is a new model for distributed data management that combines in a formal setting deductive rules as in Datalog with negation, cf. [12] (to specify intensional data) and active rules as in Datalog¬¬ [8] (for updates and communications). There have already been a number of proposals for combining active and deductive features in a rule-based language; see [19, 17] and our discussion of related work. However, there is yet to be a consensus on the most appropriate such language. We therefore believe that there is a need to continue investigating novel language features adapted to modern data management and to formally study the properties of the resulting new models.

The language we introduce, called Webdamlog, is tailored to facilitate the specification of data exchange between autonomous peers, which is essential to the applications we have in mind. Towards that goal, the novel feature we in-

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