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Querying Temporal Databases via OWL 2 QL

Abstract

SQL:2011, the most recently adopted version of the SQL query language, has unprecedently standardized the representation of temporal data in relational databases. Following the successful paradigm of ontology-based data access, we develop a practical approach to querying the SQL:2011-based temporal data model via the semantic layer of OWL 2 QL. The interval-based *temporal query language* (TQL), which we propose for this task, is based on naturally characterizable combinations of temporal logic with conjunctive queries. As the central contribution, we present rules for sound and complete rewriting of TQL queries into two-sorted first-order logic, and consequently, into corresponding SQL queries, which can be evaluated in any existing relational database management system compliant with the SQL:2011 temporal data model. Importantly, the proposed rewriting is based on the direct reuse of the standard rewriting techniques for conjunctive queries under OWL 2 QL. This renders our approach modular and easily implementable. As a notable corollary, we show that the data complexity of TQL query answering remains in AC⁰, i.e., as in the usual, non-temporal case.

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Querying Temporal Databases via OWL 2 QL

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Abstract. SQL:2011, the most recently adopted version of the SQL query language, has unprecedently standardized the representation of temporal data in relational databases. Following the successful paradigm of ontology-based data access, we develop a practical approach to querying the SQL:2011-based temporal data model via the semantic layer of

OWL 2 QL. The interval-based *temporal query language* (TQL), which we propose for this task, is based on naturally characterizable combinations of temporal logic with conjunctive queries. As the central contribution, we present rules for sound and complete rewriting of TQL queries into two-sorted first-order logic, and consequently, into corresponding SQL queries, which can be evaluated in any existing relational database management system compliant with the SQL:2011 temporal data model. Importantly, the proposed rewriting is based on the direct reuse of the standard rewriting techniques for conjunctive queries under OWL 2 QL. This renders our approach modular and easily implementable. As a notable corollary, we show that the data complexity of TQL query answering remains in AC^0 , i.e., as in the usual, non-temporal case.

1 Introduction

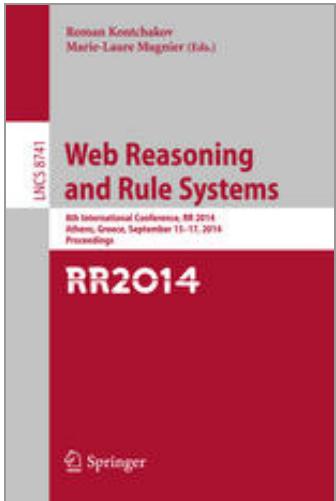
The ability to manage the temporal aspects of information is critical for a variety of applications. One natural and prevailing scenario is that of representing and querying the *validity time* of data, i.e., the time during which data is deemed true about the application domain. The significance of this task is particularly visible in the area of semantic technologies, where the systematically growing number of proposed solutions, building on different levels of the Semantic Web architecture and differing in the flavour and depth of temporal reasoning they support, aim at addressing essentially the same problem [15, 14, 5, 22, 7, 2]. A very similar proliferation of proposals was witnessed in the 1990s in the field of temporal databases. Intensive attempts to extend the traditional relational data model and SQL with temporal features inspired then a large body of candidate specifications, including such extensions as TSQL2, SQL3 or SQL/Temporal [24], which eventually failed to be adopted by the database community due to the persistent lack of consensus as to the preferred approach. Only very recently, that discussion has been picked up again and a compromise temporal extension has eventually found its way into SQL:2011 [20] — the newest standardization

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