Rules for Mapping SQL Relational Databases to OWL Ontologies

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Abstract This paper proposes an approach to automatic transformation of relational databases to ontologies, where constraints `CHECK` are also considered. A relational database is written in SQL and an ontology is written in OWL. The proposed approach can be used for integrating data that are scattered across many different domains and that reside in many separate relational databases.

1 Introduction

Today it is common to get data from a relational database whose structure is defined by a relational database schema. However, relational databases are generally separate and not easily used as merged data sources. Relational database schemas are created independently for each relational database. Even if a million companies clone the same form of relational database, there will be a million relational database schemas, one for each relational database.

On the other hand, many in the science of data integration search for ways to unify the description and retrieval of data in relational databases, by using ontologies. There are several benefits of using ontologies for data integration; e.g.:

- Ontologies provide the ability to recognize inconsistency and redundancy of data in relational databases [1].
- Ontologies are sufficiently comprehensive to support shared common understanding and mapping of data in relational databases [1].
- Ontologies provide a rich predefined vocabulary of the terms used in relational databases. This vocabulary serves as a stable conceptual interface to relational databases and is independent of relational database schemas [1].
- Ontologies provide the ability to express the equivalence of the terms used in relational databases [2].

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Since ontologies are important to data integration, there is a need to transform relational databases to ontologies. However, manual transformation is hard to do and often takes a lot of time. Thus, there is also a need to automate this transformation. Therefore, this paper proposes an approach to automatic transformation of relational databases (written in SQL [3]) to ontologies (written in OWL [4]).

2 Approach

While there are several approaches to transforming relational databases to ontologies (e.g. [5], [6], [7] and [8]), many data integration scenarios are too complex or require more flexibility than the existing approaches enable. E.g. none of the existing approaches can identify (inverse) functional properties, value restrictions and enumerated data types.

Fig. 1 illustrates the basic idea behind the proposed approach. A relational database is transformed to an ontology using a set of rules called *mapping rules*. These rules relate constructs of a relational model (i.e. tables, columns, constraints, and rows) to those of an ontological model (i.e. classes, properties, inheritance, restrictions, and instances). The mapping rules are then applied to the relational database (source) to produce the ontology (target). Since the mapping rules are specified on the model level, they are applicable to any relational database that conforms to the relational model.

Next the mapping rules will be illustrated by example. An example is the relational database of a company.

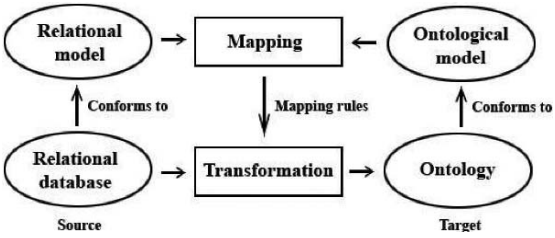

Fig. 1. Transformation of relational databases to ontologies.

2.1 Mapping Tables

A table is mapped to a class unless all its columns are foreign keys to two other tables. Then it is mapped to two object properties (one is an inverse of another).