Mapping Relational Database Schemas to Ontologies

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Introduction

We are moving toward having an extension of the current web, the Semantic Web, with the goal of bringing structure to meaningful content of web pages which results in better cooperation of computers and people .

To function, computers must have access to structured collections of information and required sets of inference rules to be able to conduct automated reasoning.

To organize information, ontologies can be used. Ontologies, which are considered as one of the fundamental building blocks of the Semantic Web, are explicit formal specifications of concepts within a domain, and relationships between them. Sharing common understanding of the structure of information among people or software agents is one of the more common goals in developing ontologies. The vocabulary of the Semantic Web can be considered as a special form of, usually light-weight, ontology.

Still, the majority of the data found in the current web is stored in relational databases. It is essential to work to improve the interoperability between ontologies and the Semantic Web applications using relational databases.

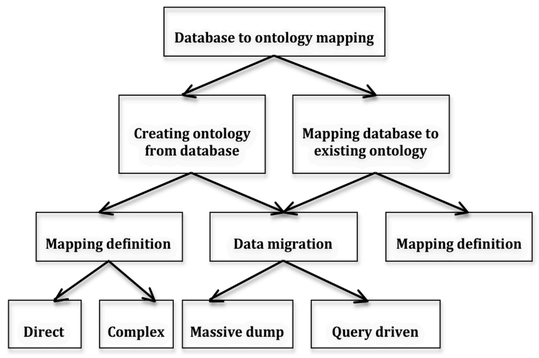

Figure 2. Classification of database to ontology mapping approaches (Ghawi & Cullot, 2007).

Problem Statement

In my research, I am working on the problem of mapping relational database schemas to ontologies (Figure 1, 2). The process by which at a conceptual level a database and an ontology are semantically related and correspondences are established between database components and ontology components.

One issue about the existing tools is that user specifies simple mappings between the relational database schema and the ontology manually. It works when ontologies and database schemas are not large and user is familiar with naming conventions of them.

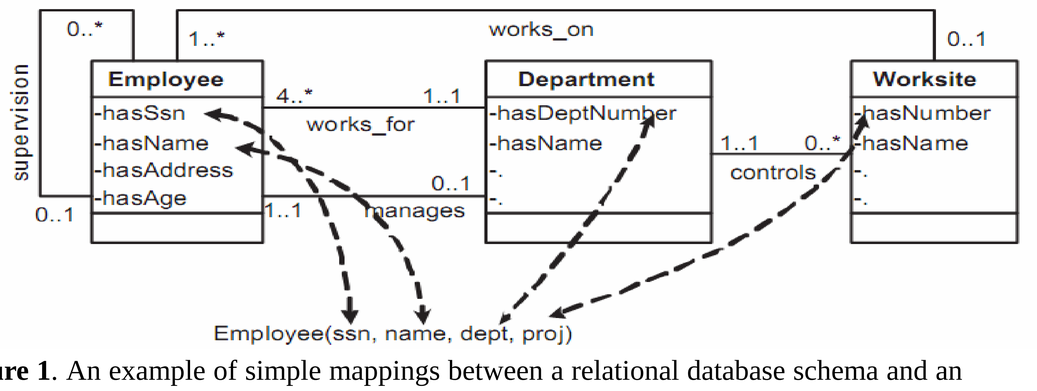

Figure 1. An example of simple mappings between a relational database schema and an ontology (An, Borgida, & Mylopoulos, 2005).

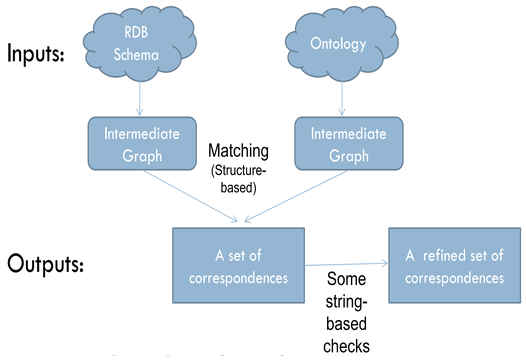

Figure 3. The proposed mapping idea

Materials and methods

I propose a new idea of finding mappings between a relational database schema and an existing ontology.

The idea (Figure 3) is to create two intermediate graphs, with the same properties, from the relational database schema and the ontology. Then compare the structure of two graphs with each other and try to find isomorphic sub-graphs by applying graph algorithms. The last step is to do some linguistic checks by following some predefined rules. One of the predefined rules can be: compare the name of the nodes in two graphs which have the same number of children.

To test the proposed approach, one method can be to repeat the process in reverse. It means to construct the relational database schema and the ontology from intermediate graphs and compare results with original ones. If they are equivalent, there is a high probability that the algorithm can work correctly on any inputs.

The results of the proposed approach will be compared to other approaches in which the linguistic checks are done prior to the structure check.

Another problem in finding mappings between relational database schemas and ontologies is that inheritance is not expressed in relational databases but it can be modeled, in different ways, in database schemas. However, it is expressed explicitly within ontologies. In my approach I suggest the use of WordNet, a large lexical database of English, as an external source to find name hierarchies and check for possible inheritances.

Real-world Applications

One of the essential requirements to evolve from the current Web of documents to the web of data or the Semantic Web is the inclusion of the vast quantities of data stored in Relational Databases. This has led to the implementation of generic mapping tools, such as MapOnto, as well as domain specific applications.

Data integration, or semantic data integration in our case, is relevant to a number of applications including medical information management, geographical information systems, and E-Commerce applications.

Selected Bibliography

Yuan An, Alexander Borgida, and John Mylopoulos, “Inferring Complex Semantic Mappings Between Relational Tables and Ontologies from Simple Correspondences,” OTM Conferences, Agia Napa, Cyprus, 2005, pp. 1152-1169.

R. Ghawi and N.Cullot, “Database-to-Ontology Mapping Generation for Semantic Interoperability,” 3rd International Workshop on Database Interoperability, *Vienna*, Austria, 2007.

Sataya S. Sahoo *et al.*, “A Survey of Current Approaches for Mapping of Relational Databases to RDF,” W3C RDB2RDF XG Report, January 2009.

For further information

Please contact *yassaman.zand@unb.ca*. More information on this and related projects can be obtained at:
http://www.unbsj.ca/sase/csas/data/awoss2-2010/AWOSS_Yassaman Zand-Moghaddam.pdf.