Ontology-Based Data Access and Constraint Satisfaction

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Abstract

In recent years, the use of ontologies (=logical theories) to access instance data has become increasingly popular. The general idea is that an ontology provides a vocabulary or conceptual model for the application domain, which can then be used as an interface for querying instance data and to derive additional facts [2, 6].

In this presentation, I will introduce ontology-based data access for ontologies given in description logics and investigate the following non-uniform complexity problem: what is the data complexity of conjunctive query answering for a fixed ontology? I will present general conditions under which this problem is in PTime and, respectively, coNP-hard. Then it is shown that for the basic description logic $\mathcal{ALC}$ (=modal logic), conjunctive query answering is equivalent to solving constraint satisfaction problems with finite templates. Examples of consequences of this result include: (i) a P/coNP dichotomy holds for conjunctive query answering with $\mathcal{ALC}$ if, and only if, Feder and Vardi's dichotomy conjecture [3] for constraints satisfaction problems holds; (ii) first-order constraint satisfaction problems investigated and characterized in [4] correspond exactly to reductions of ontology based data access with $\mathcal{ALC}$ to standard query answering over relational databases known as FO-rewriting.

By employing results from [1], we also show that if functional relations are added to $\mathcal{ALC}$, then the word problem of every non-deterministic polynomial time Turing Machine can be reduced to conjunctive query answering. Thus, by Ladner's Theorem, ontologies with coNP-intermediate conjunctive query answering exist.

The talk is based on joint work with Carsten Lutz. Preliminary results are published in [5].

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