Abstract

Title: Reasoning in Description Logics
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Abstract: We deal with several aspects of reasoning in Description Logics.

First, since description logic (DL) is a subset of First Order Logic (FOL), we use a FOL reasoner to reason in DL. We implemented *dl2fol*, a DL reasoner that takes an ontology (a DL theory with rules), translates it into a FOL theory, passes this set of formulae to an underling FOL reasoner, and interprets the result in terms of given ontology. This is an effective method for reasoning with newly introduced language constructors. However, we observed longer running times and that satisfiability of some DL concepts wasn't proved due to FOL undecidability.

Second, we extend two DLs by introducing new language construct: cartesian product (CP) of concepts and roles. This allows for expressing relationships, that are not expressible by other means in weaker DLs. We show how CP axioms can be reduced using other language constructs in $\mathcal{SROIQ}$. We present a polynomial algorithm for subsumption checking in $\mathcal{EL}^{++}$ with CP axioms. We prove that the introduction of CP does not increase the complexity of reasoning tasks in both $\mathcal{SROIQ}$ and $\mathcal{EL}^{++}$. We extend *dl2fol* to provide reasoning with CP.

Third, to deal with nonmonotonic aspects we introduce the DL of minimal knowledge and negation (MKNF-DL) as failure — an extension of DLs with modal operators **K** and **A**. We show how typical nonmonotonic reasoning tasks (epistemic queries, integrity constraints, and default rules) can be expressed in MKNF-DL. For satisfiability checking, we present two algorithms. 1. The general algorithm, which demonstrates our approach and we prove its correctness. This algorithm is unsuitable for practical application and is used to introduce 2. the tableaux algorithm with blocking. This blocking technique allows reasoning about a larger class of ontologies than was earlier possible.