Goal-oriented Type-based Reasoning for Expressive DLs*

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Reasoning in expressive Description Logics (DLs) that contain $\mathcal{ALC}$ is challenging, partly because they do not enjoy the useful universal model property of their Horn counterparts. There are efficient state-of-the-art reasoners for standard reasoning tasks, but they are still lacking for other tasks that do not reduce easily to satisfiability. For instance, for query answering, there are a few algorithms for computing *(data-independent) Datalog rewritings*. They take as an input a query and a TBox, and compile them into a Datalog query that can be evaluated over different ABoxes, e.g., [3, 2, 1]. Query rewriting is often considered the most promising approach to achieve scalable query answering beyond plain instance queries. However, most of the Datalog rewritings proposed so far for expressive DLs, especially those for answering *conjunctive queries*, are for theoretical purposes (e.g., for showing complexity bounds), and aren't amenable to implementation. Implicitly, this is due to the fact that they embed a representation of all relevant models of the TBox, for any input ABox.

In this work we aim at finding a middle ground between data-independence and practicability, one the assumption that real datasets are not arbitrary, but only use a limited number of local configurations of concepts that we call *profiles*. We propose a goal-oriented algorithm to compute, from a given set of profiles, the local configurations of concepts (known as *types*) that occur in the set of all the models that are relevant for query answering, for any ABox that uses only the initial profiles. With these types we build a disjunctive Datalog program (with negation) that yields the correct answer to any instance query. The rewriting does not depend on a concrete ABox, but only on the profiles. The experiments carried out with a prototype implementation of our technique yielded promising results. We observed that, over a large range of ontologies, ABoxes use only a moderate set of profiles. The type computation is feasible, even for large ontologies; the computed Datalog rewriting is of moderate size, and its execution is efficient. An extension to conjunctive queries is being developed. We hope this work may inspire more exploration of the 'middle ground' between data-independent and data-centric reasoning, and bring us closer to sound and complete query answering engines for expressive DLs.

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