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Title of the dissertation: Inline Evaluation of Hybrid Knowledge Bases

Abstract of the dissertation:

The deployment of knowledge representation formalisms to the Web has created the need for hybrid formalisms that combine heterogeneous knowledge bases (KBs). In the context of Semantic Web, two families of logics are of great importance. One family is Description Logics (DLs) based ontologies, and the other is rule-based logic programming. Loose coupling of rules and ontologies aims at combining respective knowledge bases by means of a clean interfacing semantics. This approach is fostered by dl-programs.

Because of the loose coupling nature, one can build engines for dl-programs on top of legacy reasoners. Although this architecture is very elegant, the performance of this implementation is suboptimal. We observe that the overhead of calling external reasoners in the classical approach can be the bottleneck of the performance.

To improve the reasoning efficiency over hybrid KBs, we propose a new strategy, called inline evaluation, which compiles the whole hybrid KB into a new KB using only one single formalism. Hence we can use a single reasoner to do the reasoning tasks, and improve the efficiency of hybrid reasoning. In the case of dl-programs, we design an abstract framework rewriting dl-programs to Datalog program with negation. The reduction is sound and complete when the DL ontologies are "Datalog-rewritable". We show that many DLs are Datalog-rewritable by introducing concrete rewriting algorithms.

To confirm the hypothesis that the inline evaluation is superior to the classical approach, we implement the inline evaluation method in the novel DReW system for dl-programs. We conduct extensive evaluations on several benchmark suites and show that DReW system outperforms the classical approach in general, especially for dl-programs of complex structures or with large instances.