A Resolution Based Framework to Explain Reasoning in Description Logics

Xi Deng and Volker Haarslev and Nematollaah Shiri

Concordia University
Dept. of Computer Science & Software Engineering, Montreal, Canada
{xi_deng,haarslev,shiri}@cse.concordia.ca

As more complex applications are developed in Description Logics (DL), providing explanation services for DL reasoners becomes more crucial. We propose to use resolution proofs to construct explanations for unsatisfiability and inconsistency problems. Our approach is based on the observation that compared to natural deduction proofs, resolution technique is more focused, as all the literals involved in a proof contribute directly to the solution. Moreover, resolution can easily deal with global axioms (TBoxes) and assertions (ABoxes) which facilitates providing explanations w.r.t TBoxes and ABoxes.

Our proposed explanation procedure[1] is described as follows. First the explanation system communicates with a DL reasoner and retrieves the answer of a query. In the circumstances of unsatisfiability or inconsistency queries, the original DL axioms/assertions will be translated into first-order logic (FOL) formulas or clauses by the translation component. Then a resolution-based automated theorem prover is used to generate resolution proofs, taking the translated formulas or clauses as the input. The proofs are then sent back to the explanation module to be transformed for better human understanding. Since the order of selecting clauses during the resolution procedure has significant effect on the quality of explanations and it is difficult to be fully controlled, our approach uses a refutation graph as a guide for this transformation. A refutation graph is a graph whose nodes are literals (grouped together in clauses) and its edges connect contradictory literals. In such a graph, contradictory literals between input clauses are directly visible, which can be used as heuristics to guide the explanation process. The main idea of explanation based on the refutation graph is to start from a literal node (or nodes) and traverse the graph. The traversal order is decided by a preference assigned to each node. For example, the axiom $A \sqsubseteq B$ is more appropriate to be considered as an inference rule to explain B is the consequence of A than considering $\neg A$ is the consequence of $\neg B$, and hence accordingly there is a preference to start from A instead of B. Finally, the resolution proof is traced back to the contributing FOL formulas and later transformed into natural language explanations.

We are planning to extend our work to explain subsumption, satisfiability, and non subsumption queries. An implementation of the proposed framework is underway.

[1] Details can be found in "Explanation of Reasoning in Description Logics", to appear in Proc. of Int'l Symposium on Explanation-Aware Computing (ExaCT 2005).