Abstract

In the last years, the vision of the Semantic Web fostered the interest in reasoning over growing sets of assertional statements in ontologies. Traditional tableau-based reasoning systems have problems to answer queries over large ontological data sets because these reasoning systems are based on efficient use of main memory data structures. Increasing expressivity and worst-case complexity further tighten the memory burden. The purpose of this thesis was to investigate how to release the main memory burden from tableau-based reasoning systems and perform efficient instance checking and instance retrieval over semi-expressive ontologies.

The key idea was to reduce instance checking for an individual in an ontology to smaller subsets of relevant axioms. Modularization techniques were introduced and further refined in order to reduce the module size. Instance retrieval performance was addressed by defining similarity criteria over individuals and their modules. Finally, this thesis investigated techniques to preserve modularizations under syntactic ontology updates.

For evaluation purposes, experiments on benchmark and real world ontologies were carried out. Modularization techniques gave rise to a distributed implementation for solving instance checking and retrieval problems. The principal conclusion is that the main memory dependency for instance checking and instance retrieval can be released from tableau-based reasoning systems for semi-expressive ontologies in practice.