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Ontology Integration with Non-Violation Check and Context Extraction

DAN WU

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Abstract

Matching and integrating ontologies has been a desirable technique in areas such as data fusion, knowledge integration, the Semantic Web and the development of advanced services in distributed system. Unfortunately, the heterogeneities of ontologies cause big obstacles in the development of this technique.

This licentiate thesis describes an approach to tackle the problem of ontology integration using description logics and production rules, both on a syntactic level and on a semantic level. Concepts in ontologies are matched and integrated to generate ontology intersections. Context is extracted and rules for handling heterogeneous ontology reasoning with contexts are developed.

Ontologies are integrated by two processes. The first integration is to generate an ontology intersection from two OWL ontologies. The result is an ontology intersection, which is an independent ontology containing non-contradictory assertions based on the original ontologies. The second integration is carried out by rules that extract context, such as ontology content and ontology description data, e.g. time and ontology creator. The integration is designed for conceptual ontology integration. The information of instances isn't considered, neither in the integrating process nor in the integrating results.

An ontology reasoner is used in the integration process for non-violation check of two OWL ontologies and a rule engine for handling conflicts according to production rules. The ontology reasoner checks the satisfiability of concepts with the help of anchors, i.e. synonyms and string-identical entities; production rules are applied to integrate ontologies, with the constraint that the original ontologies should not be violated.

The second integration process is carried out with production rules with context data of the ontologies. Ontology reasoning, in a repository, is conducted within the boundary of each ontology. Nonetheless, with context rules, reasoning is carried out across ontologies. The contents of an ontology provide context for its defined entities and are extracted to provide context with the help of an ontology reasoner. Metadata of ontologies are criteria that are useful for describing ontologies. Rules using context, also called context rules, are developed and in-built in the repository. New rules can also be added.

The scientific contribution of the thesis is the suggested approach applying semantic based techniques to provide a complementary method for ontology matching and integrating semantically. With the illustration of the ontology integration process and the context rules and a few manually integrated ontology results, the approach shows the potential to help to develop advanced knowledge-based services.

Keywords

ontology matching and integration, semantic and pragmatic matching,
semantic techniques, context, ontology and rules