A FORMAL MODELING APPROACH TO ONTOLOGY ENGINEERING

MODELING, TRANSFORMATION & VERIFICATION

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Summary

The Semantic Web has been regarded by many as the new generation of the World Wide Web. It enables software agents on the Web to autonomously and collaboratively understand, process and aggregate information by giving Web resources well-defined and machine-interpretable markups, in the form of ontologies.

Ensuring the correctness of ontologies is very important as inconsistent ontologies may lead software agents to reason erroneously. Such tasks are non trivial as the more expressive ontology languages are, the less automated are the reasoners/provers and with the growth of the size of ontologies, locating inconsistencies is also more difficult.

Further, as the expressivity of these languages is also limited in more than one way, certain desirable ontology-related properties cannot be expressed in these languages. The ability to express and check these properties will make ontologies more accurate and more robust. It is therefore highly desirable.

Dynamic Web services help make the Web truly ubiquitous. In the Semantic Web, service ontologies describe the capabilities, requirements, control structures, etc., of Web services. Their consistency must also be guaranteed to ensure the correct functioning of software agents.

Software engineering and in particular formal methods are an active and well-developed research area. We believe that mature formal methods and their tool support can contribute to the development of the Semantic Web. This thesis presents a formal modeling approach for verifying ontologies. By defining semantics of ontology languages in expressive formal languages, their proof tools can be used to ensure the correctness of ontology-related properties.

The validity of the above approach entirely relies on the correctness of the semantics of ontology languages in formal methods. Hence, the other important topic in this thesis is the proof of such correctness. An abstract approach using institutions and institution morphisms is employed to represent and reason about ontology languages and formal languages. An integrated tools environment is also presented to facilitate the application of the verification approach.

Key words: **Semantic Web, DAML+OIL, institutions, ontology, OWL, verification, Z, LSC**

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