Chapter XIII

An Extensible Approach for Modeling Ontologies in RDF(S)

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INTRODUCTION

The development of the World Wide Web is about to mature from a technical platform that allows for the transportation of information from sources to humans (albeit in many syntactic formats) to the communication of knowledge from Web sources to machines. The knowledge food chain has started with technical protocols and preliminary formats for information presentation (HTML–HyperText Markup Language) over a general methodology for separating information contents from layout (XML–eXtensible Markup Language, XSL–eXtensible Stylesheet Language) to reach the realms of knowledge provisioning by the means of RDF and RDFS.

RDF (Resource Description Framework) is a W3C recommendation (Lassila & Swick, 1999) that provides description facilities for knowledge pieces, viz., for triples that denote relations between pairs of objects. To exchange and process RDF models they can be serialized in XML. RDF exploits the means of XML to allow for disjoint namespaces, linking and referring between namespaces and, hence, is a general methodology for sharing machine-processable knowledge in a distributed setting. On top of RDF the simple schema language RDFS (Resource Description Framework...
Schema; Brickley & Guha, 1999) has been defined to offer a distinguished vocabulary to model class and property hierarchies and other basic schema primitives that can be referred to from RDF models. To phrase the role of RDFS in knowledge engineering terminology, it defines a simple ontology that particular RDF documents may be checked against to determine consistency.

Ontologies have shown their usefulness in application areas such as intelligent information integration or information brokering. Therefore their use is highly interesting for Web applications, which may also profit from long-term experiences made in the knowledge acquisition community. At the same time, this is a great chance for the knowledge acquisition community as RDF(S) may turn knowledge engineering, so far a niche technology, into a technological and methodological powerhouse. Nevertheless, while support for modeling of ontological concepts and relations has been extensively provided in RDF(S), the same cannot be said about the modeling of ontological axioms—one of the key ingredients in ontology definitions and one of the major benefits of ontology applications.

RDF(S) offers only the most basic modeling primitives for ontology modeling. Even though there are good and bad choices for particular formal languages, one must face the principal trade-off between tractability and expressiveness of a language. RDF(S) has been placed nearer to the low end of expressiveness, because it has been conceived to be applicable to vast Web resources! In contrast to common knowledge representation languages, RDF(S) has not been meant to be the definitive answer to all knowledge representation problems, but rather an extensible core language. The namespace and reification mechanisms of RDF(S) allow (communities of) users to define their very own standards in RDF(S) format—extending the core definitions and semantics. As RDF(S) leaves the well-trodden paths of knowledge engineering at this point, we must reconsider crucial issues concerning ontology modeling and ontology applications. To name but a few, we mention the problem of merging and mapping between namespaces, scalability issues, or the definition and usage of ontological axioms.

In this paper we concentrate on the latter, namely on how to model axioms in RDF(S) following the stipulations, (i) that the core semantics of RDF(S) is reused such that “pure” RDF(S) applications may still process the core object-model definitions, (ii) that the semantics is preserved between different inferencing tools (at least to a large stretch), and (iii) that axiom modeling is adaptable to reflect diverging needs of different communities. Current proposals neglect or even conflict with one or several of these requirements. For instance, the first requirement is violated by the ontology exchange language
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