Chapter II
Aristotelian Ontologies and OWL Modeling

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ABSTRACT

This chapter shows how the Aristotelian or epistemological approach to ontologies can be understood in the framework of recent domain ontology modeling languages like the Web ontology language (OWL). After a short introduction to the specific properties of the Aristotelian approach to ontological modelling, we discuss one detailed example of a reformulation of such an ontology with OWL. In the final discussion, we give some indications concerning the differences in applying an epistemological vs. a more common object oriented approach to domain knowledge engineering in practice.

INTRODUCTION

More and more industrial applications rely on communication between interacting components or actors like people in global teams, cooperating organizations, and collaborating software systems. In recent years, buzzwords like on-demand business (coined by IBM) have marked the increasing importance of dynamic composition of services for global offerings of products and services.

For business interactions involving mostly or at least partially human communication, a general necessity related to the high degrees of business interaction interoperability needed in modern service-based businesses is common understanding between agents participating in the interaction—understanding here taken in a very broad sense of the word (excluding mere translation issues between natural languages, however). If all agents use their own description conventions for business objects and relationships
with proprietary terms and meanings, cooperation or collaboration becomes extremely difficult. As a consequence, without a semantic level of shared understanding, only very limited interoperability on the business level can be reached.

The most promising way to address the problem of common understanding, that is, a representation of agreed knowledge of actors from different partners to be used for business interaction, is to define formal ontologies, understood as an agreed vocabulary of common terms and meanings shared by a group of interaction participants. In recent years, the Web ontology language (OWL) has become one de facto standard for formal ontologies. Beyond supporting development of editors for ontology building, OWL is XML-serializable and therefore allows ontologies to be shared and to be represented using an interchangeable format (Smith, Welty, Volz, and McGuinness, 2003; Bechhofer et al., 2004). OWL can be used in three dialects, one of which can be made equivalent to various dialects of description logic (Baader, Calvanese, McGuinness, Nardi, & Patel-Schneider, 2003).

From a domain specific point of view, logic oriented ontology languages with interchangeable formats like OWL do not provide sufficiently precise guidelines for ontology-building from expert knowledge. A prominent case in point is the gene ontology, as Smith (2004) has shown. Being one example of a real world ontology used for enabling data interchange and data mining across heterogeneous representation standards in the life sciences laboratories of different countries and different expertise, this ontology lacks some fundamental semantic properties that are necessary to ensure consistency and correctness of logical inferences. These problems relate to issues like the distinction of sub/superclasses from that of a part/whole relationship. For details, see Smith (2004) and further references mentioned there. Relating to domain semantics, they cannot be discovered by offering mere description logic based ontology representation language.

For business interactions involving computer systems, Web services have allowed an unprecedented level of interoperability (Zimmermann, Tomlinson, & Peuser, 2003). The Web services protocol stack contains WSDL as a common language for service interface and implementation descriptions. This enables the necessary degree of common understanding in many cases. However, if services are to be composed on the basis of textual or other semantic description criteria, the interface definition is not sufficient to establish interoperability. Therefore, research into semantic Web services has proposed additional description languages. To be more specific, there are many categorization systems for business entities and business services that can be used as descriptors in UDDI (Bellwood et al., 2004). These categorizations are only a first step towards an encompassing semantic layer on top of the Web services protocol stack. OWL-S (The OWL Services Coalition, 2003) embeds service categories in service profiles that comprise input/output relations, preconditions, and effects, as well. The Web services modeling ontology WSMO (Fensel et al., 2006), proposes several metaclasses for semantic Web services modeling, among which goals, capabilities, and mediators are the most prevailing. Both OWL-S and WSMO rely on ontologies providing agreed concepts and relationships within an interaction domain. The semantic layer defined in this way can be extended to provide semantic descriptions of business processes like those modeled in the business process execution language (BPEL). Using semantic frameworks for description of real services and their interactions can enable shared understanding on the business and on the technical level. This can be accomplished by suitably annotating Web service definitions with related business goals and by implementing mediation components that allow identification of partner services fitting a given semantic description and plug them into a given service.

In the present chapter, we will focus on ontologies for at least partially human driven business interactions. A general answer to the problem of defining languages suitable for establishing common understanding could be searched by looking at theories of concepts and definitions like in Margolis (1999), which, due to being rooted either in the analysis of natural
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