Chapter 4

Representation of Action is a Primary Requirement in Ontologies for Interoperating Information Systems

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ABSTRACT

Ontologies at the present time are generally rich data models. The interoperating information system engineering paradigm Service-Oriented Architecture recognizes that the key issue in interoperating information systems is the actions performed by these systems, not so much the data. Further, the organizationally heterogeneous nature of these interoperating systems means that the individual object is difficult to characterize by classes. This chapter investigates the problems raised by giving priority in ontology representation to individuals and actions over classes, outlining a number of significant research questions in representation languages for ontologies.

INTRODUCTION

There are several different definitions of ontology, depending on one’s point of view. A very widely cited definition, “An ontology is an explicit specification of a conceptualization” (Gruber, 1993), comes from what amounts to the software engineering community. What this means in practice is that an ontology is a collection of objects modeled in some more or less formal language, such as UML or OWL (“explicit specification”). What the objects are, from a metaphysical perspective, and what they mean from a business perspective are all packed into the notion “conceptualization.”

A metaphysical perspective recognizes that the objects exist in space/time. The DOLCE classification system (Masolo, et al., 2003; Colomb, 2007) divides object into two broad classes, endurants, and perdurants. An endurant is an object that exists in time, having no temporal parts, while a
perdurant has temporal parts. This classification is roughly the same as the classification of words in language into nouns and verbs. The two are related in that an endurant is created, destroyed, and changed by perdurants, specifically by the subclass of perdurants called actions.

To the business person using interoperating information systems, an ontology is a catalog of the objects represented in the information systems. The meaning of the objects, and therefore the conceptualization, comes from how the objects are used in the business. It has been found useful to think about the business perspective using the theory of speech acts and institutional facts put forward by Searle (1995) and others (Dietz, 2006). An institutional fact is a special kind of endurant, while a speech act is a special kind of action, therefore a special kind of perdurant. Institutional facts are created, destroyed, and modified by speech acts.

The intent of this chapter is to comment on the present state of ontology research and development. To do so requires a metalanguage consisting of concepts useful in this endeavour. We want to distinguish formal ontologies from material ontologies. A formal ontology is essentially a high-level ontology representation language. A number of formal ontologies have been published. The best known are DOLCE, cited above, and the Bunge Wand Weber system (Weber, 1997; Colomb, 2007). These formal ontologies are described as neutral with respect to content. They presuppose no knowledge of the world. For example, most objects in the world are neither endurants (objects with an eternal existence) nor perdurants (disembodied actions). Formal upper ontologies are best thought of as very high-level knowledge representation languages. Concrete representation languages like ERA, UML and OWL all can be thought of as collections of instances of the high-level concepts in the upper ontologies.

A material ontology is a representation of some aspect of the material world. Ontologies used in applications are generally material ontologies. There are thousands of examples. Colomb (2007) discusses in some depth seven of them:

- The Z39.50 information retrieval language, which describes documents, document descriptors, and operations used to locate documents;
- The game Tic-Tac-Toe;
- The Standard Industrial Classification system developed by the Bureau of Labor Statistics in the USA to classify establishments engaged in economic activity;
- The SNOMED system of medical nomenclature;
- The Periodic Table of the Elements;
- Systems of engineering dimensions;
- The terminology used in the Olympic Games.

Most material ontology work has been focused on endurants. Certainly all the seven examples above are endurant ontologies, although Z39.50 has a few operations. Two of the most popular ontology representation languages, the Entity-Relationship-Attribute (ERA) model, and the Ontology Web Language (OWL) only allow representation of endurants. UML, of course, has a rich collection of behavioral modeling languages, but for example the OMG Ontology Definition Metamodel (OMG, 2009) considers only the UML Classes Model, comparing it with OWL, Common Logic, and Topic Maps, all of which are endurant representation languages.

Speech acts and institutional facts, described above, is also a material ontology, a very abstract one, which includes both endurants and perdurants.

The fact that representation languages used in information systems and on the Web foreground data models is an artifact of long-standing common practice. The designers of database systems have concentrated on getting the data models
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