Grounding Ontologies

Werner Kuhn
Institute for Geoinformatics
University of Münster
kuhn@ifgi.uni-muenster.de

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Abstract

With ontologies, it seems that we are still confused about meaning, but on a higher level. Existing approaches to ontology design pose the classical symbol grounding problem (Harnad, S. 1990): how can we avoid to resort endlessly from one formal system to another in explaining the meaning of symbols? My position is that the model-theoretic view of semantics underlying current ontology work cannot solve this grounding problem for the geospatial domain, and that a cognitive view of semantics is required instead. This position will be substantiated with some theoretical challenges and practical examples.

The Grounding Problem

It is nice to have a logical theory of a concept - but how does this theory relate to a *human understanding* of that same concept? One can state many things in a formal theory and claim that this is what a term means. But this is only constructing an abstract theory or model for another model (a data model, for instance). The theory may be more explicit, easier to communicate, and based on some notions that are carefully axiomatized – but how does it relate to meaning? How are its primitives grounded outside the formal system?

Model-theoretic semantics, which underlies most current ontology work, either does not attempt to answer this question or claims that the meaning *is* the formal model. It uses abstract models of possible worlds to define the meaning of expressions through the truth of statements in these worlds. The relationship of these abstract models to the real world as well as to human concepts remains unspecified. Thus, model theory cannot account for human conceptualizations of the world. By putting truth before meaning, it may be useful for formal language theory, but it does not help us to establish and communicate the meaning of expressions and sentences used by human beings (Lakoff, G. 1987). Establishing that a sentence is true in an abstract model does not give it any meaning in a human mind that lives in the real world.

From a practical point of view, the question is what kind of grounding produces shareable explanations of meaning. How can we explain the terms used in geospatial databases, services, and other information resources so that others can understand this explanation and relate it to their own understanding? Formalization per se is not useful to achieve such a shared understanding, though it may serve some other purposes. If ontologies are not grounded in something that their users share, they will be of very limited practical use.

It seems fair to ask the proposers of ontologies and ontology engineering methods to supply a list of concepts (or at least of the kinds of concepts) that they consider meaningful outside their formal theories, and to state how these obtain their meaning. For the MUSIL (http://musil.uni-muenster.de) approach to ontologies, we present an image-schematic proposal for grounding in a separate position paper.

Implications

In the workshop presentation, I will raise some common problems with ontologies that result from the lack of grounding. Among these challenges to ontology engineering are the needs to

- connect human activities to entities and their functions;
- account for interactions between entities;
- define the meaning of top-level concepts in ontologies;
- account for prototype effects in categories;
- explain complex processes as a combination of simpler ones (e.g., transportation as a combination of movement and containment).

Some practical examples will illustrate these challenges. Among them is the problem to distinguish transportation links (e.g., roads, ferry lines, railways) based on their navigability for different kinds of vehicles.

References

Harnad, S., 1990. The Symbol Grounding Problem. *Physica D* 42: 335-346.

Lakoff, G., 1987. Women, Fire, and Dangerous Things. What Categories Reveal about the Mind. Chicago. University of Chicago Press.