Barriers to Effective Agent Communication

Position Statement

Michael Uschold
The Boeing Company
P.O. Box 3707, MS 7L-40
Seattle, WA 98124-2207
+1 425 865-3605

michael.f.uschold@boeing.com

ABSTRACT

In this position statement, we describe the role of ontologies in agent communication. We describe a number of key barriers to effective agent communication. We believe that these barriers are a major issue, holding back widespread uptake of agent technology. We outline a strategy for how to better understand and overcome these barriers.

Categories and Subject Descriptors

??

General Terms

Standardization, Languages, Theory, Design, Reliability

Keywords

Ontology, inter-operation, integration

Position Statement

When agents communicate with each other, there needs to be some way to ensure that the meaning of what one agent 'says' is accurately conveyed to the other agent. There are two extremes, in principal, for handling this problem. The simplest (and perhaps the most common?) approach, it to ignore the problem altogether. That is, just assume that all agents are using the same terms to mean the same things. In practice, this will usually be an assumption built into the application. This only works, however, when one has full control over what agents exist, and what they might communicate. In reality, agents need to interact in a much wider world, where it will cannot be assumed that other agents will use the same terms, or if they do, it cannot be assumed that the terms will mean the same thing.

The moment we accept the problem, and grant that agents may not use the same terms to mean the same things, we need a way for an agent to discover what another agent means when it communicates. The basic idea for how to proceed, in theory, anyway, is to encode the terms and their semantics in ontologies. If agent 1 sends a message to agent 2, then along with this message is an indicator of, or a pointer to what ontology agent 1 is using. The theory goes, that agent 2 can look in agent 1's ontology to see what the terms mean, the message is successfully communicated, the service is performed to specification, and they all live happily ever after. The holy grail is for this to be able to happen despite the following plethora of difficulties.

1. there are many different ontology languages

2. different ontology languages are sometimes based on different underlying paradigms (e.g. description logic, first-order logic, frame-based, taxonomy, semantic net, thesaurus)

3. some ontology languages are very expressive, some are not.

4. some ontology languages have a formally defined semantics, some do not.

5. some ontology languages have inference support, some do not.

Even if the exact same language is used, two different people will likely build two different ontologies in the same subject area. These ontologies can be incompatible in various ways:

6. People may use different terms for the same thing.

7. People may use the same term for different things.

8. A given notion, or concept may be modeled at different levels of detail.

9. A given notion or concept may be modeled using different primitives in the language. E.g. is the notion of being red modeled by having the attribute color, with value red? Or is modeled as a class called something like RedThings? Or is it both, where either 1) they are independent or 2) RedThings is a derived class defined in terms of the attribute color and the value red.

10. A given notion or concept may be modeled with a very different fundamental underlying primitives. For example, when modeling time, one might a *time interval* as a primitive, another might use a *time point* as a basic primitive. There is no reason to expect these two ontologies to be compatible.

Even if the exact same language is used, and if there is substantial similarity in the underlying models and assumptions, the inference required to determine whether two terms actually mean the same thing, is in general, intractable.

Many of these problems are inherent, and will never go away. The challenge to the agent community, and the ontology community is to discover where progress is possible, and to move forward. At least two main approaches exist. First, a lot of benefit can be made by increasing the degree of standardization, both in the languages and in the content of the actual ontologies. Second, where standardization is not possible, technologies need to be developed for mapping and translating between and among ontologies. Finally, when problems are known to be impossible, in general,

the challenge is to find ways to make simplifying assumptions which enable agents to do useful things in practical situations.