Debating over heterogeneous descriptions *

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Abstract : A fundamental interoperability problem is caused by the seman-
tic heterogeneity of agents'ontologies in open multi-agent systems. Morge &
Routier (2007) propose a formal framework for agents debating over heteroge-
neous terminologies. For this purpose, we have proposed an argumentation-based
representation framework to manage conflicting description. Moreover, we have
proposed a model for the reasoning of agents where they justify the description
to which they commit and take into account the description of their interlocutors.
Finally, we have provided a dialectical system allowing agents to participate in a
dialogue in order to reach an agreement over heterogeneous descriptions.

Traditionally, ontologies have been used to achieve semantic interoperability between
applications, such as software agents, by providing the definitions of the vocabularies
they use to describe the world. In open systems that agents can dynamically join or
leave, a fundamental interoperability problem is caused by the semantic heterogeneity
of agents at the knowledge level, in particular the discrepancy of the underlying on-
tologies due to the terminological heterogeneity. The current approaches such as stan-
dardization, adopted by Gruber (1995), and ontology alignment, considered by Euzenat
& Valtchev (2004), are not suitable in open systems. Since standardization requires
that all parties involved reach a consensus on the ontology, the idea of a *great uni-
fied world ontology* seems very unlikely. On the other hand, ontology alignment is a
technique that enables agents to keep their own individual ontologies by making use of
mappings. Alignments are generated by independent trustable alignment services that
can be invoked to obtain a mapping between two ontologies and used to translate mes-
sages. However, we do not know *a priori* which ontologies should be mapped within
an open multi-agent system. As observed by Bailin & Truszkowski (2002), conflicts
of representation should not be avoided but resolved.

Argumentation is a promising approach for (1) reasoning with inconsistent informa-
tion, (2) facilitating rational interaction, and (3) resolving conflicts. Morge & Routier
(2007) use some argumentative techniques in order to provide a dialogical mechanism

for the agents to reach an agreement on their representations. Agents have their own definitions of concepts and they discover through the dialogue whether or not they share these definitions. If not, they are able to learn the definition of their interlocutor. Argumentation is used to integrate the different and possibly divergent definitions and to resolve the conflict. For this purpose, the formal framework for inter-agents dialogue is based upon the argumentative techniques proposed by Morge (2006). The debate can finish with an agreement or not in case of misunderstanding on a concept. (1) We have proposed an argumentation framework built around the underlying logic language $\mathcal{ALC}$ (Schmidt-Schauß & Smolka, 1991), where the concept definitions and the assertions can be conflicting and have different relevances depending on the considered audience. In a multi-agent setting it is natural to assume that all the agents do not use exactly the same ontology. Since agents representations can be common, complementary or contradictory, agents have to exchange assumptions and to argue. (2) For this purpose, we have proposed a model of agent reasoning to put forward some representations and take into account the representations of their interlocutors. Our agents individually evaluate the perceived commitments with respect to the estimated reputation of the agents from whom the information is obtained. When a set of social and autonomous agents argue, they reply to each other in order to reach the goal of the interaction. (3) For this purpose, we have provided a dialectical system in which a protocol enables two agents to reach an agreement about their representations.

In this work, we have focused on multi-agent systems but, our approach is also relevant to the Web and its proposed extension, the Semantic Web, where different services performing the same tasks may advertise their capabilities differently, or where service requests, and service offers may be expressed by using different ontologies, and thus need to be reconciled dynamically at run time.

References

BAILIN S. & TRUSZKOWSKI W. (2002). Ontology negotiation between intelligent information agents. *Knowledge Engineering Review*, **17**(1), 7–19.

EUZENAT J. & VALTCHEV P. (2004). Similarity-based ontology alignment in owl-lite. In I. PRESS, Ed., *Proc. of the 16th European Conference on Artificial Intelligence*, p. 333–337.

GRUBER T. R. (1995). Toward principles for the design of ontologies used for knowledge sharing. *International Journal of Human-Computer Studies, special issue on Formal Ontology in Conceptual Analysis and Knowledge Representation*, **43**(5-6), 907–928.

MORGE M. (2006). Collective decision making process to compose divergent interests and perspectives. *Artificial Intelligence and Law*, **13**(1), 75–92.

MORGE M. & ROUTIER J.-C. (2007). Debating over heterogeneous descriptions. *Applied Ontology, Special issue on Formal Ontology for Communicating Agents*, **3**, 14.

SCHMIDT-SCHAUSS M. & SMOLKA G. (1991). Attributive concept descriptions with complements. *Artificial Intelligence*, **48**.