

Chapter XV

A Methodology for Ontological Mediation in Multi-Agent Systems¹

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ABSTRACT

The effectiveness of current search and retrieval systems is restricted as they do not use the semantics of the data but mainly utilize keywords. Multi-agent systems in which agents gather information and organize it, by creating ontologies, are being utilized to improve the performance and quality of the data gathering and integrating systems. Major difficulties that arise during collaboration among such agents are ambiguity and data misinterpretation. This is due to the diversity of ontology creators, differences in linguistics and ontological overlapping. Users may also knowingly or unknowingly add incorrect information to ontologies. Ontological Mediation tries to address such collaboration issues relating to ambiguous and unfamiliar information arising due to various reasons. We propose a communication based approach for ontological mediation. In the process, we also present a classification model for ontological mediation.

INTRODUCTION

The way information is searched and retrieved across vast collections such as the internet is still very raw. Generally, keywords are entered in search engines and documents are searched looking for the keywords. Any such enormous collection can be processed more efficiently if its data is organized. Organization here means data arrangement and representation in such a way that information retrieval is faster, relevant and better, with machines themselves being able to understand the semantics. Creating ontology of terms and forming hierarchy of concepts is one such organization. Such organization of vast sets of data into a well structured ontological representation presents difficulties. The data may be in different formats, using a variety of different languages and with conflicting ideas. Further it is not an easy task to verify the reliability of data, or for that matter, to update or alter any data and make it transparent across the system.

Even after organization of data into ontologies, effectiveness and efficiency are not guaranteed. To be effective the organized information should also form a cohesive interpretation. Without coherence, information will not be useful irrespective of how well it is organized. Uniformity in a multi-agent architecture like ours is not guaranteed without intervention. With different agents gathering and organizing information on different domains, inter agent collaboration is needed. This collaboration with other information providing agents (called information agents for the remainder of this chapter) can unfortunately lead to misunderstandings and ambiguities. Such problems are due to the inherent complexity that arises during automated information exchange, linguistic differences, overlapping information and also due to the diversity of users who create ontological documents. Different information agents may reply with conflicting information for a single query. There can be a variety of reasons for conflicting information. Conflicting informa-

tion may be the result of a conflicting domain. For example in response to an information request about “OWL”, one agent may reply “OWL” as a Web Ontology Language while other agent might respond to the query as a nocturnal bird. Though both agents provide correct information, the information becomes futile as the receiving agent cannot process such ambiguous response.

Conflicts arising from difference in domain are easier to mediate. Few questions relating to where the information is being used can help determine the domain and hence resolve the conflict. Nevertheless, conflicts do not always involve different domains. As different users may be involved in creating the ontology for the information agents, the information itself may be flawed and incorrect. This can result in conflicting information for a same term within the same domain. Linguistic difference can also be one of the causes of such conflicting information. For example, British English uses “first floor” to refer to the first floor above the ground, however in American English, it is another name for the ground floor itself. Among other reasons (discussed later) being able to identify and resolve linguistic difference as in the above example is the goal of ontological mediation. The need for ontological mediation goes beyond the interactions between existing ontologies. It is also desirable that new ontologies bringing in new information are easily incorporated within the system. For this ontological reorganization, reconciliation, merging and update are necessary.

Our model uses techniques suggested in “A Multi-Agent Architecture for Distributed Domain-Specific Information Integration” (Rahimi, Carver & Petry, 2005) as the method for collecting data through knowledge discovery, information gathering and integration from multiple sources. Similar to the Domain Model and the Information Source Model introduced in (Rahimi et al., 2005), our agents have an ontology of terms (its knowledge base) and also partial information about other agents that provide further specialized

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