Agents Arguing Over Ontology Alignments

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1 Extended Abstract

Ontologies play an important role in inter-agent communication, by providing the definitions of the vocabularies used by agents to describe the world [4]. An agent can use such a vocabulary to express its beliefs and actions, and so communicate about them. Ontologies contribute to semantic interoperability when agents are embedded in open, dynamic environments, such as the Web and its proposed extension, the Semantic Web [2]. However, in this type of environment there cannot be a single universally shared ontology that is agreed upon by all the parties involved, as this would result in imposing a standard communication vocabulary. Instead, every agent will typically use its own private ontology, which may not be understandable by other agents. Interoperability therefore relies on the ability to reconcile different existing ontologies that may be heterogeneous in format and with partially overlapping domains [7]. This reconciliation usually relies on the existence of correspondences (or mappings) between agent ontologies, and using them in order to interpret or translate messages exchanged by agents. The underlying problem is usually termed an *ontology matching* problem [3]. Many matching algorithms that are able to produce such alignments have been proposed [6]. The availability of a dedicated agent, here termed as an *Ontology Alignment Service*, that is able to provide such correspondences between two ontologies is only the beginning of a solution to achieving interoperability between agents, as any given candidate set of alignments is only suitable in certain contexts. For a given context, agents might have different and inconsistent perspectives; i.e. interests and preferences, on the acceptability of a candidate mapping, each of which may be rationally acceptable. This may be due to the subjective nature of ontologies, to the context and the requirement of the alignments and so on. For example, an agent may be interested in accepting only those mappings that have linguistic similarities, since its ontology is too structurally simple to realise any other type of mismatch. Moreover, any decision on the acceptability of these mappings has to be made dynamically (at run time), due to the fact that the agents have no prior knowledge of either the existence or constraints of other agents.

In order to address this problem, we present a framework to support agents to negotiate agreement on the terminology they use in order to communicate, by allowing them to express their preferred choices over candidate correspondences. Agreements are determined by means of argument-based negotiation to deal specifically with arguments that support or oppose the proposed correspondences between ontologies. Our argumentation framework is based on the Value-based Argument Frameworks ($VAFs$) of [1]. It prescribes different strengths to arguments on the basis of the values they promote and the ranking given to these values by the *audience* for the argument. This allows us to systematically relate strengths of arguments to their motivations, and to accommodate different audiences with different interests and preferences. Thus, the preferences will represent the motivations of the agents to determine whether a mapping is accepted or rejected. The set of potential arguments are clearly identified and grounded on the underlying ontology language, the standard OWL[1], and the kinds of mapping that can be supported by any such argument

[1] `http://www.w3.org/OWL/`

are clearly specified. The reasons justifying the correspondences are classified in several different types, which correspond to the type of categorizations underlying ontology matching algorithms [7]. Such a classification will also coincide with the types of values in the VAF. Therefore, for example, an audience may specify that terminological arguments are preferred to semantic arguments, or vice versa. This may vary according to the nature of the ontologies being aligned. For example, semantic arguments will be given more weight in a fully axiomatised ontology, compared to that in a lightweight ontology where there is very little reliable semantic information on which to base such arguments. Therefore, in $VAFs$, arguments against or in favour of a candidate mapping are seen as grounded on their type. In this way, we are able to motivate the choice between preferred extensions by reference to the type ordering of the audience concerned.

Given a set of arguments justifying mappings organised into a valued-based argumentation framework, an agent will be able to determine which mappings are acceptable by computing the preferred extensions with respect to its preferences. Since, in our framework, an audience may have multiple preferred extensions, we thus define an *agreed alignment* and an *agreeable alignment*. An agreed alignment has been defined as the set of correspondences supported by those arguments which are in every preferred extension of every agent. An agreeable alignment extends the agreed alignment with those correspondences supported by arguments which are in some preferred extension of every agent. Whilst the mappings included in the agreed alignments can be considered valid and consensual for all agents, the agreeable alignments have a uncertain background, due to the different alternative positions that each agent can take. However, given our context of agent communication, we seek to accept as many candidate mappings as possible. We will therefore take into consideration both sets of alignments - agreed and agreeable. The dialogue between agents consists simply of the exchange of individual argumentation frameworks, from which they can individually compute acceptable mappings. Therefore, this work provides a concrete instantiation of the *meaning negotiation* process that we would like agents to achieve. Moreover, in contrast to current ontology matching procedures, the choice of alignment is based on two clearly identified elements: (i) the argumentation framework, which is common to all agents, and (ii) the preference relations which are private to each agent. We believe that this approach will achieve more sound and effective mutual understanding and communication in agents system.

Future work includes the use of a negotiation process to enable agents to reach an agreement on a mapping when they differ in their ordering of argument types. Another interesting topic for future work would be to investigate how to argue about the whole alignment, and not only the individual candidate mappings. These arguments could occur when a global similarity measure between the whole ontologies is applied.

More details can be found in an extended version of this paper [5].

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