Using Ontology Alignment to Dynamically Chain Web Services

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Abstract. This statement of interest presents a brief rationale and description of issues for using ontology alignment as a key step in dynamically chaining together a sequence of web services.

Keywords: Ontology Alignment, Web Services, Dynamic Service Chain Composition

1 Introduction

As in much of the world, the Department of Defense (DoD) has seen an explosion in the growth of web services. But integration of these disparate information sources to answer complex questions remains a challenge. Many information integration tasks are unforeseen at the time the services are constructed, and are therefore difficult to perform "on the fly". This typically involves searches among various web service definitions and deciding how best to arrange and call them in an ad-hoc manner. A better method of assembling a dynamic service chain is needed.

Using semantic web technology to semi-automatically create a service chain is an active area of research [2, 3, 4, 5]. However, most of this work is centered on the use of formal ontologies using standards such as WSMO (Web Services Modeling Ontology), WSML (Web Services Modeling Language), OWL-S, or SAWSDL (Semantic Annotations for WSDL), which assume that the builders of web services will also build the accompanying ontologies necessary for integration. This hasn't been the case for DoD web service builders. This is in part because there is a lack of consensus about ontology standards, and the skills needed to develop ontologies are different from those needed to build and deploy web services. As a result, these services do not have formal ontologies that define the domain within which the service operates or that describe the service messages.

We have developed a different approach for dynamic web service assembly that takes advantage of the formal structure inherent in web services that are defined by WSDL documents. This is based on our past efforts using ontology alignment to integrate different sources of information [1, 6]. The XML Schema definitions are extracted from the WSDLs, and the schemas are then converted into OWL. The resulting OWL files are aligned using ontology alignment tools, which allows for

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semi-automated mapping of the service input and output messages at the semantic level. A theorem prover is then used to construct a service chain based on the aligned service inputs and outputs which meets some information goal.

2 Issues

We are sometimes asked to justify converting schemas into ontologies to do alignment when there are schema alignment tools available. Our response is that by converting to an ontology, it enables us to apply the power of the underlying logic model to make better decisions – an example being the case where there are two schemas with the word 'mustang', but one refers to the car and the other the horse. A purely linguistic aligner will almost always align these – and usually the schemas we work with are small enough such that a structural analysis doesn't have enough information to make a better decision. But by using ontologies, it is fairly easy for a person to add some additional taxonomy information above each of the 'mustang' classes, by asserting for example that one mustang is a subclass of vehicle and the other is a subclass of animal, and that the two classes are disjoint. This should enable an ontology matcher to reach the correct conclusion. In addition, of course, using an ontology enables one to perform automated consistency checking on it – something that is not easy to do with a schema. As alignments become complicated, and the ontologies involved become large and complex, consistency checking becomes increasingly valuable.

In practice, when applying ontology alignment to real-world services a number of difficulties are encountered, with missing and false alignments being the most frequent. Some of the areas about which we would like to engage alignment researchers are: an increased emphasis on meta-properties, such as disjointness, to help with alignment decisions, and techniques for including domain information (such as mid-level ontologies or controlled vocabularies) to improve performance.

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