OPOSSUM: Bridging the Gap between Web Services and the Semantic Web

Eran Toch[1], Iris Reinhartz-Berger[2], Avigdor Gal[1] and Dov Dori[1]

[1] Technion – Israel Institute of Technology, Technion City, Haifa 32000, Israel
erant@tx.technion.ac.il, {avigal, dori}@ie.technion.ac.il
[2] University of Haifa, Carmel Mt., Haifa 31905, Israel
iris@mis.haifa.ac.il

1 Introduction and Background

Web services are distributed software components, which are accessed through the World Wide Web. The increasing use of Web services raises the need for efficient and precise retrieval solutions of Web services. We propose to investigate aspects of Web service retrieval, facing a gap between user specifications, given in some form of a semantic description, and Web service definition, given in a standard interface description such as Web Service Description Language (WSDL), that conveys the syntax of the service. Bridging this gap is becoming more and more urgent as users need to find Web services among increasing numbers of Web services within organizations and on the Web. One of the major challenges of service-retrieval is to make services accessible without having to do additional semantic work of classification.

The main challenge in service-retrieval is the lack of semantics in their interface description for precise search. Current retrieval solutions can be classified as either *linguistic-based* or *semantics-based*, each of which exhibits different limitations. Linguistic-based solutions are based on textual analysis of WSDL description. This approach is taken, for example, by the Woogle search engine [3]. While linguistic approaches dramatically increase the precision and recall of finding WSDL-described Web services, they do not reach the level of certainty required to support a fully automated solution. The semantic approach to service-retrieval is based on expanding the description of Web services with formal semantic models, such as OWL-S [1]. These models provide an inambiguous description of service properties by relating them to concepts belonging to *Web ontologies*. Several works, including [4], had proposed methods for matching queries and advertisements of semantic Web services. While these methods retrieve services with very high precision and certainty, they require full semantic models in order to perform the matching. These semantic models may not be available in all application fields.

2 Ontological-Based Search

In order to address the current limitations of service-retrieval, we had developed *OPOSSUM* (Object-PrOcedure-SemanticS Unified Matching). Our approach relies on ontologies as a mean for increasing certainty of matching service functionality. By using data integration and conceptual model techniques, WSDL documents are analyzed and transformed into a generic service model. Following that, the service properties are mapped to concepts that belong to ontologies, which are collected from the Semantic Web [2]. For instance, a corporate book-buying service will be mapped to ontologies that describe e-commerce, finance, and corporate concepts.

The service-retrieval problem is transformed from a mapping problem between a query and a set of services to a mapping problem between a set of query concepts and a set of service concepts. A novel algorithm [5], is used to match queries with the ontological-based model of Web services. Rather than using purely linguistic methods for measuring the affinity between concepts, the matching algorithm analyzes the ontology, using related concepts and the structure of the ontology itself. Results are ranked according to the accumulated certainty (over the set of query expressions, concepts and messages) of the mapping between the query and the services. Similarly, semantic affinity methods are used to determine relations between Web service operations. These relations are used in order to support retrieval of composed services.

Users communicate with the $\mathcal{OPOSSUM}$ search engine using a simple query language, which is based on a natural language. A set of query operators enable users to refer to specific properties of desired Web services. For instance, the operator *input* returns all services that have an input that correlates with the query concept. Other operators include *output*, *description*, *name*, *etc*, as well as disjunction and conjunction of properties. Furthermore, the search engine can retrieve dynamically-created services, which are composed of several atomic services. Thus, even if a query is not answered by a single service, it might be answered by combining several services. Compositions of Web services are evaluated in a preprocessing stage, in which semantic methods are used in order to infer the underlying relations between individual Web services.

References

1. Anupriya Ankolekar, David L. Martin, Zeng Zeng, Jerry R. Hobbs, Katia Sycara, Burstein Burstein, Massimo Paolucci, Ora Lassila, Sheila A. Mcilraith, Srini Narayanan, and Payne Payne. DAML-S: Semantic markup for web services. In *Proceedings of the International Semantic Web Workshop (SWWS)*, pages 411–430, July 13 2001.
2. T. Berners-Lee, J. Hendler, and O. Lassila. The semantic web. *Scientific American*, 284(5):34–43, 2001.
3. Xin Dong, Alon Y. Halevy, Jayant Madhavan, Ema Nemes, and Jun Zhang. Simlarity search for web services. In *VLDB*, pages 372–383, 2004.
4. Massimo Paolucci, Takahiro Kawamura, Terry R. Payne, and Katia P. Sycara. Semantic matching of web services capabilities. In *International Semantic Web Conference*, pages 333–347, 2002.
5. Eran Toch, Avigdor Gal, and Dov Dori. Automatically grounding semantically-enriched conceptual models to concrete web services. In *ER*, pages 304–319, 2005.