

Chapter 47

A Similarity Measure Across Ontologies for Web Services Discovery

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ABSTRACT

Given the critical and difficult nature of discovering Web services in the development process of service oriented architectures, several studies have been proposed to solve this problem. There is a real need to work for matching semantic Web services which use different ontologies. In responding to this need, measuring semantic similarity between SWS may be reduced to the calculation of similarity between ontological concepts. This work is a contribution to achieve semantic interoperability for Web services in a multi-ontology environment, for which the authors present a generic framework for Web services discovery. Here their focus is on the semantic similarity measure-based core of their framework and the authors present a novel algorithm for concepts matching between different ontologies. Results of the experiments confirm the viability of the semantic similarity measure.

1. INTRODUCTION

Klusch (2008) defines service discovery as “the process of locating existing Web services based on the description of their functional and non-functional semantics”. Lack of semantics in description creates inefficiencies in exploiting the Web service discovery. Describing Web service with semantics facilitates the ability for automatic Web discovery, invocation and composition. Semantic Web Services (SWS) extend the idea of the Semantic Web to Web Services (WS). They aim to complement the cur-

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rent knowledge-poor syntactic industry standards with ontology as semantic model in order to facilitate automation of WS related tasks such as discovery.

Ontology is a modern AI knowledge representation technique. It is identified as the basetechnology for the Semantic Web — the grand vision for the further evolution of the WWW (Berners-Lee, Hendler & Lassila, 2001) — and it is used as the formalized domain knowledge specifications for SWS descriptions. Ontologies are employed extensively in numerous fields such as knowledge engineering, artificial intelligence and applications related to knowledge management, information retrieval, linked data and the semantic Web.

Ontology can be defined as a tuple: $O = (C, R, H_C, I)$ where C represents the set of concepts in ontology; $R \subseteq C \times C$ is the set of relations over concepts; $H_C \subseteq R$ is a subset of R , represents hierarchical relation set between concepts; and a set of instances I . A concept is composed of:

1. A URI (Unique Resource Identifier);
2. A set of names (comment, name, label);
3. Internal context (a set of internal properties) or each property consisting of Name, Range, and Domain;
4. External context composed of Fathers (set of concepts), Childs (set of concepts) and Brothers (set of concepts).

The ontologies are used to provide semantic interoperability, but the ontologies themselves can be heterogeneous. One of the most promising and mature approaches to achieve interoperability is ontology matching (Sure, 2004). It establishes relations between ontological entities by calculating semantic similarity of them. With the growing information resources on the Web, there is a need for developing methods which would compute similarity among concepts belonging to different ontologies. Measuring of similarity between concepts is needed for operations such as aligning, merging, mapping and measuring semantic similarity between Web services as well as being an important factor for discovery, composition and execution. In order to achieve Web services discovery in a multi-ontology environment, Klusch (2008) identifies three aspects to the discovery task:

- Service description language is used to represent the functional and non-functional semantics of Web services;
- Semantic matching for service selection is the comparison of a query with a service to determine the degree of their semantic correspondence; and
- Discovery architecture concerns the environment in which the discovery is assumed to be performed.

A very important dimension that is not taken into account by Klusch is the treatment of multiple ontology descriptions in matchmaking. Here we focus mainly on the second aspect, semantic matching, in the presence of multiple ontology. Klusch classifies semantic Web service matchmakers according to “what kinds and parts of service semantics are considered for matching” and “how matching is actually to be performed”. A general view and generic architecture of Web services discovery seem necessary in the first place, something that shows the need for interoperability of ontologies to achieve the goal of discovery in multi ontology context.

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