

Chapter 3.10

Web Services Discovery with Rough Sets

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ABSTRACT

Web services are emerging as a major technology for building service-oriented distributed systems. Potentially, various resources on the Internet can be virtualized as Web services for a wider use by their communities. Service discovery becomes an issue of vital importance for Web services applications. This article presents ROSSE, a Rough Sets based Search Engine for Web service discovery. One salient feature of ROSSE lies in its capability to deal with uncertainty of service properties when matching services. A use case is presented to demonstrate the use of ROSSE for discovery of car services. ROSSE is evaluated in terms of its accuracy and efficiency in service discovery.

INTRODUCTION

Web services are emerging as a major technology for developing service-oriented distributed systems. Potentially, many resources on the Internet or the World Wide Web can be virtualized as services for a wider use by their communities. Service discovery becomes an issue of vital importance for Web service applications. As shown in Figure 1, discovered services can either be used by Web service applications or they can be composed into composite services using workflow languages such as BPEL4WS (Andrews Curbera, Dholakia, Golland, Klein, Leymann et al., 2003). UDDI (Universal Description, Discovery and Integration, <http://www.uddi.org>) has been

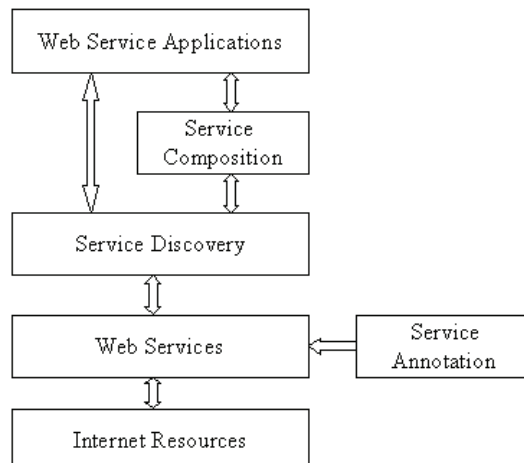
proposed and used for Web service publication and discovery. However, the search mechanism supported by UDDI is limited to keyword matches. With the development of the Semantic Web (Berners-Lee, Hendlet, & Lassila, 2001), services can be annotated with metadata for enhancement of service discovery. The complexity of this metadata can range from simple annotations, to the representation of more complex relationships between services based on first order logic.

One key technology to facilitate this semantic annotation of services is OWL-S (Martin, Paolucci, McIlraith, Burstein, McDermott, McGuinness et al., 2004), an OWL (Web Ontology Language, <http://www.w3.org/TR/owl-features/Reference>) based ontology for encoding properties of Web services. OWL-S ontology defines a service profile for encoding a service description, a service model for specifying the behavior of a service, and a service grounding for invoking the service. Typically, a service discovery process involves a matching between the profile of a service advertisement and the profile of a service request using domain ontologies described in OWL. The service profile not only describes the functional properties of a service such as its inputs, outputs, pre-conditions, and effects (IOPEs), but also non-functional features including service

name, service category, and aspects related to the quality of a service. In addition to OWL-S, another prominent effort on Semantic Web services is WSMO (Roman, Keller, Lausen, Bruijn, Lara, Stollberg et al., 2005), which is built on four key concepts—ontologies, standard WSDL based Web services, goals, and mediators. WSMO stresses the role of a mediator in order to support interoperation between Web services.

However, one challenging work in service discovery is that service matchmaking should be able to deal with uncertainty in service properties when matching service advertisements with service requests. This is because in a large-scale heterogeneous system, service publishers and requestors may use their pre-defined properties to describe services, for example, in the form of OWL-S or WSMO. For a property explicitly used in one service advertisement, it may not be explicitly used by another service advertisement within the same service category. As can be seen from Table 1, the property P_1 used by the service advertisement S_1 does not appear in the service advertisement S_2 . When services S_1 and S_2 are matched with a query using properties P_1 , P_2 and P_3 , the property P_1 becomes an uncertain property when matching S_2 . Similarly, the property P_3 becomes an uncertain property when matching

Figure 1. A layered structure for service-oriented systems



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