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Semantic Discovery of Web Services through Social Learning

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Abstract

The increasing numbers of web services impose automatic discovery process in Service Oriented Architecture (SOA). But the existing SOA enables only syntactic discovery which produces coarse irrelevant results or sometimes no results. Different researches challenge this problem by introducing semantic discovery process in SOA to enable relevant and desired search results. These research outcomes cannot discover services efficiently which are created independently with different knowledge bases. To overcome these problems, a new architecture of SOA is proposed which incorporates a new adaptive technique called social learning that improves service provider's domain ontology from service consumer's concept contributions and thus eventually makes the service more semantically discoverable. The proposed architecture contains new similarity measure and automatic merging algorithms on weighted ontology. From mathematical reasoning it is induced that the proposed architecture reduces overlapping concepts and thus more relevant discovery results are ensured. To test the proposed architecture's performance, a prototype of Universal Description Discovery and Integration (UDDI) is implemented and a simulation is conducted with real data set of OWL-S Technical Chart (OWLS-TC). About 67% noise responses from syntactic search (N-Gram String Distance algorithm) are reduced in the proposed architecture. The results also illustrate the proposed architecture's capabilities of concept learning and so about significant improvement in service discovery after a few social concept contributions.

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1. Introduction

The web has been evolving into the world's largest distributed system for sharing information. The growth of web and wide acceptance of web protocols in different systems makes the hype of Service Oriented Architecture (SOA) popularly known as web service [1]. In SOA, a service provider exposes its services in standard Web Service Description Language (WSDL). From the WSDL specification the service consumer can make software clients to consume the service. The interacting messages are carried in SOAP as payload of different web protocols like HTTP, SMTP etc. The service provider can register their services

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in Universal Discovery, Description and Integration (UDDI). The UDDI gives API for searching web services for the service requester. The architecture of web services can be treated as a great application field of Semantic Web [2]. Sir Timothy John "Tim" Berners-Lee (director of W3C and the creator of WWW) visualized semantic web more powerful than traditional web where the machines can understand the meaning of the information and can process the information automatically. But the standard SOA architecture does not provide semantic interoperability in any of its components . WSDL does not specify about what the service does (Service Domain and UDDI only provides service for syntactical discovery of web services. It restricts user agents to find desired service. The syntactic search produces either noisy irrelevant results or no results. But if we can annotate WSDL with semantic knowledge and make UDDI capable of semantic search then complex discovery of web services is possible.

Over the years different researchers have approached differently to add semantic search capability in SOA. Some researches only describe the service semantically [3]. But they do not give semantic searching capabilities in UDDI. Some researchers add semantic searching in UDDI but restrict the architecture in non-scalable single point searching methodologies [4]. Besides some researchers restrict the service requester and provider to follow an imaginary world concept [5]. These researches restrict SOA to be more flexible semantically. From this paper viewpoint semantically enabled SOA should follow the following characteristics.

- it should allow the semantic description of services within the concrete service description.
- it should allow scalable searching with different service mechanisms at different endpoints. Thus different searching algorithms can be used at different endpoints.
- it should allow the service requester and provider to create service ontology in a distributed manner. It is trivial that the chance of prior contact between them is very low. So they should create service description independently.

In this paper a new architecture of SOA is proposed that follows the above characteristics and is capable of semantic search. As the service domain ontology is completely distributed, the proposed architecture imposes a social form of improving ontology of the registered services. The main motto is that if service requester consumes a service, then it may contribute to improve the service provider's ontology. Besides there is no world ontology in the proposed architecture, so there should be a mechanism to update provider's ontology over time through learning from internet. In this paper this kind of learning is called social learning and a new service discovery process is proposed based on this social learning. The Fig 1(b) illustrates the concept of social learning. To carry this social learning new ontology matching and merging algorithm are introduced since existing ones can not meet the exact requirement. The rest of the paper is divided into sections where section 2 illustrates the new architecture; section 3 is describing new semantic matching algorithm; The social learning process through semantic merging of ontologies is in section 4 and finally simulation results are in section 5.

2. A New Social Architecture of SOA for Semantic Discovery

The architectures provided by J. Phatak et al. [6], Ivan M et al. [7], Bo Zhou et al. [8], Kim Christensen et al. [9], Naveen Srinivasan [10] etc. provide semantic discovery. Some of them are closed system whether some of them are distributed. In ideal case we need a distributed system to protect single point failure. Some of the existing architectures do not provide representation heterogeneity. That means to represent the concept in different formats. But again it is a desired option. Popular systems do not impose a certain format so that it can find popular format through recommendation. The main lack of the existing discussed architectures is to perform poor with services created with different knowledge bases. For example, assume there is no knowledge base to reason that "Toyota is a car". So, all the existing discussed architectures will return null matching in searching "Toyota" in "car" concept all the time. But the knowledge base can be improved over time through adaptive learning techniques. Thus further queries will not return null matching. Thus the overall searching results get improved. Another important lack in present architectures remains for

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