

Using Semantics to Discover Web Services Based on Partial Data: An Update of Previous Research

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ABSTRACT

The authors developed an algorithm and a proof-of-concept tool to help business analysts search a pool of hundreds or thousands of services to find the closest ones to their needs when they are composing business processes, even when an exact match does not exist. The authors achieve this by semantically annotating the services with properties from an ontology, while, traditionally, only the concepts are used. This enables them to generate finer-grained partial semantic mappings between a query and the signature of the services published in a registry, despite potentially different parameter cardinalities and types. Their searches return a ranked list of those services available in the registry that most closely match the query specification. The analyst can then study the hits to see which of the suggested alternatives is more convenient. Such an approach is fundamental to effectively manage reuse in large service-oriented deployments, where the number of services in the registry becomes too voluminous for browsing individually or even syntactic searches that rely on some degree of memorization by the analyst.

Keywords: Matching Service Descriptions, Ontology, OWL-S, Semantic Web Services, Service-Oriented Architectures (SOA)

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INTRODUCTION

Traditionally, business logic has been sealed inside monolithic software packages. This silo approach hinders the reuse of such functionality and the flexibility to change business processes that must cut across the boundaries of distinct vertical applications, such as order-to-cash. Conversely, in service-oriented architectures (SOA) that same business logic is made available in a common pool of basic “building blocks”, which can be reused to assemble the various business processes that need them. However, the advantages become harder to reap as that pool grows to hundreds or thousands of services, as the business analyst struggles to find among them the ones that best match the needs of a specific step when building a business process. A mechanism is needed to identify the most viable candidate services, without knowing their precise names and allowing for flexibility in what regards the number and type of inputs and outputs. In fact, even if an exact match is not available, a work-around can be engineered with a close enough alternative. For example, if a suitable service requires two input parameters instead of one the analyst has available, it may be possible to elicit the second one and still use the service. If a service returns more outputs than those required, the unneeded ones may be discarded. If the output is not the desired, it may be possible to use it as input for a second service that translates it to the one that is needed, in a two-step process.

This was the actual challenge we faced when working with a major telecom company looking to migrate to a service-oriented architecture.

This paper is based on and updates our previous research reported in Ferreira da Silva et al. (2010). In the next sections we start by exploring the background literature in two major areas: approaches and standards to semantically annotate services and mechanisms to perform their semantic matching. After setting this common ground, we move to describe our proposal, present future trends in this area, and close with conclusions.

BACKGROUND

By nature, all large systems are heterogeneous, *i.e.* they lack uniformity. Their components were initially developed to address various purposes and evolved towards accretions of different platforms, programming languages, and even middleware. The SOA paradigm enables dealing with such heterogeneous systems in a decentralized way as much as possible. Decentralization helps to obtain loose coupling, one of SOA’s key technical concepts along with services and interoperability. We briefly describe these three concepts below.

Although several definitions exist, in short, a service is an information technology (IT) representation of self-contained business functionality.

Loose coupling minimizes dependencies and thus helps scalability, flexibility and fault tolerance. When dependencies are reduced, modifications have minimized effects and the systems still run when part of them are down. When problems occur, it is important to decrease their effects and consequences. Josuttis (2007) elaborates on several strategies to apply loose coupling.

The ISO terminology recommendation (ISO/IEC JTC-1 (ISO) 1993) describes interoperability as the capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units. Thus, interoperability enables systems to communicate, understand each other and exchange information. Syntactic and structural interoperability is already set up with transformations, for instance, using standards like XML and XML Schema and associated tools. Syntactic and structural transformations are used to convert schema representations into a target format. However, approaches that target at enhancing interoperability based on structure and on syntax can only produce improvements when a certain conceptual homogeneity between graphs to compare exists. Solving mismatches on the semantic level, *i.e.* to come up to semantic

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