

## Chapter 2.18

# Utilisation of Case-Based Reasoning for Semantic Web Services Composition

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### ABSTRACT

With the rapid proliferation of Web services as the medium of choice to securely publish application services beyond the firewall, the importance of accurate, yet flexible matchmaking of similar services gains importance both for the human user and for dynamic composition engines. In this article, we present a novel approach that utilizes the case based reasoning methodology for modelling dynamic Web service discovery and matchmaking, and investigate the use of case adaptation for service composition. Our framework considers Web services execution experiences in the decision making process and is highly adaptable to the service requester constraints. The framework

also utilizes OWL semantic descriptions extensively for implementing both the components of the CBR engine and the matchmaking profile of the Web services.

### INTRODUCTION

The Internet has become the market-place for a colossal variety of information, recreational and business services. Web services are increasingly becoming the implementation platform of choice to securely expose services beyond the firewall. Moreover, multiple Web services can be integrated either to provide a new, value-added service to the end-user or to facilitate co-operation between

various business partners. This integration of Web services is called “Web services composition” and is feasible to achieve because of the Web services advantages of being platform, language neutral and loosely coupled.

Automatic Web service discovery and match-making is the principal aspect for dynamic services composition. The accuracy of the matchmaking (selection) process enhances the possibility of successful composition, eventually satisfying the user and application requirements. The current standard for Web service discovery, the Universal Description, Discovery and Integration (UDDI) registry is syntactical and has no scope for automatic discovery of Web services. Hence, current approaches attempting to automate the discovery and matchmaking process apply semantics to the service descriptions. These semantics are interpretable by the service (software) agents and should include WSDL-based functional parameters such as the Web services input-outputs (Martin et al., 2004a)(Akkiraju et al., 2005), and non-functional parameters such as domain-specific constraints and user preferences (Aggarwal, Verma, Miller, & Milnor, 2004).

The accuracy of automatic matchmaking of web services can be further improved by taking into account the adequacy of past matchmaking experiences for the requested task, which gives us valuable information about the services behaviour that is difficult to presume prior to service execution. Hence, there is a need for a methodology that uses domain-specific knowledge representation of the required task to capture the Web services execution experiences and utilise them in the matchmaking process. Case Based Reasoning (CBR) provides such methodology as its fundamental premise is that experience formed in solving a problem situation can be applied for other similar problem situation.

The article begins with describing the motivation behind the work. In the following section we review theory of Case Based Reasoning and describe how it can be utilised for modelling Web

services matchmaking. Next we discuss the design of our matchmaking algorithm, its implementation highlights, and analyze preliminary results. Finally we investigate how case adaptation can further extend our matchmaking algorithm to cater for service composition and review related work.

## **MOTIVATION**

The most practically deployed Web services composition techniques use the theory of business workflow-management as composition process model to achieve formalization for control and data flow. Mainly based on the Business Process Execution Language (BPEL) standard (Andrews et al., 2003), these techniques also have practical capabilities that fulfil the needs of the business environment, such as fault handling and state management. However, the main shortcoming of these techniques is the static selection and composition approach, where the service selection and flow management are done a priori and manually.

A popular research direction attempts to improve BPEL composition by introducing semantics to workflow-based composition (Osman, Thakker, & Al-Dabass, 2005). However, these approaches also match the static behaviour of Web services in terms of whether the service has similar description for functional and non-functional parameters. While for the candidate Web services it is highly likely that these parameters are semantically similar, it is the execution values for such functional and non-functional parameters that provide valuable guidance for the decision-making process regarding the service adequacy for the task. This is because service behaviour is difficult to presume prior to service execution and can only be formed based on the experience with the service execution.

Hence, the problem requires a methodology, which has the domain-specific knowledge repre-

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