Chapter 4
An Agent-Enabled Semantic Web Service Composition Framework

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ABSTRACT

A Semantic Web service composition system can be considered as a multi-agent system, in which each of the component service is considered as an agent capability. This chapter presents a multi-agent system based Semantic Web service composition approach. The proposed approach deals with some of the untouched issues and uses cognitive parameters and quality of service (QoS) parameters in service-provider selection. Education planning, a new application area for Semantic Web technology that involves planning the admission process for higher education courses has been introduced and the proposed approach and models are applied to it.

1. INTRODUCTION

Semantic Web Services (SWSs) are web services with well-defined semantics, having their own properties and capabilities described in an unambiguous and computer-interpretable way, and thus providing inter-operability between them (Mellraith et al., 2001). These are self-contained, reusable software components, which can be used independently to fulfill a need or can be combined with other SWSs to carry out a complex aggregation. SWSs have modular structure and can be published, located, or called through the web. The different services can be combined with other homogeneous or heterogeneous services to form complex web applications. So, the interfaces, properties, capabilities, and effects of SWSs are encoded in a machine-understandable form to allow an easy integration of heterogeneous services. This process of generating aggregated service by the integration of independent available
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component services for satisfying a client-request that can not be satisfied by any single available service is called as SWS Composition.

A Multi-Agent System (MAS) consists of a team or organization of software agents, collectively performing a task, which could not be performed by any individual agent. This paper is based on the understanding that a SWS composition system can be considered as a MAS, where each component service is considered as an agent capability implemented as a self-contained software component. Some of the issues in composition process are there, which are not discussed till now. We have presented a detailed overview of these issues and also proposed a MAS based SWS composition process, which can handle these issues. A detailed evaluation and comparison with the existing similar works has also been presented in the paper. We have used the two mathematical models for service-provider selection, which assess cognitive parameters, and Quality of Service (QoS) parameters in selection. A novel model has been presented for providing the cognitive parameters based selection. This model is an enhancement of a previous work, Hybrid Selection Model (HSM) (Kumar & Mishra, 2008). The work has also been extended by applying the proposed models for education planning. The main contribution of the presented work includes:

- A novel Multi-Agent System based Semantic Web Service Composition approach.
- A novel cognitive-parameters based model for dynamic selection of agents. The model not only considers the past performance of the agent for its selection, but also provides dynamic selection by providing a feedback system.
- Introducing a new domain area of education planning as an application of semantic web based systems. The presented semantic web service composition system has been successfully applied on this problem of education planning.

The paper has been structured as follows. Apart from Introduction in Section-1, some of the related works has been presented in the Section-2. Section-3 presents a novel MAS based SWS composition approach. Section-4 presents a novel selection-model based on cognitive parameters. A brief introduction to HSM has also been presented in this section. Evaluation of the presented composition approach and its validation and comparison with existing similar works has been presented in Section-5. Section-6 introduces a new area of application i.e. education planning and deals with the issues involved in the implementation of proposed service composition approach and service selection models. Finally, the paper has been concluded in section-7, with some discussion on the future work.

2. RELATED WORKS

From the last decade, a lot of researchers are involved in the research on SWS composition. Among other, some of reported works on SWS composition are (Gomez-Perez et al., 2004; Sell et al., 2004; Wu et al., 2003; Lecue & Leger, 2005; Arpinar et al., 2004; Chen et al., 2003; Pistore et al., 2004; Vallee et al., 2005; Kungas & Matskin, 2006; Agarwal et al., 2004; Mellraith & Son, 2002; Kvaloy et al., 2005; Ermolayev et al., 2004; Charif & Sabouret, 2005; and Wu et al., 2006). But, a little attention has been paid to the field of multi-agent based service composition. Out of the above listed works, (Vallee et al, 2005; Kungas & Matskin, 2006; Ermolayev et al., 2004) have presented the use of MAS in SWS composition. A P2P based multi-agent environment providing SWS composition has been presented by the Kungas & Matskin (2006). They have mainly discussed the issues pertaining to the P2P networks and MAS environments. In their presented MAS,
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