A Framework Towards Semantic Web Service Composition Based on Multi-Agent System

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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. The article 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. A new application area for the Semantic Web technology, that is, education planning involving planning the admission-process for higher-education course has been introduced and the proposed approach and models are applied on it.

Keywords: Cognitive Parameters; Multi-Agent System; Quality of Service Parameters; Semantic Web; Service Selection and Composition

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 interoperability between them (McIlraith, Son, & Zeng, 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 avail-
able component services for satisfying a client-request that cannot 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 article 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. Many works (e.g., Gomez-Perez, Gonzalez-Cabero, & Lama, 2004; Sell, Hakimpour, Domingue, Motta, & Pacheco, 2004; Wu, Parsia, Sirin, Hendler, & Nau, 2003; Lecue & Leger, 2005; Arpinar, Aleman-Meza, Zhang, & Maduko, 2004; Chen et al., 2003; Pistore, Bertoli, Cusenza, Marconi, & Traverso, 2004; Vallee, Ramparany, & Vercouter, 2005; Kungas & Matskin, 2006; Agarwal, Handschuh, & Staab, 2004; McIlraith & Son, 2002; Kvaloy, Rongen, Tirado-Ramos, & Sloot, 2005; Ermolayev, Keberle, Kononenko, Plaksin, & Terziyan, 2004; Charif & Sabouret, 2005; Wu, Ranabahu, Gomadam, Sheth, & Miller, 2006) have been reported on the SWS composition. Out of this, Vallee et al. (2005), Kungas and Matskin (2006), and Ermolayev et al. (2004) have presented the use of MASs in SWS composition. But, some of the issues in composition process are there, which are not discussed until 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 article. 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 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 article has been structured as follows. Apart from introduction in the first section, the second section presents a novel MAS based SWS composition approach. The third section 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 the fourth section. The fifth section introduces a new area of application, that is, education planning, and deals with the issues involved in the implementation of a proposed service composition approach and service selec-
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