Issues and Challenges in Web Service Management Systems

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Service computing is a new research discipline which combines the efforts of multiple established disciplines like computer science, software engineering, information system, and social science. It aims to provide service-oriented solutions to enterprise applications. In addition, it provides foundation technologies to next generation computing paradigm such as cloud computing. Web Services (WS) and Service-Oriented Architectures (SOA) are the technologies of choice for the development and deployment of service-oriented solutions. Web services are autonomous, platform-independent software unit that can be described, published, discovered, queried, changed, trusted, and programmed.

As the industry moves forward on utilizing full potential of WS and SOA technologies, the fast increase in the number of deployed Web services will transform the enterprise system from a data-oriented system to a service-oriented system. Thus far, these deployed Web services work as self-contained entities to fulfil users' specific requests. However, the real benefits of the service computing lie on the cooperation and interactions among multiple Web services within and across organisational boundaries. As the Web services proliferate on the enterprise systems, the deployed services become difficult to manage due to (a) the complex interactions between services, (b) several changes in services during their lifetime, (c) the need of management of trust in services, and (d) the need to select, query and compose services on the fly. Therefore, there is a need to go beyond and above the basic building blocks of SOA to provide novel service management solutions that deal with the whole lifecycle of services from inceptions to disbandment. Thus, the major challenge is not on building and deploying Web services based on existing business logics, but on building a rigorous and holistic foundation for the end-to-end management of services [A. Bouguettaya et al 2010]. In this special issue, we report the recent research in this area through the following six papers.

Service composition has been well studied in the literature. Many service composition solutions have been proposed such as Business Process Execution Language (BPEL). These solutions have largely ignored the User Interface (UI) components. In order to address this shortcoming, standards such as BPEL4People and WS-HumanTask have been introduced. The focus of these specifications was largely on coordination logic. They have ignored the design aspects of UI such as it can be implemented as a service and composed with other existing services. In a nutshell, we have to develop User Interface as a Service as proposed in (UIaaS)[W. Sherchan et. al 2012]. The added serendipitous benefit of the proposed concept is that the composition of a customized user interface with the requested service is performed by the service composition engine, as is the case with any other services. However, there are a number of issues associated with such concept such as UI ontology, UI language, and UI query and composition. The article "Developing Mashup Tools for End-Users: On the Importance of the Application Domain" aims to address some of these issues in the context of mashup application. It proposes a domain-specific approach to mashups that is aware of the terminology, concepts, rules, and conventions (the domain) the user is comfortable with. The article presents a domain-specific mashup tool and how it is applied to a specific case study.

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An important aspect in service-oriented systems is the selection of services that meet the needs of the end applications. Therefore, there is a need of a mechanism that helps to select the most appropriate services that meets functional and non-functional requirements of the applications. There are many different approaches proposed in the literature such as context matching, profile comparison, similarity matching, signature matching, and constraint matching. In the service-oriented Web, we expect to have a large number of Web services. The service selection mechanism thus needs to be efficient (in terms of time and space). The article "S2R: A Semantic Web service Similarity and Ranking Approach" proposes an efficient approach of selecting the best Web services using both synthetic and semantic matching. It provides a selection of services that have the highest number of operations in coherence with the consumer request, and have corresponding acceptable QoS parameter values. It also compares the proposed approach with similar existing approaches to show its applicability and performance.

The number of service selection mechanisms proposed in literature has an underlying assumption that QoS of Web services (such as availability) is readily accessible and services with better availability are selected in the composition. Providing real time availability information to service selection, when the pool of Web services to select from is very large, is a challenging issue and remained to be addressed. The issue gets even more complicated when the service is a composite service, as the availability of a composite service depends on the availability of the component services. The article "Achieving High Availability of Web Services Based on A Particle Filtering Approach" aims to address this problem by exploiting particle filltering-based techniques. In particular, the article proposed algorithms to accurately predict the availability of Web services and dynamically maintain a subset of Web services with higher availability ready to join service compositions.

A large number of applications developed by composing services are interactive, i.e., human interactions are necessary in order to complete the process built by composing various services. This brings a new challenge of building new applications by composing machine-based computation with human-based computation in order to design and implement complex applications. The article "Virtualizing Software and Humans for Elastic Processes in Multiple Clouds a Service Management Perspective" partially addresses this problem by examining the fundamental issues in virtualizing human-based computing elements and machine-based computing elements using service-oriented computing concepts in order to create highly scalable computing systems of hybrid services to support the elasticity of software and people in complex applications. The article outlines the Vienna Elastic Computing Model which aims at introducing techniques and frameworks to support multi-dimensional elastic processes over multiple cloud systems of software-based and human-based services.

Semantic Web plays an important role in managing service-orientated systems on the Web. Ontology is one of the key concepts behind semantic Web and has been used in managing Web services in recent times. One of the challenging tasks is the development of the service ontologies. The article "An Integrated Framework for Web Service Ontology Development" proposes a framework to construct a Web service ontology in a bottom up fashion. The current approaches of developing and deploying a service ontology are mainly performed in a top-down fashion. In a top-down method, a service ontology is predefined by domain experts through a thorough study on a service space There are two major shortcomings of top-down methods. First, intensive human efforts are required during the process of constructing service ontology. Second, top-down methods assume that service providers will link their services to the service ontology. The article proposes a bottom-up method to address the shortcomings of top-down ontology development approaches. The main idea of the bottom-up method is that, it starts with service descriptions, which have already been published by service providers and available on the Web, and automatically extract inter-service relationships to construct service ontologies using well-known information retrieval techniques.

Service publication and discovery is another interesting and challenging problem. When there

are a large number of services providing the similar functionalities, these services need to be put together so that they can be discovered while searching for the same functionality. Current techniques involve either the use of service description expressed through WSDL or joining the community at the time of publishing the service. First, WSDL rarely provides rich description for service that can be used to search services with similar functionality. Second, there are many communities in the Web and joining a single community does not guarantee the selection of service. In order to address this problem, the article "Integrating User Invocation Data and Extended Semantics for Service Community Discovery". In this article, authors present an integrated service discovery framework based on Non-negative Matrix Factorization (NMF). NMF provides an effective means to cluster high-dimensional sparse data with both high clustering accuracy and good interpretability of the clustering result. This makes NMF especially suitable for service community discovery by clustering the Web service description data.

This special is a result of direct and indirect involvements of many people. We would like to express our gratitude to authors of accepted papers. We would also like to thank reviewers for their contributions to this special issue. We hope that through this special issue we are delivering a state-of-the-art glimpse of issues and challenges in Web Service Management Systems, bringing to the attention of the community novel problems that must be investigated. We hope that this special issue will serve as a valuable reference for researchers and practitioners working in Web Services.

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