A Study on Recommendation Methods in Web Services: Existing Solutions and Their Limitations

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Abstract

Due to Web Services' platform and language independent nature, many business corporations have used them for the integration of various applications. However, the growing amount of available Web Services on Web forms a new problem - how to select and recommend an appropriate Web Service that matches the user requirements. In this paper, we investigate recommendation methods in Web Services, and discuss their strength and limitations.

1. Introduction

Web Services add a new level of functionality to the existing Web, and change the way we find and share data. This is due to Web Services' platform and language independent nature, which enabled many corporations, to use Web Services for the integration of various applications [4, 5]. However, the growing amount of available Web Services on Web forms a problem - how to select and recommend an appropriate Web Service that matches the user requirements.

Different recommendation methods in Web Services with variety of success level have been proposed to deal with this problem. In this paper, we first investigate these recommendation methods by categorizing them into three groups, such as the machine learning based methods, social network based methods and semantic web based methods. Then, we discuss the characteristics, strength and limitations of each recommendation method.

The rest of the paper is proceeds as follows. Section 2 describes the existing recommendation methods in Web Services, and Section 3 demonstrates various features of these methods. Chapter 4 highlights conclusions.

2. Recommendation Methods in Web Services

In this section, we discuss recommendation methods in Web Services.

Machine Learning Based Methods. Zheng et al. [8, 9] proposed a collaborative filtering method for predicting QoS values of Web Services and recommending appropriate Web Service. The authors first propose a user-collaborative mechanism for collecting past QoS information about Web Service from different service users. Then, based on the collected QoS data, QoS values prediction method for Web Services is proposed by combining the traditional user-based and item-based collaborative filtering methods. Finally, to examine the QoS value prediction accuracy of the proposed method, large-scale real-world experiments are performed.

Cao et al. [1] argued that recommendation methods based on collaborative filtering cannot define the relationship between Web Services and providers. In order to solve this problem, the authors first propose a novel three-dimensional cube model to define the relationship among providers, consumers and Web Services. Then, the authors propose two algorithms for bidirectional Web Service recommendation, such as a Standard Deviation based Hybrid Collaborative Filtering (SD-HCF) for Web Service Recommendation (WSRec) and an Inverse consumer Frequency based User Collaborative Filtering (IF-UCF) for Potential Consumers Recommendation (PCRec).

Social Networking Based Methods. Tang et al. [7] argued that collaborative filtering based methods are unreliable by investigating the trustworthiness issues in Web Service recommendation. In order to handle this problem, the authors propose a collaborative, trust-aware service recommendation method for Web Services with social networks. The main idea of the proposed method is to integrate the user-service relation and the user-user social relation. In other words, the proposed method combines the similarity and trust relationships among users based on the collaborative filtering and make service recommendation for a target user.

Chen et al. [2] proposed a methodology to connect distributed services into a global social service network for social influence-aware service recommendation, called recommend-as-you-go. The authors first propose a novel platform to design a global social service network by connecting distributed services with social link using quality of social link; and then present a flexible model for effective awareness of social influence to provide a quantitative measure of the influential strength. Based on the proposed global social service network, a novel social influence-aware service recommendation approach is introduced.

Semantic Web Based Methods. Lecue [3] proposed a hybrid method by merging collaborative filtering methods and a semantic content-based method. In order to analyze semantic similarity of services, the proposed method performs Description Logic based reasoning on semantic descriptions of services. Thus, comparing to traditional collaborative filtering methods, the proposed method is able to reduce the impact of the cold start (e.g. gather and to analyze a set of end-user's interactions) problem and improve the semantic accuracy of services' recommendations. Raymond and Song [6] argued that proposed Semantic Web methods rarely examine discovery, services choreography, services enactment, and services contracting, the non-monotonicity in Web Services discovery and recommendation. In order to deal with this problem the authors proposed a development of a belief revision logic based service recommendation agent to address the non-monotonicity issue of service recommendation.

<Table 1> Summary of Recommendation Methods in Web Service

Methods	Characteristics	Advantage	Disadvantage	Comment
Machine Learning Based Methods	- Construct a matrix of users and Web Services using collaborative filtering - Recommend services based on user similarities calculated using statistical analysis	- Highly accurate (95%)	- Similarities calculation is time consuming	- High dimensional data (many QoS attributes)
Social Network Based Methods	- Form a social network of service consumers - Recommend services based on user similarities in social networks	- Easy connection to all major social networking services	- Trustworthiness degree of recommenders is a problem	
Semantic Web Based Methods	- Construct ontology of Web Service's classes - Recommend services based on class similarities	- Visualize service properties as taxonomy - Highly accurate (99%)	- Building, querying, making interface for ontology are bothersome	

3. Discussions

In this section, we describe the characteristics, strength and shortcoming of recommendation methods discussed in Section 2. Table 1 summarizes recommendation methods in Web Service.

The main characteristics of machine learning based recommendation methods, which mainly use collaborative filtering, is that these methods build a matrix of users and items (e.g. Web Services), and recommend Web Services based on user or item similarities calculated using statistical analysis. However, calculating these similarities could be time consuming, especially, when the data is multi-dimensional. The advantage of machine learning based recommendation methods is that they have high accuracy level of 95%.

The social network based recommendation methods form a social network of services consumers, and recommend services based on user similarities in specific social network. The strength of these methods is that they can easily get connected to major social networking services. For example, Amazon and eBay have already introduced a platform for social networking called Amazon Friends and eBay Groups. However, the main drawback of social network based recommendation methods is that they have a low level of trustworthiness between various participants of social network.

The Semantic Web based recommendation methods construct ontology of various features of Web Services, and make recommendations based on similarities of these features. The advantages of these methods are that they visualize service properties as taxonomy and show high accuracy of 99%. However, constructing, querying and making interface for ontology can be bothersome as it demands a specific set of technologies.

4. Conclusion

In this paper, we first discussed recommendation methods in Web Services and then, described their strength and limitations. Through discussions, we can conclude that a good recommendation method would incorporate several features, such as high accuracy, trustworthiness and simplicity. Thus, in the future, we will construct a recommendation method that embraces these metrics.

Reference

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