Collaboration reputation for trustworthy Web service selection in social networks

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A B S T R A C T

Traditional trustworthy service selection approaches focus the overall reputation maximization of all selected services in social networks. However, the selected services barely interact with each other in history, which leads to the trustworthiness among services being very low. Hence, to enhance the trustworthiness of Web service selection, a novel concept, collaboration reputation is proposed in this paper. The collaboration reputation is built on a Web service collaboration network consisting of two metrics. One metric, invoking reputation, can be calculated according to other service's recommendation. The other metric, invoked reputation, can be assessed by the interaction frequency among Web services. Finally, based on the collaboration reputation, we present a trustworthy Web service selection method to not only solve the simple Web service selection but also the complex selection. Experimental results show that compared with other methods, the efficiency of our method and the solution's trustworthiness are both greatly increased.

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1. Introduction

Social networks have recently received much attention on the mobile Internet. For example, YouTube, MySpace and Facebook are among the most popular social network sites, and continue to experience explosive growth both in terms of the number of communities and the overall population [1]. The social networks are constructed to provide a powerful means for users to share, organize and locate interesting services such as mobile APP, open API, Web services.

As a large number of functionally equivalent (or similar) Web services have been built and deployed, customers face a difficult task in choosing the best service to build their composite service which satisfies their personalized Quality-of-Services (QoS) requirements. Thus, the efficiency associated with selecting a Web service with a QoS guarantee has increasingly become a critical issue in the Web service selection process [2].

One of the major problems in the Web service selection process is that QoS cannot reflect the real situation of Web services because the dynamic environment imposes a stochastic nature on Web services. Some enhanced QoS measurement algorithms [3] have been proposed to eliminate the uncertainty. However, in actual practice, some Web service providers may intentionally exaggerate their QoS values, and QoS measurement cannot reveal this sort of malicious deception. To address this problem, trustworthy Web service selection is needed, which assigns high level reputation values to different Web services. Then the performance of selected Web services can be guaranteed based on their reputation value (score).

The reputation represents a collective perception of the users in the social network about a Web service. The reputation of an invoked Web service is a collective feedback rating of the users that have interacted with or used the service in the past [4]. Accurate reputation measurement about Web services in social networks plays an important role in identifying good nodes and connections. Hence, the ability to obtain an accurate reputation score of each Web service within a large social network structures is also important [5].

Unfortunately, we found most Web service methods only rely on the reputation value of individual Web service. In such case, the total reputation of all selected Web services which composite a new value-added service (i.e. composite service), is maximized, but the total trustworthiness among services is very low. Why? For a service, if its reputation value is very high, it will be selected with higher probability than other services with low reputation. However, in this composite service, there is a selected service that had little or no interaction with other Web services. Then when one service invokes the service for a new task or instance, the trustworthiness between the two services is less than the average reputation of the two services. If each of the two services has a high reputation value, but they barely interact with each other, which shorten the total trustworthiness of the composite service because of unknown interaction risks.

Hence, in such cases, the trustworthiness of Web service selection may not be the highest, i.e., we let the best selection scheme slip away. What do we do?

The answer may be collaboration, which in this paper denotes the invocation collaborative relationship of Web services, including invoking and invoked relationships. The invoking relationship means that one service invoked other services, and the invoked relationship means that one service is invoked by other services in this paper. Actually, we find that the collaboration among Web services can provide a good prospect for trustworthy Web service selection, and it should be taken into consideration actively. Moreover, the collaboration does not only considers the reputation of individual service, but also pays more attention to the intimate relationship between multiple services. Therefore, we think that an ideal trustworthy Web service selection approach should be able to exclude the Web services with low reputation by collaborating with other services and provide the trustworthy Web service selection for composite services.

In this paper, based on our previous work [6], we aim to propose a trustworthy Web service selection approach that does not only consider individual Web service reputation but also the collaboration reputation of Web services. The main contributions of our work include:

To support collaboration reputation, we first construct a Web service collaboration network (WSCN) to eliminate the Web services with low reputation from the WSCN using our proposed neighbor update strategy and then divide normal Web services into different Web service community using community detection.

To avoid subjective reputation measurement, based on WSCN, we propose a novel concept, collaboration reputation, which is evaluated by invoking reputation and invoked reputation. Invoking reputation is used to evaluate the performance experience of a Web service, and can be calculated according to other services' recommendation in the Web service community. Invoked reputation is used to evaluate the performance importance of a Web service, and can be obtained according to the interaction frequency between the invoking Web service (which means it invoked other services) and invoked Web services (which means it was invoked by other services) in the Web service community.

Finally, based on the collaboration reputation, we present a trustworthy Web service selection method. This method does not only solve the simple Web service selection but also the complex selection. We conduct extensive experiments to evaluate the effectiveness of our approach. The experimental results reveal that our approach not only increases the trustworthiness of Web service selection but also improves the efficiency.

The paper is organized as follows. To begin with, it presents related work on Web service selection in Section 2, and then introduces a framework for trustworthy Web service selection in Section 3 and the WSCN is constructed in Section 4. Furthermore, we propose a novel concept about collaboration reputation for Web service selection in Section 5. Based on the collaboration reputation, we show the trustworthy Web service selection approach in Section 6. Finally we conduct experiments in Section 7 and conclude the paper in Section 8.

2. Related work

A number of researchers have recognized the importance of reputation in Web service selection, and many state of the art solutions have been proposed. They adopted different techniques in different aspects to establish the trustworthiness of Web services or service selections.

Wang and Vassileva [7] discussed QoS trust as applied to web service selection and presented further research directions. Vu et al. [8] collected users' reports on QoS to rank and select Web services based on past QoS data predictions. Yau et al. [9] identified the deviation between the QoS provided by their service providers and the QoS values determined by monitors and service user feedbacks to improve the trustworthiness of the QoS information. The method might result in a false rating when the user's feedback is taken into account. In addition, fuzzy theory has been applied to enhance the QoS trust. Manchala [10] proposed a fuzzy matrix that is defined based on the transaction history to establish transaction trust. Nepal et al. [11] added a query model and underlying data to the fuzzy trust management framework, which represents and queries customer perception. Alfaro et al. [13] concluded on a note of optimism concerning the role of reputation systems in mediating online collaboration, and gave important references of design and optimization of reputation systems. McNally et al. [14] proposed a good approach to modeling user and item reputation in social recommender systems and it is more efficient than other approaches.