

Location-Aware and Personalized Collaborative Filtering For Web Service Recommendation

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Abstract Collaborative filtering explores techniques for matching people with similar interests and making personalized recommendations on the web. The Collaborative Filtering (CF) is widely employed for making Web service recommendation. The main aim is to predict missing QoS (Quality-of-Service) values of Web services. Although several CF-based Web service QoS prediction methods have been proposed in recent years, the performance still needs significant improvement. In this the Quality of Service (QoS) prediction methods rarely consider personalized influence of users and services and it consider Web service QoS factors, such as response time and throughput, usually depends on the locations of Web services and users. In this paper, we propose a location-aware personalized CF method for Web service recommendation. The proposed method sways both locations of users and Web services when selecting similar neighbors for the target user or service it also includes an intensify similarity measurement for users and Web services, by taking into account the personalized influence of them. To evaluate the performance of our proposed method, We conducted a set of comprehensive experiments employing a real-world Web service dataset, which demonstrated that the proposed Web service QoS prediction method significantly outperforms previous well-known methods. We also incorporate the locations of both Web services and users into similar neighbor selection, for both Web services and users. Comprehensive experiments conducted on a real Web service dataset indicate that our method significantly outperforms previous CF-based Web service recommendation methods and it improves the QoS prediction performance, we take into account the personal QoS characteristics of the both web service and user to compute similarity between them.

Keywords: Web services, service recommendation, QoS prediction, collaborative filtering, location-aware

I. INTRODUCTION

WEB service is a software system designed to support interoperable machine-to-machine interaction over a network. With the prevalence of Service-Oriented Architecture (SOA), more and more Internet applications are constructed by composing Web services. As a consequence, number of Web services has increased rapidly over the last decade. Web service discovery has become a crucial and challenging task for users. In addition to functional requirements, users also want to find Web services that satisfy their personal non-functional requirements. Quality-of-Service (QoS) is widely employed to represent the non-functional performance of Web services. QoS is usually defined as a set of non-functional properties, such as response time, throughput, reliability, and so on. Due to the paramount importance of QoS in building successful service-oriented applications, QoS-based Web service discovery and selection

has garnered much attention from both academia and industry. Typically, a user prefers to select a Web service with the best QoS performance, provided that a set of Web service candidates satisfying his/her functional requirements are discovered. Employing CF technologies, Web services with optimal QoS can be identified and recommended to the user

II. RELATED WORK

Collaborative filtering is one of the most popular recommendation techniques, which has been widely used in many recommender systems. In this section, we give a brief survey of CF algorithms, and summarize recent work on CF-based Web service recommendation.

2.1 Collaborative Filtering (CF)

Collaborative filtering is a method of making automatic predictions (filtering) about the interests

of a user by collecting preferences or taste information from many users(collaborating) .

2.2 Web Service Recommendation

Web service QoS prediction is used in different ways in LoRec to facilitate Web service recommendation. First, when a user searches Web services using LoRec, predicted QoS values will be shown next to each candidate service, and the one with the best predicted value will be highlighted in the search result for the active user. It will be easier for the active user to decide which one to have a try.

III. MOTIVATION

Now we give a further explanation regarding the motivation of our work

3.1 Incorporating QoS Variation into User and Service Similarity Measurement

We argue that the personalized characteristics (e.g., QoS variation) of both Web services and users should be incorporated into measuring the similarity among users and services. Web service QoS factors, such as response time, availability and reliability, are usually user-dependent. From different Web services, we can derive different personalized characteristics, based on their QoS values, as perceived by a variety of users. These Web services are also likely to have small variation of QoS values over different users. Many other Web services may have a relatively large variation of QoS over different users.

3.2 Incorporating Locations of Users and Services into Similar Neighbor Selection

Web services are deployed on the Internet. Thus, QoS of Web services (such as response time, reliability and throughput) is highly dependent on the performance of the underlying network . If the network between a target user and a target Web service is of high performance, the probability that the user will observe high QoS on the target service will increase. There are several factors affecting the network performance between the target user and the target service.

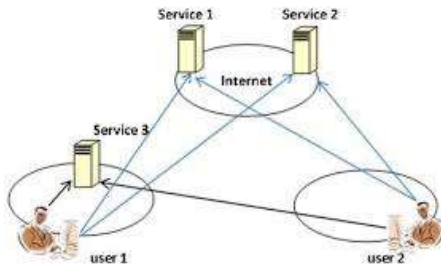


Fig. 1. Influence of user location on QoS prediction

IV. OVERVIEW OF OUR WEB SERVICE

Recommendation Method:

We consider the following scenarios where an active user is searching for high-quality Web services in a Web service discovery system or the system is recommending high-quality Web services to an active user. In these scenarios, predicting QoS values for Web services unknown to the active user is firstly required; then, Web services with satisfactory QoS can be identified and recommended to the user. This work focuses on predicting QoS values of Web services for recommendation. As shown in Figure 2, our Web service recommendation method consists of the following main ingredients:

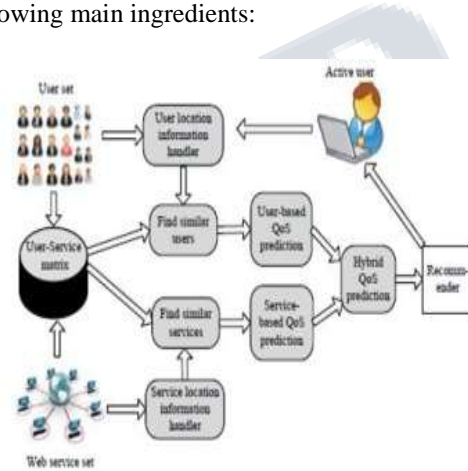


Fig 2 : Overview of our Web service recommendation method

(1) User location information handler: This module obtains location information of a user including the network and the country according to the user's IP address. It also provides support for efficient user-querying based on location.

(2) Service location information handler: This handler acquires additional location information of Web services according to either their URLs or IP addresses. The location information includes the network and the country in which the Web service are located. It also provides functionalities for supporting efficient locationbased Web service query.

(3) Find similar users: This module finds users who are similar to the active user by considering both the users' QoS experiences and locations. For accurate user similarity measurement and scalable similar user selection, we propose a weighted user-based PCC via exploring QoS variation of Web services and incorporate user locations into similar user selection.

(4) Find similar services: In contrast to finding similar users, this module finds similar Web services for a target service, considering both QoS of Web services as well as service locations. A

weighted service-based PCC for measuring similarity between services is proposed.

(5) User-based QoS prediction: After a certain number of similar users are identified for the active user, this function aggregates the QoS values they perceived on target Web services, and predicts the missing QoS values for the active user.

(6) Service-based QoS prediction: After a certain number of similar services are identified for a target Web service, this function aggregates their QoS values to predict the missing QoS values for the active user.

(7) Hybrid QoS prediction: This function combines the user-based QoS prediction and the service-based QoS prediction results, making final QoS predictions. The cold-start problem and data-sparsity problem in QoS predictions are also addressed in this module (details will be provided in Section 7.3).

(8) Recommender: After predicting missing QoS values for all candidate Web services, this function recommends Web services with optimal QoS to the active user.

V. LOCATION INFORMATION REPRESENTATION, ACQUISITION, AND PROCESSING

This section discusses how to represent, acquire, and process location information of both Web services and service users.

5.1 Location Representation

We represent a user's location as a triple $(IP_u, ASN_u, CountryID_u)$, where IP_u denotes the IP address of the user, ASN_u denotes the ID of the Autonomous System (AS) that IP_u belongs to, and $CountryID_u$ denotes the ID of the country that IP_u belongs to. Typically, a country has many ASs and an AS is within one country only. The Internet is composed of thousands of ASs that interconnected with each other. Generally speaking, intra-AS traffic is much better than inter-AS traffic regarding transmission performance, such as response time. Also, traffic between neighboring ASs is better than that between distant ASs. Therefore, the Internet AS-level topology has been widely used to measure the distance between Internet users. Note that users located in the same AS are not always geographically close, and vice versa. The above representation for locations of both users and Web services enables us accurately and easily measure closeness between both users and Web services. We will demonstrate this later in this section.

5.2 Location Information Acquisition

Acquiring the location information of both Web services and service users can be easily done. Because the users' IP addresses are already known,

to obtain full location information of a user, we only need to identify both the AS and the country in which he is located according to his IP address.

5.3 Location Information Processing

To efficiently determine which user is close to the target user, we group users according to their location information so that those within the same group are really close. Likewise, we group Web services according to their location information so that those within the same group are close to each other.

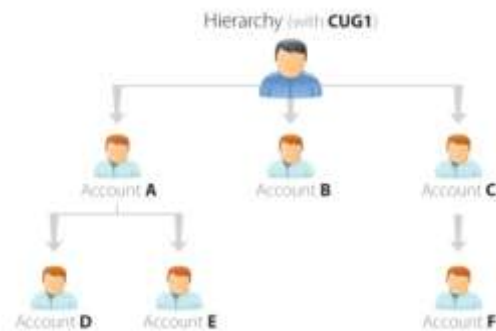


Fig 3 : Hierarchy of user groups

VI. EXPERIMENTS

We have conducted a set of experiments to evaluate the performance of our QoS prediction method. We also have conducted experiments to verify the relation between users' (or Web services') locality and QoS similarity. More specifically, we addressed the following questions:

- ❖ Is there a correlation between location closeness and QoS similarity for either Web services or users? How strong is it?
- ❖ How does the data density affect the performance of the QoS prediction? What is the performance of our method under different data sparseness conditions?
- ❖ How much better is our approach when compared with other CF-based QoS prediction methods? We compared our approach with several previous, well-known methods, in both prediction accuracy and prediction time.

All experiments were developed with Mat lab. They were performed on an HP desktop computer with the following configuration: Intel Core i3 3.20GHz CPU, 2GB RAM with the Windows 7 operating system.

6.1 Dataset

During our experiments, we adopted a real-world Web service dataset, WSDream dataset 2 [36], published in www.wsdream.com. This dataset

contained the QoS records of service invocations on 5825 Web services from 339 users. The dataset can be transformed into a user-service matrix. Each item of the user-service matrix is a pair of values: response time (also called Round Trip Time, RTT) and throughput (TP). This dataset also contained both the IP addresses of all users and the URLs of all Web services. Through analysis, we found that all 339 users were distributed within 137 ASs and 31 countries. Among the 5825 Web services, 5102 Web services are distributed within 1021 ASs and 74 countries. The AS numbers and country names of the other 723 services is unknown because we either failed to transform their URLs into IP addresses or failed to obtain their AS numbers and country names.

6.2 Correlation between Location Closeness and QoS Similarity

In this subsection, we present experimental results on the relation between the location closeness and QoS similarity for both users and Web services. The QoS similarity both between users and between Web services is computed with PCC. To correctly evaluate this relationship, we developed the following two series of experiments:

1) For a user, we first identified its top K similar neighbors based on the QoS similarity measurement. We then calculated the proportion of the user's similar neighbors that are within the same AS or country of the user. A higher proportion indicates a stronger correlation between location closeness and QoS similarity with respect to users. Because most ASs and countries have only a few users (as mentioned previously), in this experiment we therefore choose the top 5 ASs and countries with the most users, performing calculation for each user in them and taking the average proportion as the result. In a similar manner, we also tested the correlation between location closeness and QoS similarity for Web services.

2) We computed the average QoS similarity between every pair of users within the same AS or country, which is referred to as Local User Similarity (LUS), denoted by either *A-LUS* (AS-based) or *C-LUS* (Country-based). On the other hand, we computed the average QoS similarity between every pair of users across different ASs or countries, which is referred to as Global User Similarity (GUS). Again, depending whether AS or country is regarded, GUS is denoted by *A-GUS* or *C-GUS*. Likewise, we also computed both the local service similarity (denoted by either *A-LSS* or *C-LSS*) and the global service similarity (denoted by either *A-GSS* or *C-GSS*). If each type of local similarity is significantly greater than the corresponding global similarity, the location closeness is

considered highly correlated with the QoS similarity.

6.3 Screen Shots



Fig 4 : Home Page

In this project, we proposed a location-aware personalized CF method for Web service recommendation. The proposed method leverages both locations of users and Web services when selecting similar neighbors for the target user or service. It contains home page, admin page, user page and registration page as shown in fig 4.



Fig 5: Admin Page

In this the admin login into this using his username and password and uploads the data or web services regarding the location as shown in fig5.



Fig 6 : Admin Upload Page

Admin uploads the data or web services regarding the location .The user can access the required data or web services by searching location as shown in fig6.



Fig 7 : User Registration

To access webservices the user need to register as shown in fig7.



Fig 8: User Login Page

After registering into this the user can login using his username and password and access web service as shown in fig 8.



Fig 9 : User access Page

After login the user can access web services using location and he can search the required information as shown in fig 9.

VII.CONCLUSIONS AND FUTURE WORK

This paper presents a personalized location-aware collaborative filtering method for QoS-based Web service recommendation. Aiming at improving the QoS prediction performance, we take into account the personal QoS characteristics of both Web services and users to compute similarity between them. We also incorporate the locations of both Web services and users into similar neighbor selection, for both Web services and users. Comprehensive experiments conducted on a real Web service dataset indicate that our method significantly outperforms previous CF-based Web service recommendation methods. In the future, we will take more detailed location in-formation into consideration for QoS prediction, such as the Internet’s AS topology. We will also consider incorpo-rating the time factor into QoS prediction,

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