ISSN No. 0976-5697

Volume 5, No. 1, Jan-Feb 2014

International Journal of Advanced Research in Computer Science

REVIEW ARTICLE

Available Online at www.ijarcs.info

A Survey on Web Service Recommender Systems

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Abstract: With the increased use and emerging of web services on World Wide Web, recommender systems plays a vital role in data gathering and service selection in the internet technology. There are many types of filtering techniques that used in recommender systems. The most effectively used technique is collaborative filtering. Based on the collaborative filtering many web service recommender systems are introduced. The analyze of Quality of Service aware web service recommendation and personalized Quality of Service aware web Service recommendation are explained.

Keywords: Collaborative filtering; Filtering Techniques; Quality of Service; Recommender system; Web service.

I. INTRODUCTION

Web services are software system designed to support interoperable machine- to- machine interaction over a network. The increase of available services may present a significant problem if consumers want to find relevant services. When functionally equivalent web services available on the internet we need to select an appropriate one from the equivalent service set. Quality-of-Service (QoS) is widely employed to represent the nonfunctional performance of web services and has been considered as the key factor in service selection. Different users may observe different QoS performance of the same web service because the QoS performance is susceptible to network conditions such as user location, network conditions. So QoS values evaluated by one user cannot be used directly by the other in service selection and recommendation. The personalized QoS based web service recommendations help to select the optimal one among the functional equivalents.

II. RELATED WORK

In this section, the related work regarding the collaborative filtering and web service recommendation is discussed.

A. Web service recommendation:

Web service recommendation plays an important role in the area of service computing. Blake and Nowlan [1] introduced a score called web service recommendation score by matching the strings collected from the user's operational sessions and the description of the web services. Whether a user is interested in the service or not is calculated based on this web service recommendation score. Maamar [2] Proposed a context of web service interaction models and resources on which the web service performed. Zhao[3] Proposed a model service and their linkages by semantic algorithm. Mehta [4] proposed a service mediation architecture, That describes the quality and usage pattern.

Collaborative filtering methods are widely used in commercial recommender systems [5]. The user-based approaches and the item-based approaches are the most analyzed examples of memory based collaborative filtering [7].

There are many challenges to be addressed when applying collaborative filtering techniques to the Web service recommendation. The main challenges include the QoS information collection of various web services and verification of recommendation results. Open data sets are used in traditional movie recommendation such as MovieLens [6] for studying the recommendation results. However, in the field of service computing, large service selection datasets are difficult to obtain, making verification of the Web service recommendation results a big challenge. In order to overcome the above challenges Zibin Zheng [8] proposed a systematic user-contribution mechanism for collecting QoS information of Web services, novel hybrid collaborative filtering algorithm for the Web service recommendation.

III. QUALITY OF SERVICE AWARE WEB SERVICE RECOMMENDATION

It is a collaborative filtering based web service recommender system. The system architecture of WSRec includes the following procedures: An active service user provides the individually obtained Web service QoS information to the WSRec. The Input Handler in the WSRec processes the input data. The Find Similar Users finds similar users from the training data of WSRec. The Predict Missing Data predicts the missing QoS values for the active user using a hybrid collaborative filtering algorithm and saves the predicted values. The Recommender employs the predicted QoS values to recommend optimal Web services to the active user.

A. Recommendation Algorithm:

The recommendation algorithm works in three phases. It includes similarity computation, missing value prediction and web service recommendation.

Pearson Correlation Coefficient (PCC) is used for the similarity computation. PCC is employed to calculate the similarity between two service users a and u based on the Web service items they commonly invoked.

B. QoS Value prediction:

Similar neighbors selection is an important process for making the missing value predictions. Traditional algorithms still include dissimilar neighbors to predict the missing value, that will reduce the prediction accuracy. To overcome this problem, an enhanced algorithm called Top-K algorithm introduced.

C. Missing value Prediction:

The missing values are predicted by using the similar users' data set. Instead of predicting all the missing values in the user-item training matrix, it predicts only the missing values, which have similar users and items. After predicting missing values in the user-item matrix, that matrix is used for predicting QoS values for active users.

The main disadvantage of this method is for the selection of web service the entire dataset need to be searched.

IV. PERSONALIZED QOS AWARE WEB SERVICE RECOMMENDATION

A. QoS Value prediction:

Users usually provide QoS values on a small number of web services in the web service recommender system. Traditional memory-based collaborative filtering algorithms have the difficulty of sparse user contributed data set, because it's difficult to find similar users without much knowledge of their service experience. Different from the previous methods, the similarity between users' physical locations and QoS properties are considered to solve this problem. It concentrates on the QoS properties that have a chance to change and can be easily obtained by individual users such as response time.

A region is a group of users who are closely located with each other and likely to have similar QoS properties. Each user belongs to exactly one region. Regions are needed to differentiate from each other. The region creation phase is a three step process. In the first step, put users with similar IP addresses into a region and extract region features. In the second step, calculate the similarity between the different regions. In the last step, aggregate highly similar regions to form a certain number of large regions.

B. Feature Extraction:

For each region, the region center is used as the main feature to reflect the performance of web services observed by region users. Region center means the median and it is the value separating the higher half of a sample from the lower half. It is a numeric value. The element i of the center is the median RTT value of service i observed by users from the region. From region to region the service response time varies. It is clear from the large number of QoS records. Some services have long response times or even unavailable in some regions.

C. Similarity Computation:

Before region aggregation the determination of whether two regions are similar is important. The similarity of two regions M and N is measured by the similarity of their region centers m and n. Pearson Correlation Coefficient (PCC) is used in recommender systems to calculate the similarity of two users. PCC value ranges from -1 to 1. Positive PCC value shows that the two users are similar while the negative PCC value shows that the two user preferences are opposite.

D. Region Aggregation:

A region aggregation method based on the region features are considered because it is difficult to find similar users and predict the QoS values of the unused web services for the active user. After the region aggregation, thousands of users are grouped into a certain regions based on their physical locations and QoS value similarities. The region center represents the service experience of users in a region. Here the similarity between the active user and users of a region is calculated by the similarity between the active user and the region center. So, it is more helpful to predict the QoS value for active users based on their region, for users in the same region are more likely to have similar QoS values on the same web service, especially in the regions-sensitive areas.

V. CONCLUSION

Collaborative filtering is the widely used technique in the web service recommender system. The personalized Quality of Service aware web service recommendation is the best to identify the web services, because this method groups the similar users in a region and according to the region feature the Quality of Service aware web services are recommended. More Quality of Service properties will consider in near future.

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