A Feedback Recommendation Based QoS Enabled Web Service

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ABSTRACT
QoS value prediction of Web services is an important issue for service recommendation and selection. QoS value is an important factor for service selection because the quality of whole system is dependent on the QoS of single Web service. In reality predicting the missing QoS value of web service using the existing information is a difficult problem. Collaborative Filtering (CF) is one of the most widely used methods which employ QoS values contributed by similar users to make predictions. So the previous QoS value contributed by the different users is used for the prediction and the evaluation of missing QoS values. The reputation of the user is also an important factor for QoS value prediction. Existing Web service QoS value prediction approaches take data credibility into consideration, but did not take the location information, which may reduce the prediction accuracy. To overcome this problem, a reputation-aware QoS value prediction approach is introduced, which first take the location information into consideration and cluster the users. Then it calculates the reputation of each user based on their previous values, and then takes advantage of reputation-based ranking to exclude the values contributed by untrustworthy users. Experimental results show that this approach has better prediction performance.

Keywords- Data credibility, QoS value prediction, reputation, 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. In the presence of multiple Web services with identical or similar functionalities, Quality of Service provides non functional Web service characteristics for the optimal Web service selection. Since the service providers may not deliver the QoS it declared, and some QoS properties (e.g., network latency, invocation failure-rate, reputation, etc.) are highly related to the locations and network conditions of the service users. Quality-of-Service is 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. While considering reputation it is important to take data credibility into consideration because some users may give random values for unevaluated services and some may give high QoS values of their own services and low for the others.

II. RELATED WORK
Collaborative Filtering
It is a technique used by some recommender system. Breese et al. [1] divided the algorithm into two: Memory based algorithms and model based algorithms. Model based algorithms uses K-means clustering [2], Bayesian model [3], etc., can quickly generate recommendations. Limited work has been done for the web service recommendation using the collaborative algorithm. Shao et al. [4] introduced a user-based collaborative filtering algorithm for the prediction of the QoS values. Zheng et al. [5] combined the memory based and model based algorithms for the web service recommendation. Work [6] introduced the Region KNN approach, which considers the user location information and the response time of the services. Different from all these methods, we propose an effective collaborative algorithm for web service recommendations with the consideration of region factor and the user reputation.

Reputation System
Reputation systems computes and gives the reputation scores for a set of service providers, services, entities. Reputation systems are related to recommender systems and collaborative filtering, but with the difference that reputation systems produce scores based upon the
explicit ratings from the community, whereas recommender systems use some external set of entities and events to generate recommendations to users. Reputation systems produce reputation score and it can be used as a measurement of trustworthiness for the entities.

![Fig 1: QoS Value Prediction Framework](image)

**III. CLUSTERING OF USERS**
For the web service recommendation the correlation between the user's physical location and QoS properties are considered. We assume that there are \( m \) services and \( n \) users. The relationship can be denoted by an \( n \times m \) matrix \( R \). Each entry \( R_{ij} \) of the matrix represents the response time of service \( j \) observed by the user \( i \). We create a region as a group of users who are closely located with each other and likely to have similar QoS values. Each user is a member of exactly one region. The regions should be clearly different from each other. The clustering of users is a three-step process.

**FEATURE EXTRACTION**
For each region, there exist a region center and it reflects the average performance of web services observed by region users. It is defined as the median vector for all the response time vectors associated with the region users. Median and MAD (Mean Absolute Deviation) is the two measures to find the mean \( \mu \) and standard deviation for the sample population.

**COMPUTATION**
Before the region aggregation it is necessary to compute the similarity between the regions. Pearson Correlation Coefficient (PCC) is widely used in recommender systems for the web service recommendation. The similarity between two regions can be calculated by the equation.

\[
\text{sim}'(m,n) = \frac{|s(m) \cap s(n)|}{|s(m) \cup s(n)|} \text{Sim}(m,n)
\]

where \(|s(m) \cap s(n)|\) is the number of web services invoked by users in either in region \( M \) or region \( N \).

**AGGREGATION**
Based on the region feature the regions are aggregated. Users only provide limited number of QoS values, so the data set always leads to poor recommendation. It treats users with similar IP address as a region at outset. In
region iteration the two most similar and non sensitive regions are selected and aggregated.

IV. REPUTATION CALCULATION

Assume there are $m$ service users and $n$ Web Services. The reputation score for each user is calculated by the equation

$$r_i^{k+1} = 1 - \frac{d \sum_{j \in I_i} |q_{t,j} - avg_j^{k+1}|}{|I_i|}$$

(2)

where $I_i$ is the set of services invoked by user $i$, $d$ is the damping factor whose value is in $(0, 1)$ and $avg_j$ denotes the aggregated evaluation value for service $j$. In Eq.(2), $avg_j^{k+1}$ can be calculated by:

$$avg_j^{k+1} = \frac{1}{|U_j|} \sum_{i \in U_j} q_{i,j} \cdot r_i^k$$

(3)

where $U_j$ denotes the set of users and $r_i^k$ is the reputation value of user $i$.

Once the reputation score is obtained the users are ranked according to their reputation values. Thus the untrustworthy users are identified.

COLLABORATIVE FILTERING METHOD FOR REPUTATION CALCULATION

Pearson Correlation Coefficient (PCC) is used for the similarity computation. Untrustworthy users are not considered, only trusted user's value are considered for the computation.

V. RESULTS AND DISCUSSIONS

We conducted the experiments on the dataset contains real-world QoS values from 339 users on 5825 Web services.

In the above figure measure the performance evaluation of web services at various categories such as 10 services, 20 services and 30 services. Time taken to complete web services are increased when the number of services increases in online process manner.

VI. CONCLUSION

QoS is described as a set of properties including response time, availability, reputation, etc. An innovative approach to web service recommendation is used based on the reputation. This employs the characteristic of QoS by clustering users into different regions. Based on the region feature QoS value will predicted and the recommender system recommends the web service to the user. This recommendation approach deals with the similarity between QoS records and users physical locations by using IP addresses, which has had a good recommendation and prediction performance.

REFERENCES


