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A SURVEY ON HIGHLY ACCURATE PREDICTION ALGORITHM FOR UNKNOWN WEB SERVICES WITH FUZZY CLUSTERING

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Abstract: *Quality of Service (QoS) assurance is an important factor of service recommendation. The web services which are never been used before by users have some indefinite QoS values for that service, and hence the accurate prediction of indefinite QoS values is important for the successful consumption of Web service-dependent applications. Collaborative filtering is the technique which is broadly accepted in the prediction of indefinite QoS values as it is significant for predicting missing values. Though, collaborative filtering derived from the processing of subjective data. The QoS data of Web services are generally objective, implies that present collaborative filtering-based approaches are not applicable every time for indefinite QoS values. Fuzzy clustering method is the new approach of achieving the QoS prediction with calculating the user's similarity increases the prediction accuracy and this is verified by evaluating experiments with other processes. The quality of web services is additionally supposed as a multi-dimensional object, and every dimension is one feature of the web services non-functional properties. This approach is used in web services ranking by a score function and multi-dimensional QoS properties are mapped into a single dimensional value.*

Keywords*: Web Service, service recommendation, QoS prediction, collaborative filtering, objective data, fuzzy clustering*

1. INTRODUCTION

Web services are mainly designed for interaction between computers over a network. The web services publication over network is increasing speedily. The users need to select web services from a huge set of applicant services. Most of the users target on evaluating the differences of non-functional properties between web services with related features, and hence useful and competent service suggestion is necessary to determining the most appropriate service element. For that reason, Quality of Service (QoS), which characterizes the non-functional properties of services, is applied as a base to evaluate whether a service is appropriate to recommend.

Since many web services have the similar features, users have to make service selecting judgment without any awareness about service contender. The recommender systems endeavor at helping users in service selection. Some QoS properties are user independent, having matching values for different users while other QoS properties are user-dependent. For example, response time, invocation failure rate etc [9]. The user dependent QoS values are indefinite for the user, if the recommender system recommends user a service that has not been applied before. So, predicting the indefinite QoS values is very essential to find out whether this service is a suitable to recommend or not.

Collaborative Filtering (CF) is a widely used approach to build many popular commercial recommender systems. In order to make prediction of unknown QoS values, numerous approaches are proposed based on CF and accuracy of the predicted values is achieved by making several attempts [8]. Existing quality of web service predicting approaches or web service recommendation methods merely focus on modeling the response time or the throughput of web services. Therefore, these quality attributes cannot comprehensively characterize the performance of a specific service. There is a need of providing web service users with an efficient and effective approach to generate multi-dimensional QoS recommendations and to establish a score function to represent the overall performance of services.

Our approach composes application of the fuzzy clustering in QoS prediction. In this approach, each pattern does not belong to an exact cluster. This is further close to the QoS prediction problem where services or users have dissimilar characteristics and it is complex to determine the exact cluster. Here we take web service users as the clustering objects and improve the traditional FCM for the web service recommendation [8]. We are focusing on minimizing the fault of prediction in the case of data sparsity, and developing the quality of recommendation by offering a complete QoS characteristics ranking result.

2. LITERATURE REVIEWS

The earlier QoS-based approaches like service composition and service selection have restrictions in some respect. Most of them suppose that they can get the service QoS values from third-party associations or service contributors effortlessly, but the values they get may be not consistent and the more difficult-the values needed may be unknown. Hence, several researchers have studied how to predict the indefinite QoS values. Indefinite QoS values prediction is further important particularly for service recommender system, as the prediction's quality concludes the recommendation's quality.

The creator Y. Zhang, Z. Zheng, and M. R. Lyu performs assessments on user-observed QoS of Web services from scattered locations. Service users execute a huge number of Web service invocations under heterogeneous environments on real-world Web services.
Complete experimental results are obtained and reusable datasets are free. More QoS properties will be explore, in addition to failure probability, response-time, and throughput, this is circulated in "Investigating QoS of Real- World Web Services," *IEEE Trans, Services computing*, vol. 7, no.1, pp. 32-38, 2014 [1].

The mainly accepted and successful recommendation method, Collaborative Filtering (CF) has been broadly used in various well-liked viable recommender systems. Forecasting the indefinite rating values is the main job of CF in such recommender systems.
The creators Y. Feng, L. Chen, and Q. Yu, J. Wu illustrated the CF-based process usually consist of two steps:

1. Discover related users or items and withdraw their resemblance.
2. Computing unidentified QoS values according to the identified data of related users or items.

This is circulated in "Collaborative QoS Prediction via Feedback-Based Trust Model" *Proc.6th Int'l Conf. Service- Oriented Computing and Applications (SOCA'13)*, pp. 206-213 2013 and "Hybrid Collaborative Filtering algorithm for bidirectional Web service recommendation," *Knowledge and information systems,* vol. 36, pp. 607-627, 2013 [3].
In [4] "Collaborative Web Service QoS Prediction via Neighborhood Integrated Matrix Factorization," *IEEE Trans, Services Computing*, vol. 6, no. 3, pp289-299, 2013, the creator illustrates Model-based CF uses training data to discover the user significance pattern and then predict user's significance in haven't accessed items. But most of these QoS prediction process are unaware that conventional CF does not work well for objective data.
Zheng enhanced the calculation method of PPC similarity. Small amount of data may lead to an unpredictable similarity in [5] "Personalized QoS-aware web service recommendation and visualization" Services Computing, *IEEE Trans, Services computing,* vol. 6, pp.35-47, 2013.

3. HAPA OVERVIEW

However both the user-based and item-based HAPAs can make prediction individually, HAPA (Highly Accurate Prediction Algorithm) combines these two types of HAPAs to further improve the prediction accuracy.

Below Fig. 1 shows a schematic architecture of web service recommender system. The functionality of the user interface agent is to accept the user's requests and recommend services as per the results from the ranking module. The agent should differentiate if the user is an existing active user or a new one, when service users send a query request for a web service to the user interface agent. Means, the agent needs to interrelate with the users history so as to find out whether the user is an active user (already has an invocation record in database). In case where a user is an active user, system will use the fuzzy clustering module. The functionality of this module is to retrieve the cluster related data. This module accepts the parameters of clustering and similarity as input; and outputs the membership values matrix and the cluster centers matrix. These two matrixes are the input of next module, missing data prediction which predicts missing values of QoS properties. The QoS values will be normalized in the step of multi-dimensional QoS normalization in different methods, and then mapped into a single dimensional value on which the ranking module works. If the user is not an active user, which means she/he do not have any invocation experience, then we look up all the cluster centers, compute an average values for each service and come to the normalization module and ranking module for the recommendation which is reliable with the active user situation.

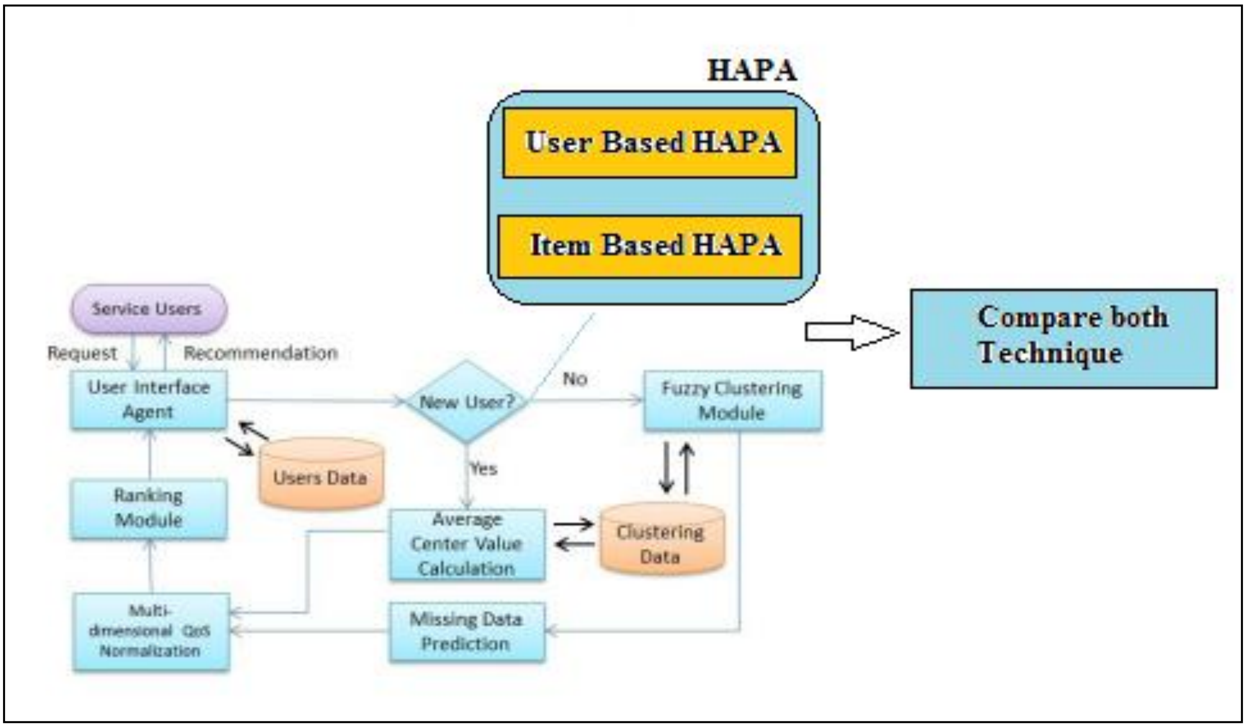

Fig.1: Architecture of HAPA (Highly Accurate Prediction Algorithm) [8]

In HAPA (Highly Accurate Prediction Algorithm), the advantages of similarity computation and fuzzy clustering are combined, and hence increase the accuracy of prediction. Here, it computes the Pearson Correlation Coefficient (PCC) between users. For active users, who have had some web services invocation knowledge, it uses fuzzy clustering algorithm to predict the performance of web services they are going to access.

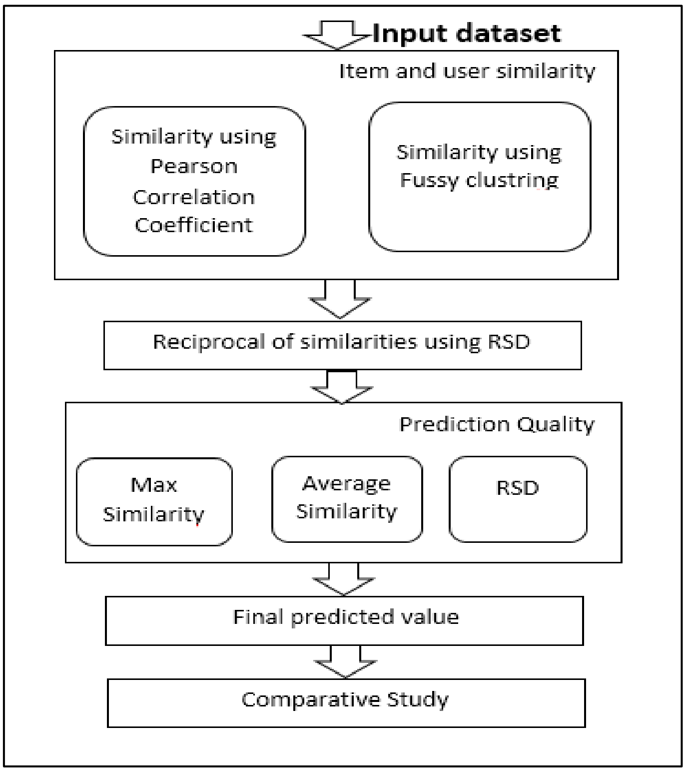

Fig.2: Data flow of recommended system

Below is an application example where 10 services are chosen from serviceXchange and all of them provide weather forecast service. After calling these services from 10 nodes scattered over network, we arbitrarily select 100 invocations record of each service. We select the user as a potential weather forecast service user. After the similarity calculation and fuzzy clustering, construct prediction for each QoS property dimension. The results are shown in Table 1.

WS name	Performance	Strength	Scalability	Reliability	Accuracy
ShowTheWeather	5.435	7.923	5	0.076	0.021
BerreWeather	0.326	20.032	2	0.122	0.019
GlobalWeather	0.258	9.784	6	0.178	0.101
LivedoorWeather	3.587	0.924	2	0.210	0.038
GlobalWeatherService	0.295	5.822	14	0.053	0.076
Weather	0.052	53.489	3	0.032	0.022
WeatherStationService	1.776	5.211	1	0.131	0.201
WeatherService	0.137	4.932	2	0.244	0.100
WeatherForecastService	0.231	23.193	2	0.089	0.049
DASWorldWeather	0.849	10.622	6	0.057	0.105

Table 1: QoS Properties of selected Web Service [8]

WS name	Performance	Strength	Scalability	Reliability	Accuracy
ShowTheWeather	0.269	0.495	0.508	0.924	0.979
BerreWeather	0.554	0.505	0.471	0.878	0.981
GlobalWeather	0.558	0.497	0.521	0.812	0.899
LivedoorWeather	0.372	0.490	0.471	0.790	0.962
GlobalWeatherService	0.556	0.493	0.621	0.947	0.924
Weather	0.569	0.531	0.484	0.968	0.978
WeatherStationService	0.473	0.493	0.459	0.869	0.799
WeatherService	0.565	0.492	0.471	0.756	0.900
WeatherForecastService	0.559	0.507	0.471	0.911	0.951
DASWorldWeather	0.523	0.497	0.521	0.943	0.895

Table 2: Normalized QoS Properties for Ranking [8]

WS name	Score	Ranking
Weather	3.530	1
WeatherForecastService	3.399	2
BerreWeather	3.389	3
DASWorldWeather	3.379	4
GlobalWeatherService	3.354	5
GlobalWeather	3.287	6
WeatherService	3.184	7
ShowTheWeather	3.175	8
WeatherStationService	3.093	9
LivedoorWeather	3.085	10

Table 3: Ranking Result [8]

In Table 1, represents the predicted QoS values of 10 web services. With the normalization functions, compute the normalized value for each QoS property dimension. This result is shown in Table 2. Table 3 shows the final result by mapping the multi-dimensional QoS value into a single dimensional score. One may simply build a web service recommender system with this overall quality score of web services.

4. CONCLUSION

We have used CF to anticipate obscure QoS values. Entirely talking, our methodology is basically distinctive from conventional CF which is not appropriate to objective information expectation. QoS data relates to a variety of factors. It is difficult to divide all QoS data observed by different users into groups on some exact constraints. In our approach, we improve the clustering process based on the FCM algorithm by combining PCC calculation. We use the value of similarity between user's data and cluster centers instead of using Euclidean distance. In other words, we make use of the PCC as the distance measure function to calculate the membership function it make prediction for the missing QoS values more accurately in the case of data sparsity. So we get more accurate similarity values, based on these characteristics, we proposed our HAPA. The prediction accuracy of HAPA was shown to outperform that of many of existing QoS prediction methods. There are still numerous parts of QoS properties can be considered later on in future, for example, the security, system environment and so forth.

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