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Web Service Ranking using Rank Aggregation Method

Ashwini Chavhan
M.E. Student
Department of Computer Engineering
MIT Academy of Engineering,
Pune, Maharashtra, India

R. R. Badre
Associate Professor
Department of Computer Engineering
MIT Academy of Engineering,
Pune, Maharashtra, India

M. A. Kulkarni
Assistant Professor
Department of Computer Engineering
MIT Academy of Engineering,
Pune, Maharashtra, India

Abstract*— Web Service is the electronic processing of Internet communication system. The different applications communicate with each other to share data and services with the help of web services. The idea behind Web services is to make it as a practical tool to use the Internet as a visual tool. Web service fulfils both users functional and non-functional needs. Because of increase in the availability of web services, it is difficult to select appropriate candidates to serve the people in a huge number of web services. Hence, to choose and rank the web services we presented web service ranking approach using rank aggregation method by exploring the user behaviour. The invocation histories are used to infer the user behaviour. To rank the web services three aspects of web services Functional relevance, CF based scores, and the final QoS utility are considered. Moreover with the help of our system user gets recommendation according to his/her profile and current location.

***Keywords*— Web service, Functional Relevance, Collaborative Filtering, QoS, Rank Aggregation, user behavior**

I. INTRODUCTION

Software components like Web services are designed to help communication over the internet between two computers or electronic system. Fast development of technologies based on Web service increases the large quantities of Web services availability on the internet, Recommendation of web services helps in selecting a top quality Web service from a list of a huge number of candidates.[1] Nowadays QoS for web services has become a key success to service providers. For Web services, QoS (Quality of Service) is a key aspect that differentiates service provider offering similar services. The QoS mainly includes reliability, performance, capacity, security, accuracy, accessibility, availability and network. Web Service Selection is considered as two sequential steps which are functional requirements and non-functional requirement. First step functional requirements are achieved by using Matching based method whereas filtering and ranking based method used for the non-functional requirement. The majority of the current approaches believe that functional equivalent Web services are obtained first, and then select the Web service with the best QoS for the user.[2]-[6] However, the functional matching may not always return the correct or appropriate results due to the terminology mismatch or inadequate details provided in WSDL (Web Services Description Language) files. Web service recommendation is the process of automatically identifying the usefulness of Web services and proactively discovering and recommending suitable Web services to end users only based on user's usage history. Currently, collaborative filtering (CF) is widely used for Web service recommendation techniques [14].

In the existing system, there was a problem with finding most appropriate Web services which satisfy both user's functional and non-functional requirements and also finding Web services according to users profile based search. The existing system assumes that the Web service candidates are the functional equivalent. In the existing system, how to combine QoS utility with CF based score for the final Web service ranking is not presented in details. We solve the problem of the existing system in proposed system. In the proposed system we improve the computation of user similarity based on three factors invocation records, functional query, and QoS query, which indicate the historical user behavior. In our system with the help of functional relevance, collaborative filtering based score, and QoS utility, we perform the final Web service ranking. In our system rank aggregation method is used to combine the three aspects of Web services. Moreover, we give a recommendation of web services to users by using users profile and its current location.

II. REVIEW OF LITERATURE

The different authors presented several Web Recommendation Approaches. These approaches enable quality web services search using more reliable and accurate way.

G. Kang et al. (2015), presented the recommendation of web service, which is Diversified by exploring service usage history [7]. Author propose a novel web benefit suggestion approach consolidating a client's potential QoS inclinations and assorted qualities highlight of client interests on web administrations. Client's interests and QoS inclinations on web administrations are initially mined by investigating the web benefit use history. At that point author process scores of web administration applicants by measuring their pertinence with authentic and potential client interests,

and their QoS utility. Finally, a wide variety of grain-based web service and web service graph derived from an original variation-aware web service ranking algorithm to rank the candidates.

Z. Zheng et al. (2013), have proposed Collaborative Web service QoS prediction using neighborhood integrated matrix factorization [8]. The author applies the method of user collaboration for the Web service using QoS information sharing. Then, on the basis of collected QoS data, the neighborhood-based integrated approach for personalised web service is designed for QoS value estimation.

Z. Zheng, H. Ma, M. Lyu, I. King. (2011), presented the QoS-aware recommendation of Web service by collaborative filtering [9] which display a community oriented sifting approach for anticipating QoS estimations of Web administrations and making Web benefit suggestion by taking preferences of past utilisation encounters of administration clients. It first proposes a client community oriented instrument for past Web benefit QoS data accumulation from various administration clients. At that point, in view of the gathered QoS information, a collective separating methodology is intended to foresee Web benefit QoS values.

Lina Yao, Quan Z. Sheng, Anne. H. H. Ngu, Jian Yu, and Aviv Segev (2014), Presented Unified Collaborative and Content-Based Web Service Recommendation [10]. The author proposes a novel hybrid approach that consolidates collaborative filtering and semantic content-based methods for a recommendation of services. A three-way aspect model is exploited by this approach and at that time holding the users and semantic web service content. User inclinations are spoken to utilising latent variables set that can be statistically evaluated. It facilitates the creation of two methodologies (data smoothing and implicit user-descriptor aspect model) to explicitly manage the over-fitting issue brought about by data sparsity.

Q. Zhang, C. Ding, and C. H. Chi. (2011), in their research Collaborative filtering based service ranking using invocation histories [11]. The presented scheme uses CF for service ranking based on invocation histories. In aggregate, existing administration positioning and choice methodologies concentrate on selecting the administration with the best QoS from a positioning of administrations having effectively fulfilled clients' utilitarian prerequisite. Indeed, their useful pertinence is pretty much extraordinary. Functional matching may not necessarily return the accurate results due to the language mismatch or incomplete description information for function or QoS provided in WSDL files. Thus, functional relevance should be considered simultaneously.

Y. Jiang et al. (2011), have proposed A powerful web-based personalised service filtering recommended approach [12] Different Web Services similarities are computed to recommend a web service. Personal profile information of users has been considered to identify the similarity measurement model of Web services. Using personalised user- based and personalised item-based algorithm an effective Personalized Hybrid Collaborative Filtering (PHCF) technique is presented.

III. PROPOSED WORK

A. Objectives

- To rank web services using Functional relevance, CF based score and QoS utility.
- To recommend web services by considering user profile and location.
- To improve ranking performance by considering availability and response time as a QoS parameters.

B. System Architecture

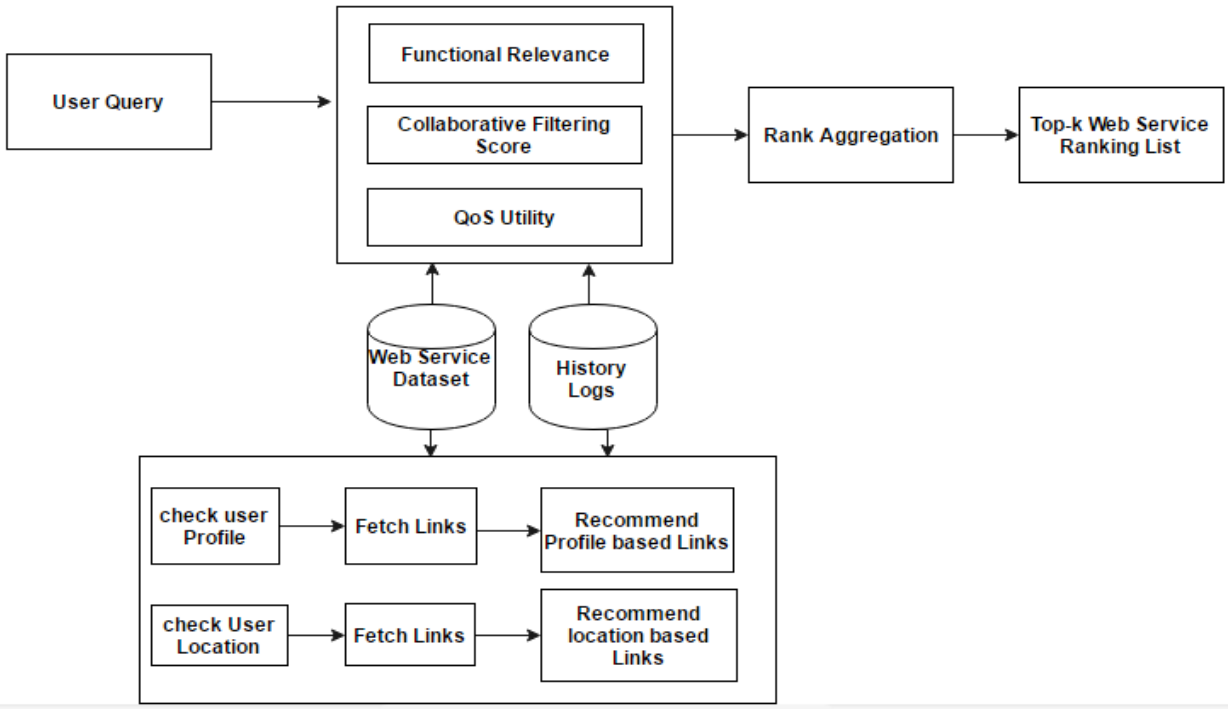

Fig. 1 Architecture of CF based Web Service Ranking and Recommendation

The Architecture of CF based Web Service Ranking and Recommendation is shown in Fig.1. User first login with the system and then send web service query to the system. Then system identifies the stop words and removes it from user search query. Links stored in the dataset are selected using the search keywords. Functional relevance, CF based score, QoS values are calculated by using users history for each selected link. Finally, it will calculate final web service rank Score by rank aggregation method, the top-k Web service ranking list can be returned to the active user. It will store data into history table for web link used by the user. Our proposed system also recommends web services to active users.

- Profile based recommendation: Recommend web services which are not used by the active user but used by profile based similar user.
- Geo-based recommendation: Recommend web services by considering user location information.

The system consists of following modules:

1) Module 1: Remove Stop Words

User first login with the system and then send Web service query to the system. Then system identifies the stop words and removes it from user search query. Links stored in the database are selected using the search keywords.

2) Module 2: Web service Ranking

For each fetched link from dataset calculate

i) Functional relevance value is calculated as the ratio of number of times link is used by the active user to the total number of functionally related links in history.

ii) CF based score is calculated as a number of times the web link is used by the active user in history.

iii) For QoS two parameters are considered availability and Response time.

Availability is calculated as the ratio of success attempt to the total attempt of web link and response time is a time difference between end time and start time of link.

iv) Finally, Rank Aggregation method is used to compute the final rank score and web services are ranked using this rank score and displayed to the active user.

3) Module 3: Web service Recommendation

- Profile based recommendation:

Web services are recommended to the user by considering user profile. Web services not used by the active user but used by other profile similarity based user are recommended to the active user.

- Geo-based recommendation:

Web services recommended to the user on the basis of user location.

IV. MATHEMATICAL MODEL

- Let S be as a system to get Web Services and Web Service Recommendations.
  S = {In, P, Op}
- Identify Input In as: In = {U_q, U_l, U_p}
  Where, U_q = User Query
  U_l = User Current Location
  U_p = User Profession
- Identify Process P as:

P = {FR, CFs, QoS, RA, FS_i}
Where,
FR = Functional Relevance
FR = prob((Link Count)/(Total Count))
Where, Link Count= Number of times link used
Total Count= Total number functional relevant links in history
CFs = Collaborative Filtering Based Score

$$CFs_{Ui} = Count(U_i, l_1 \dots l_m)$$ where, U_i = User
$l_1 \dots l_m$=links

QoS = QoS Utility
Availability = $\frac{S_a}{t_a}$
Where, S_a is success attempt
t_a is total attempt
Response time = edtm - sttm
Where, edtm= end time
sttm= start time
RA = Rank Aggregation

$$FS_i = Ri^{FR} + \beta Ri^{CF} + Ri^{QU}$$

FS_i= Final Rank Score

- Identify Output Op as : Op = {WS_L, WS_R}
  Where,

WS_L = Top k Web Service Ranking List
WS_R = Recommendation of web services based on Active User's Current location and his profile.

V. ALGORITHMS

A. Algorithm to calculate functional relevance

INPUT: Searched keyword/query
OUTPUT: Functional relevance value
BEGIN
Let Sw is the searched keyword after removing stop words from query
Let Lk is the fetched links from dataset
FOR each keyword Sw
Do
Fetch links Lk from dataset by matching keyword
For each fetched link
Calculate Functional Relevance
Link count /Total count
End for
End DO
End FOR
End

B. Algorithm for Web Service Ranking

INPUT: User Search Query
OUTPUT: Web Service Ranking List
BEGIN
Remove stop words from Query
FOR each keyword
DO
Fetch links from dataset
Calculate functional relevance value for each fetched link
Calculate Collaborative Filtering Score for each fetched link
Calculate QoS utility for each fetched link
Calculate Final Rank Score for each fetched link by Rank aggregation method
END DO
END FOR
END

VI. PERFORMANCE METRICS

Availability and Response time are considered as two parameters for QoS utility.

A. Availability is calculated as the ratio of success attempt to the total attempt of the web link.

B. Response time is a time difference between end time and starts time of link.

VII. CONCLUSIONS

The system presents, the User behavior and QoS based hybrid service ranking approach. The system identifies the stopwords and removes it from user search query. Links stored in the dataset are selected using the search keywords. Functional relevance, CF based score, QoS values are calculated by using user's history for each selected link. Finally, it will calculate final web service rank Score by rank aggregation method. The top-k Web service ranking list can be returned to the active user. It will store data into history table for web link used by the user. Moreover in our system user gets recommendation according to his/her profile and its current location. Profile based system will recommend web services which are not used by the active user but used by profile based similar user and for Geo-based recommendation system will recommend web services by considering user location information.

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