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QoS Based Approach for Web Service Recommendation

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Abstract: ***Web services are important integrated software components for the support of interoperable machine to machine communication over internet. Web services have been widely used for building services oriented applications in industry in recent years. On internet publically available web services are widely increased in recent years. For the web services users it is very hard to select a proper web services among a large amount of services available on internet. Improper selection of web services may cause many problems (e.g., ill-suited performance) to the resulting applications. In this paper we proposed Collaborative Filtering (CF), we propose an innovative CF algorithm for Q-o-S-based web service recommendation. we provide a personalized map for browsing the recommendation results. The map explicitly shows the QoS relationships of the recommended web services as well as the basic structure of the QoS space by using map metaphor such as dots, areas, and spatial arrangement.***

Keywords: Web service, quality of service (QoS), Caching, Routing;.

1. Introduction

The state-of-the-art in business integration is outlined by implementation of the service-oriented vision using net service technology. Web services are loosely coupled, distributed entities that can be represented, published, characterized and invoked via the web infrastructure. Three vital standards Web Service Description Language (WSDL) for presenting service interfaces, Universal Description, Discovery and Integration (UDDI) registries for publishing, and Simple Object Access Protocol (SOAP) for message transporting .With ever increasing number of offered net services it's problematic to end a service with needed practicality and acceptable quality characteristics. Most of the plans in the area of net service discovery rely on logically recise linguistics descriptions of net services by providers [1][2][3]. Such approaches are economical solely if providers publish comprehensive service specifications. Tools for automatic or semi-automatic semantic annotation will considerably reduce needed work, but, in principle, the consumer trust on provider to deliver the service totally compliant with the description. Additionally, web services or suppliers will be assessed by a trusted party, i.e., by a specialized unbiased agency that tests web services, verifies their descriptions (whether there is a discrepancy between specified and enforced features), publishes Quality of Service (QoS) data, etc. This solution is comparatively costly and inefficient owing to its rather static nature. Automated central monitors are sophisticated, and either provide restricted observance facilities or need involvement of domain-specific logic for verifying net service behavior [4][5]. On the other hand, there are service shoppers WHO antecedently have experience in victimization net services and so will facilitate in selecting services with adequate quality. This principle is extensively used by (collaborative) recommendation and reputation systems [6][7]. Often net services are adapt not on public use but aim at enabling simple info exchange between a set of partner organizations. Since web services belong to different domains, only a specific set of net services is interesting for a specific client. A group of shoppers with common interests form a virtual community wherever they will exchange the experience, i.e., the knowledge achieved when having interaction with a web service. Being a member of such a community can facilitate to scale back the data overburden and enhance web service discovery and choice facilities. A. System for Web Service Discovery This section gives a confession of the method of net service discovery within the system .The motivation for adopting the implicit culture approach for web service discovery branch from the difficulty of developers find and choosing net services suitable for their applications [10]. The system is designed for the use by a virtual community, giving. suggestions about net services appropriate for this community. In our domain, developers and their applications execute actions on web services. Types of actions confirm by the SICS and can be made clear later in detail. Behavior, agents and objects also may have more than one attributes, i.e., features helpful for their scrutiny. For example, information about a web service (id, name, etc.) is stored as an attribute of an object activity. The description of the entire set of the stored attributes is not needed for considerate the current paper and therefore is missing here.

In order to use the system, each user must install a remote client. The aim of the remote client is to interact with the SICS, and forward user requests and store observations about user actions, applications and behavior of web services. For observations of interaction with a web service we have.

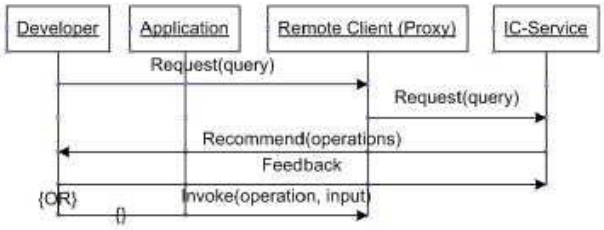

Figure 1: Search process

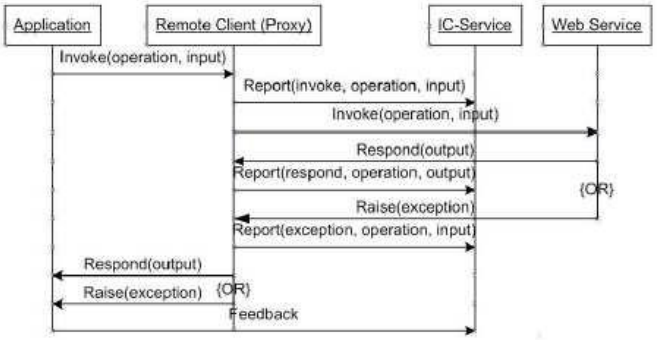

Figure 2: Monitoring Process

2. Related Work

Collaborative Filtering ways, content based ways and hybrid ways square measure three totally different methods that square measure universally used in Web service recommendation system.

A. CF Methods: The memory based mostly and model based ways square measure two different sort of CF techniques that square measure universally utilized in recommendation systems. Well known memory based mostly ways include user {based|based mostly|primarily based mostly} approaches [7] and item based approaches [8]. Memory based cooperative Filtering techniques have been recently adopted to provide QoS-aware recommendations [9, 10]. Shao et al. [9] propose a typical user-based CF method to anticipate QoS which supposes that same sort users seemingly to receive same QoS from same services, and they use Pearson Correlation Coefficient (PCC) to calculate similarity between users. Zheng et al. develop a model which enhance the user based Collaborative Filtering by fusing item-based CF [10]. The model-based method permits the system to create clever forecast for the CF algorithms tasks based on some learned models [5, 6]. Matrix factorization (MF) is one of the perfect works. In [11], MF is used to develop a worldwide model for forecast Qos data, which will accomplish higher prediction accuracy. Yu et al. [13] recommend a matrix finishing approach using Associate in Nursing effective unvaried rule.

B. Content Based ways: The content based ways in the main concentrate on providing a mechanism to characterize users' choice, resource, and the description of Web services, and recommendations are generated based on the predefined linguistics models. Zhao et al. [15] provide a approach to model services and their correlation by semantic rule. Based on the input keywords, users can get a set of recommendations with correlation to the question. Blake and Nowlan [24] cipher a recommendation score by matching strings collected from the user's operational sessions and the description of the net services. Based on this score, they inspect whether or not a user is interested in the service. Mehta et al. [5] add quality and usage pattern to the service information to provide additional data to get a service that meets user requirements. Maamar et al. [6] introduce a model for the context of Web service interactions and highlighted the Resource on which the internet service performed.

C. Hybrid Method Combination CF with other techniques will provide additional exact expectation, they are wide used. Numerous hybrid models have been presented that involve different connected factors to improve service recommendation quality, such as users' locations [16, 17], social network information [18] and temporal effects [19]. Chen et al. [16] introduce a CF algorithm that takes into account of users' physical locations and style a region model for large-scale Web service recommendation. Tang et al. [17] determine a location aware CF model by incorporating locations of both users and services. Tang et al.[18] Present a trustworthy recommendation technique with social network which accommodate some social relation. Amina et al. [19] denote an approach that integrates ARIMA and GARCH models to catching the QoS attributes' changeability. All the above mentioned approaches do not take into concerns the cold-start problem in service recommendation.

There are some approaches focusing on Defeat the matter. For instance, Yu [12] integrates MF with call tree grasping to bootstrap service recommendation. MF is used to forecast Qos data and then handle new user issue. Bobabdilla et al.[25] design new similarity metrics mistreatment optimisation based mostly on neural learning which provide bigger accuracy to check new user cold start things. However, works [12,25] are both target on providing additional precise classification of new users, while we have a tendency to in the main deal with dynamic situation .Ling et al [14] prepare an on-line framework for CF to handle totally different scenario. We advantage their theory of on-line learning to handle cold-start problem in service recommendation. Wsdl Document Parsing and knowledge Extraction The Web Service Description Language (WSDL) is associate degree XML-based language, designed in keeping with standards such by the W3C that has a model for describing internet services. It characterize one or additional services as collections of network endpoints, or ports. It provides the specifications necessary to use the net service by describing the communication protocol, the message format needed to speak with the service, the actions that the consumer will invoke and the service location. 2 versions of WSDL recommendation endurei: the one. 13version that is employed in the majority existing systems, and the 2.04 version that is calculated to exchange 1.1. These 2 versions area unit functionally fully similar however have substantial variations in XML structure. To manage expeditiously internet services descriptions, we extract all options that describe an internet service from the WSDL document and store them into a computer database. we tend to acknowledge both WSDL versions (1.1 and 2.0) throughout this method, we proceed in 3 steps (see Figure 1) the primary step for checking availability of internet service and supportive the content of internet service Description language document. The second step is to collect the WSDL document and browse it from the WSDL URI to fetch all details of the document. during this step we tend to describe the options to extract from the

WSDL document:

(1) the name, the documentation and therefore the version of the WSDL,

(2) WSDL varieties utilized by messages to transmit info between internet services. Knowledge varieties area unit typically such victimization a XML Schema Definition (XSD). we tend to extract all reasonably elements {and varieties|and kinds} that may be as straightforward or complicated types as a collection of components and/or attributes, and

(3) a set of services declared within the WSDL document. for every service we tend to extract the name, the documentation and a collection of endpoints. Then, for each end point we tend to extract the name, the address (which defines
the affiliation purpose to internet service. it's usually portrayed by an easy protocol URL) and therefore the binding (Name, Type, Style, Transport protocol). The binding specifies the interface as well as shaping the SOAP binding vogue (RPC/Document) and transport SOAP protocol. The interface defines the operations to be performed for an internet service, and therefore he messages that are accustomed perform the operation. We tend to conjointly extract for every operation the name, the documentation, the input and therefore the output parameters. The input/output parameters may be referred to the antecedently extracted types/elements. Finally, the third step is devoted to save lots of the extracted WSDL options into a database. The extracted info are used throughout the generation of representations (B, RBTT and SR). Before presenting the ways for calculative representations, we discuss some text- processing customary used thenceforth.

1) Tag removal: This step deletes all hypertext mark-up language tags, CSS components, symbols (punctuation, etc.). 2) Divide and take away a stop words: Some terms area unit poised by many words separated by a capital letter; we use thus regular expression to extract these words. To emphasize, the appliance of the regular expression ([A-Z][a-z]+) on this string "GetAll Country Currencies Response" produces' Get', 'All', 'Country', 'Currencies' and 'Response'. Moreever, to extract the potential content words, we remove all the stop words. Finally, the potential content words for the sooner example area unit 'Country' and 'Currencies'. 3) Word Stemming: during this step we tend to use the Porter Stemmer [21] to get rid of words, that have the same stem. Words with an equivalent stem can typically have the duplicate which means. for instance, 'computer', 'computing' and 'compute' have the stem 'compute'.

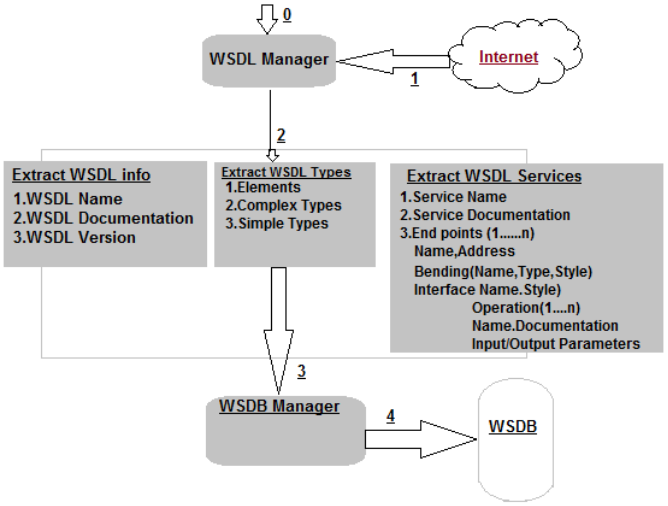

Figure 3: Process Flow

3. method Flow:

Representations Of internet Services In this section, we tend to gift a enervation methodology of the standard representation of internet service and that we introduce 2 new representations. allow us to note that the generated representations are Victoria.

1. Baseline illustration (B) A web service may be characterized by a matter description extracted from WSDL document or given by its supplier when business within the UDDI. the present UDDI written record only permits looking out internet services by their matter description. The first illustration is focused on matter descriptions of services and their offered functions. this is often made from the web service descriptions and enriched by group action the descriptions of operations offered by services. allow us to remark that the major disadvantage is that the majority internet services have a poor or an empty description. To full fill this illustration, we added all info delineate by WSDL varieties. the kinds area unit used by messages to transmit info between internet services. Consequently, WSDL varieties area unit nice options to explain the operations of a service and area unit the foremost descriptive part in WSDL document. For this reason, we tend to extract all sort names
(elements, complicated varieties, straightforward varieties, attributes, catalog) and we apply the matter process (see Section three -steps a pair of and 3) to produce a collection of words. Thus, we tend to use the obtained set of words to construct the new illustration and that we contemplate it as a baseline illustration (B) for an internet service.

2. Rules primarily based Text Tagging of internet services descriptions (RBTT): Multiple services have terribly elaborated descriptions, especially when they provide many operations with their own descriptions. the most focuse is the way to acknowledge important parts or entities within the text description and the way to use the filtered info to explain the net service? Our approach consists within the definition of extraction rules to spot, retrieve and comment relevant multi-word terms from internet service descriptions. This approach has been already used for biological data [19]. The process steps (Tokenization, Part-Of- Speech tagging, Extraction and output generation) of knowledge Retrieval are developed as modules exploitation the Lingua Stream platform5. articulator Stream [20] is Associate in Nursing integrated experimentation surroundings targeted to soul in natural language process

(NLP). allow us to note that we have a tendency to used Tree Tagger6 for the Part-Of-Speech tagging step. The extracted information is given during a style of a XML file. within the context of the online service descriptions, we've got destine a Rules set into logic programming giving back the Definite Clause descriptive linguistics (DCG) to recognize 3 forms of information: internet service names (namews), intention of the online services(purpose), and the domain of utilization (domain). allow us to denote that we have a tendency to don't use patterns within the sense of knowledge Extraction that's without a previous on the shape of the expressions.

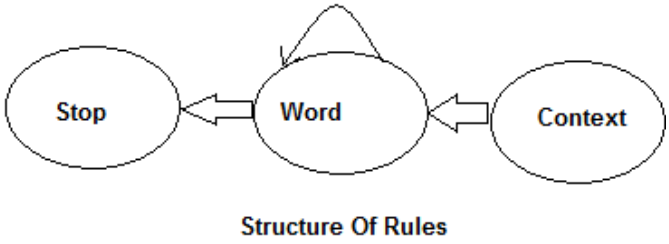

Figure 4: Structure of Rules

3. Existing System

When building service orienting applications, developers first style the business method per necessities, and then attempt to realize and utilise existing services to create the method. now a days, multiple developers search services through public sites like Google Programmers(developers.google.com), Yahoo Pipes (pipes.yahoo.com), programmable internet (programmableweb. com), etc. still, none of them give location-based QoS data for users. Such details is more vital for package preparation particularly once trade compliance thinks about. Some internet services square measure solely gift in EU, therefore package using these services can't be

1 shipped to different countries.Without data of those things, deployment of service-oriented package will be at nice risk.
2 internet service QoS performance has token correlation
3 to the locations of users.
4 No internet Service Recommendation.
5 Service-oriented package will be at additional risk.

4. Projected System

We introduced a innovative cooperative filtering-based Web service recommender system to assist users choose services with best Quality-of-Service (QoS) performance. Our recommender system exploit the situation data and QoS values to cluster users and services, and makes personalized service recommendation for users supported the bunch results. correlate with existing service recommendation strategies, our approach achieves right smart improvement on the recommendation accuracy. broad experiments square measure conducted containing quite one.5 million QoS records of active world.

Web services to spot the effectiveness of our approach.

1) Avoid risk and deliver high-quality business processes.

2) internet service QoS outcome has massive correlation to the locations of users.

3) shopper Collaboration.

4) Location elaborate is additionally thought-about once bunch users and services.

5) Service region and User region.

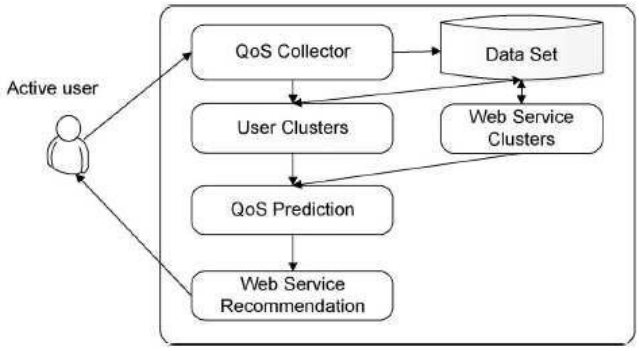

Figure 5: Design of Projected System Collaborative Filtering Collaborative Filtering (CF) is wide utilized in business recommender systems, like Netflix and Amazon.Com. the fundamental idea of CF is to predict and suggest potential favorite things for a specific user using rating knowledge collected from different users. CF is relay on processing the user-item matrix .classify the CF algorithms into 2 broad classes: memory relay algorithms and model relay algorithms. The foremost evaluated samples of memory based collaborative filtering embody user-based approaches item-based approaches and their fusion. User-based approaches predict the ratings of users supported the ratings of their same kind of users, and item-based ways that anticipate the ratings of users supported the data of item similarity. Memory based algorithms square measure simplest to implement, need very little or no coaching price, and might simply take ratings of recent users into account. However, memory based mostly algorithms don't scale well to a large variety of users and things because of the high computation complexness.

1. Quality of Services

First, we nominate a unique location-aware internet service recommendation approach, that considerably improves the recommendation accuracy and time complexness compared with existing service recommendation algorithms.

Second, we have a tendency to done inclusive experiments to live our approach by using a true world internet service QoS knowledge set. excess than one.5 million real-world internet service QoS records from quite twenty countries square measure busy in our experiments. Broad analysis on the impact of the formula parameters is also provided.

2. User Regions and repair Regions

Given a recommender system consisting of m users and n Web services, the connection between users and internet services can be denoted by Associate in Nursing m n user-item matrix. Associate in Nursing entry during this matrix ru;i represents a vector of QoS values (e.g., response time, failure rate, etc.) determined by user u on internet service i. If user u has ne'er used internet service i before, then ru:i 1/4 null.

3. Sensitive Web Services

Definition one. The sensitivity of a section is that the fraction between the numbers of sensitive services within the region over the total range of services. Definition two. a section may be a sensitive region iff its region sensitivity exceeds the predefined sensitivity threshold (lamda).

4. Net Service Recommendation Web service QoS forecast is employed in several ways in which in LoRec to facilitate net service recommendation. First, when a user searches net services victimization LoRec, expected QoS values are

displayed next to every candidate service, and the one with the most effective expected price are highlighted in the search result for the active user. it'll be simplest for the active user to determine that one to own a strive. Moreover, LoRec selects the most effective acting services (services with the best submitted QoS) and services with the most effective expected QoS from the complete service repository for the active user in order that he/she will straightaway realize potential valuable ones rather than checking the service one by one.

5. Methodology

Values of some QoS properties (e.g., response time) on the same net service vary quite otherwise from user to user. sThrough the analysis of a true worldWeb service QoS information set to(see Section five for details), that contains one.5 million service invocation records evaluated by users from over twenty countries, we discover that some QoS properties extremely relate to the physical locations of users. as an example, the response time of a service ascertained by closely placed users sometimes fluctuates gently around a precise price. On the opposite hand, the response time ascertained by users United Nations agency square measure far-flung from every other typically varies considerably. supported this finding, our recommendation formula takes location data into consideration to boost the advice accuracy.

- User Region Creation In this section, users are clustered into completely different regions according to their locations and historical QoS records. At the beginning, we have a tendency to retrieve users' approximate locations by their informatics addresses.3 the placement data reveals a user's country, city, latitude/longitude, ISP and name. Then users from identical town are classified along to create initial regions. These tiny regions are collective into massive ones with a bottom-up stratified bunch methodology [20].The clustering methodology has 2 parts: data formatting and aggregation. In the data formatting half, we have a tendency to choose no sensitive user regions for aggregation, and reason the similarity between every region pair with combining weight. (5). To mixture regions,

I. choose the foremost similar region combine merge the two regions to regions if their similarity exceeds the similarity threshold u, otherwise stop this region aggregation method.
To merge the 2 regions,
a. reason the sensitivity and region center of this recently merged region regions. take away this region from aggregation process if it becomes a sensitive one.
b. take away similarities between region and different existing regions.
c. Update similarities between region and different existing regions.

II. Repeat the higher than step.
Threshold u may be a tunable parameter which will be adjusted to trade off accuracy for time and area needs.

Service Region Creation Normally, every user solely uses a restricted quantity of net services. Compared with the massive range of services on the Internet, the quantity of services with user submitted QoS records is comparatively tiny. Thus, it's troublesome to seek out similar users, and predicting missing QoS values solely from user's perspective isn't enough. bunch net services will facilitate LoRec realize potential similar services. completely different from retrieving user location from Associate in Nursing informatics address, LoRec directly clusters net services supported their QoS similarity. this can be as a result of some companies regard the physical location of information center as a secret and use informatics address to cover the $64000 locations. Take Google for example. it's information centers placed in Asia, Europe, America, etc, however physical locations retrieved from Google's informatics addresses employed in completely different country-specific versions of Google Search square measure all listed to Mountain read, California. Another reason is because of the utilization of the distributed system design. To enhance user interaction and to reduce delay, service providers can route user requests to completely different servers according to user locations or application sorts. sometimes the server that processes requests is completely different from the one that responds to the users. Thus, retrieving a service location from Associate in Nursing informatics address doesn't prove a lot of price. In LoRec,Web services square measure aggregated with a bottom-up stratified bunch formula. We use median vector instead of mean vector because the cluster center to reduce the impact of outliers. The similarity between 2 clusters is outlined because the similarity of their centers. every net service is considered a cluster at the commencement. The formula aggregates the pairs of the foremost similar clusters until none of the pairs' similarities exceeds threshold w.

Personalized QoS Prediction The first 2 phases mixture users and net services into a precise range of clusters supported their individual similarities. QoS predictions is generated from each service regions and user regions. With the compressed QoS information, searching neighbors and creating net service QoS predictions for a full of life user is computed quicker than standard methods.

- Net Service Recommendation Web service QoS prediction is employed in range of the way in LoRec to facilitate net service recommendation. First, when a user searches net services victimization LoRec, expected QoS values are displayed next to every candidate service, and the one with the most effective expected price are highlighted in the search result for the active user. it'll be easier for the live user to determine that one to own a strive. Moreover, LoRec selects the most effective acting services (services with the most effective submitted QoS) and services with the most effective expected QoS from the whole service repository for the active user in order that he/she can straightaway discover potential valuable ones rather than checking the service one by one.

6. Result

In this system we have a tendency to propose Associate in Nursing innovative CF formula for QoS-based net service recommendation. to deal with the third problem Associate in Nursingd modify an improved understanding of QoS based mostly approach for net service recommendation the net service recommendation explanation, we offer a customized map for browsing the advice results. The map expressly shows the QoS relationships of the suggested net services as well because the basic structure of the QoS area by victimization map metaphor like dots, areas, and arrangement.

7. Conclusion

This paper presents a QoS-aware Web service recommendation approach. The basic idea is to conclude Web service QoS values and recommend the best one for active users based on historical Web service QoS records. We combine prediction results generated from service regions and user regions, which achieves better results than existing approaches. We also find that the combination result is much better than the result from any single method, either the prediction generated from user regions or the one generated from Web service regions. This is because these two methods analyze the problem from different aspects and the combination of them counteracts the error of individual methods.

References

[1] M. Alrifai and T. Risse, "Combining Global Optimization with Local Selection for Efficient QoS-Aware Service Composition," in Proc. 18th Int'l Conf. WWW, 2009, pp. 881-890.

[2] L. Barakat, S. Miles, and M. Luck, "Efficient Correlation-Aware Service Selection," in Proc. IEEE 19th ICWS, 2012, pp. 1-8.

[3] J.S. Breese, D. Heckerman, and C. Kadie, "Empirical Analysis of Predictive Algorithms for Collaborative Filtering," in Proc. 14th Annu. Conf. UAI, 1998, pp. 43-52.

[4] R. Burke, "Hybrid Recommender Systems: Survey and Experiments," User Model. User-Adapt. Interact., vol. 12, no. 4, pp. 331-370, Nov. 2002.

[5] J. Canny, "Collaborative Filtering with Privacy via Factor Analysis," in Proc. 25th Int'l ACM SIGIR Conf., 2002, pp. 238-245.

[6] X. Chen, X. Liu, Z. Huang, and H. Sun, "RegionKNN: A Ascendable Hybrid CF Algorithm for Individualized Web Service Recommendation," in Proc. IEEE 8th ICWS, 2010, pp. 9-16.

[7] X. Chen, Z. Zheng, X. Liu, Z. Huang, and H. Sun, "Personalized QoSAware Web Service Recommendation and Visualization," IEEE Trans. Serv. Comput., vol. 6, no. 1, pp. 35-47R1st Quart., 2013.

[8].Chun,D.Culler,T.Roscoe,A.Bavier,L.Peterson,M.Wawrzoniak,andM.Bowman, "Planetlab: An OverlayTest bed for Broad -CoverageServices," ACM SIGCOMM Comput. Commun. Rev., vol. 33, no. 3, pp. 3-12, July 2003.

[9] M. Deshpande and G. Karypis, "Item-Based Top-n Recommendation Algorithms," ACM Trans. Inf. Syst., vol. 22, no. 1, pp. 143-177, Jan. 2004.

[10] J.E. Haddad, M. Manouvrier, and M. Rukoz, "TQoS: Transactional and QoS-Aware Selection Algorithm for Automatic Web Service Composition," IEEE Trans. Serv. Comput., vol. 3, no. 1, pp. 73-85, Jan./Mar. 2010.

[11] J. Herlocker, J. Konstan, A. Borchers, and J. Riedl, "An Algorithmic Framework for Performing Collaborative Filtering," in Proc. 22nd Int'l ACM SIGIR Conf. Res. Dev. Inf. Retrieval, 1999, pp. 230-237.

[12] T. Hofmann, "Collaborative Filtering via Gaussian Probabilistic Latent Semantic Analysis," in Proc. 26th Int'l ACM SIGIR Conf. Res. Dev. Inf. Retrieval, 2003, pp. 259-266.

[13] T. Hofmann, "Latent Semantic Models for Collaborative Filtering,"ACM Trans. Inf. Syst., vol. 22, no. 1, pp. 89-115, Jan. 2004.

[14] S.-Y. Hwang, E.-P. Lim, C.-H. Lee, and C.-H. Chen, "Dynamic Web Service Selection for Reliable Web Service Composition," IEEE Trans. Serv. Comput., vol. 1, no. 2, pp. 104-116, Apr./June 2008.

[15] R. Jin, J. Chai, and L. Si, "An Automatic Weighting Scheme for Collaborative Filtering," in Proc. 27th Int'l ACM SIGIR Conf., 2004, pp. 337-344.

[16] K. Karta, "An Investigation on Personalized Collaborative Filtering for Web Service Selection," Honours Programme Thesis, Univ. Western Australia, Brisbane, Qld., Australia, 2005.

[17] G. Linden, B. Smith, and J. York, "Amazon.com Recommendations:Item-to-Item Collaborative Filtering," IEEE Internet Comput.,vol. 7, no. 1, pp. 76-80, Jan./Feb. 2003.

[18] H.Ma, I. King, andM.R. Lyu, "EffectiveMissingData Prediction for Collaborative Filtering," in Proc. 30th Int'l ACM SIGIR Conf. Res. Dev. Inf. Retrieval, 2007, pp. 39-46.

[19] C.D. Manning, P. Raghavan, and H. Schu tze, An Introduction to Information Retrieval. Cambridge, U.K.: Cambridge Univ. Press, 2009.

[20] M.R. McLaughlin and J.L. Herlocker, "A CF Algorithm and Evaluation Metric that exactly Model the User Experience," in Proc. 27th Int'l ACM SIGIR Conf. Res. Dev. Inf. Retrieval, 2004, pp. 329-336.

[21] P. Resnick, N. Iacovou, M. Suchak, P. Bergstrom, and J. Riedl, "GroupLens:An Open Architecture for Collaborative Filtering of Netnews," in Proc. Conf. CSCW, 1994, pp. 175-186.

[22] B. Sarwar, G. Karypis, J. Konstan, and J. Reidl, "Item-Based Collaborative Filtering Recommendation Algorithms," in Proc. 10th Int'l WWW Conf., 2001, pp. 285-295.

[23 . Shao, J. Zhang, Y. Wei, J. Zhao, B. Xie, and H. Mei, "Personalized QoS Prediction for Web Services via Collaborative Filtering," in Proc. 5th ICWS, 2007, pp. 439-446.

[24] R.M. Sreenath and M.P. Singh, "Agent-Based Service Selection," J.Web Semantics, vol. 1, no. 3, pp. 261-279, Apr. 2003.