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An Efficient Ranking Method for QoS–Aware Service Discovery

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Abstract: *In current scenario the information technology acts as a business enabler for industries and organizations. They use services to realize or implement their business process requirements. The service should be selected from collection of compliant services using service discovery based on functional and non-functional requirements. The contemporary service discovery methodologies rank services using statistical or fuzzy methods to select relatively better services. The existing Service discovery is extended to improve the service selection. The proposed system extracts system Quality QoS attribute values of all complaint service and constructs a hybrid matrix. This matrix is transformed into a fuzzy judgement matrix using fuzzy limits. Entropy weight is used to obtain information gain from fuzzy judgement matrix. The scores of service are calculated using information gain and relatively better service is selected from set of similar service. The experiments are conducted using a set of benchmark web services that concludes that the proposed ranking method discovers relatively better service than the existing service discovery methodologies.*

Keyword: *Entropy weight; Fuzzy matrix; Quality of service; Service discovery.*

1. INTRODUCTION

Service Oriented Architecture is a style of building software applications that promotes loose coupling between components so that they can be reused. The basic building block of SOA is the service. A service is a self-contained software module that performs a predetermined task. Web Services are the key technology for the realization of SOA. Web Services are applications that can be published, located, and invoked across the Internet [1].

The enterprise and organization adapt service oriented computing for realizing their business processes like decision support, content management, manufacturing and resource allocation. The services of various processes are designed, implemented and advertised by service providers. The information of services is provided in service registry using Web Service Description Language [WSDL] description. Services available in service registry are classified under various categories and sub-categories using their description. Required services are selected using functional and non-functional or QoS requirements of user.

Service discovery process identifies the required service from service registry and list all services. Identified services are ranked using QoS parameters. In conventional system services are evaluated using benchmark tools and QoS attributes value are calculated and stored along with service description using WSDL. Most of these values are either average value or maximum value or minimum value of QoS attributes of service. Existing service ranking methodologies uses co-variance, multi-utility functions and Fuzzy techniques. Still service discovery and QoS based ranking the services is a challenging issue in service computing due to imprecise attribute values. Some of existing fuzzy techniques define these imprecise QoS attribute values.

This paper proposes a hybrid ranking algorithm for service selection. This extends the conventional service discovery process to obtain more information about QoS values. The proposed system extracts minimum, maximum and average values of each QoS attribute using available benchmark tool. If tools do not provide the required multiple values of QoS attribute the system uses fuzzy techniques. These values are converted as fuzzy judgment values and entropy weight is calculated for information gain of QoS attributes. The services are ranked using entropy weight and best service is selected for binding. The selected service is cached for future reference.

Experiments are conducted using collection benchmark web service dataset. These experiments conclude that the proposed hybrid ranking methodology selects relatively better service than the existing statistical and fuzzy methodologies.

2. BACKGROUND AND RELATED WORKS

Fuzzy approaches [2] are used to overcome the difficulties of defining the QOS property. Fuzzy approach represented in developing QOS-based ranking algorithms for web services

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which can deal with fuzzy QOS values. QoS - aware Service Selection by a Synthetic Weight [3] applies the fundamental principles of fuzzy set theory and models the web service selection as fuzzy multiple criteria decision making.

Ranking Algorithm [4] is a hybrid of matrix and fuzzy based ranking algorithms. Matrix method is the effective capturing of the user needs and fuzzy method is used to define the QoS criteria precisely.

A QoS - Evaluation Algorithm [5] for Web Service Ranking Based on Artificial Neural Network. The accuracy of the web service ranking is improved by adjusting the. It can be learnt from the early experiences through adjusting the connection weights and can use the Knowledge learned before.

In web service ranking [6], each web service is characterized by many attributes so that ranking should be based on each attribute or a combination of the attributes. Ranking web services for a task includes ranks for a particular task in relation to one or multiple attributes. Rank aggregation is an efficient way of producing a global rank from multiple input ranking lists.

Service filtering, ranking and selection algorithm [7] is concerned with filtering out redundant services, normalizing the QoS values of each parameter, computing the overall QoS score for each service, arranging the relevant web services in descending order of overall QoS score and recommending the best service to the requester based on user preferences.

The QoS ontology [8] describes QoS information and also facilitates the various service participants expressing their QoS offers and demands at different levels of expectation. The QoS-based ranking algorithm adopted Analytic Hierarchy Process (AHP), a multiple criteria decision making technique, as a fundamental mechanism for developing a elastic and dynamic ranking algorithm.

A hybrid approach [9] for web service selection uses AHP (Analytical Hierarchy Process) to evaluate the weights of criteria and VIKOR (VIšekriterijumsko KOmpromisno Rangiranje) to rank the appropriate candidate services.

An optimal QoS based web service selection scheme [10] helps the service requesters to select services by considering two different contexts: single QoS-based service discovery and QoS - based optimization of service composition.

The service filtering, ranking and selection algorithm [11] is concerned with filtering out redundant services, normalizing the QoS values of each parameter, computing the overall QoS score for each service, arranging the relevant web services in descending order of overall QoS score and recommending the best service to the requester based on user preferences.

User – centered design of a QoS – based web service selection model [12] could handle both exact and fuzzy requirements, return two categories of matching namely super-exact and partial matches, and rank them using a two-level ranking algorithm.

Service Selection [13] based on QoS ranking Using Associative Classification. The main objective is to address service selection in the context of QOS aware middleware for dynamic service environments.

The survey about web service ranking algorithm based on the QoS is useful for an efficient ranking method for Qos-aware service discovery. The service selection and ranking is mainly based on the QoS values of each parameters.

3. RANKING APPROACH

Ranking entails assigning a score to each web service, quantifying its suitability for the given request. It is vital that useful results must appear higher in the list so that users typically view only top few results. In web service selection process, the user searches for the service that satisfies their requirements based on the overall functionality and Quality of Service (QoS).

Each user might have various QoS requirements as to which are more relevant to the application that are requested by the user. These QoS values are difficult to be defined precisely. For example, user may be interested on high performance, cheap service than the low performance and expensive service.

Service discovery process identify list of required service from the service registry. Service registry provides the information such as service definitions, interfaces, operations and QoS parameters like response time, availability, throughput, success rate, reliability, latency. Each web service is characterized by many attributes, the ranking is based on combination of the attributes.

The boundaries between multiple quality attributes are vague and imprecise. The proposed system uses fuzzy approaches to improve the service selection process. This method is based on the theory of linguistic variables.

A linguistic variables assumes as it values terms in some natural language such as “good”, “fair”, “bad” are used to describe the quality of product. Each term represented by special fuzzy set called fuzzy number which is associated with membership function.

$$Q_{ij} = \begin{cases} \dfrac{Q_{ij} - L}{M - L}, ifL \le Q_{ij} \ge M \\ \dfrac{U - Q_{ij}}{U - M}, ifM \le Q_{ij} \ge L \\ 0, otherwise \end{cases} \quad (1)$$

To determine the QoS parameters correctly, the system uses the fuzzy information which is represented by the triangular fuzzy numbers. Triangular fuzzy numbers are also called as fuzzy limits for each QoS parameter represented as [L, M, U] where L, M, U are the lower, medium and upper values for that QoS parameter. These fuzzy limits are assigned manually according to the QoS parameters defined in the

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WSDL documents. Each value in the fuzzy matrix needs to be calculated using the membership function for each parameter.

The fuzzy method on the other hand stresses on the importance of weights and control the inputs given by the user. The use of fuzzy logic further allows wide number of web services to be taken into account. The advantage of fuzzy representation is that the imprecise QoS criteria can be defined. The fuzzification process build a fuzzy judgement matrix as shown in the figure 1.

$$f_{ft}^{'} = \begin{bmatrix} f_{11} & f_{12} & \cdots & f_{1t} \\ f_{21} & f_{22} & \cdots & f_{2t} \\ \vdots & \vdots & & \vdots \\ & & \cdots & \\ \vdots & \vdots & & \vdots \\ f_{f1} & f_{f2} & \cdots & f_{ft} \end{bmatrix}$$

Figure 1 Fuzzy Judgement Matrix

3.1 Entropy Weight

The term entropy is also called as information gain. Entropy weight is used to measure the interval and fuzzy data. When there is a fuzzy or interval data, the value of each web service with respect to each criterion can change within a range and have different behaviors. So there is a need to apply the entropy for these data.

$$E_j = -e * \sum_{f=1}^{n} f_{ft} \ln f_{ji} \qquad (2)$$

Where e = 1/ ln m

$$f_{ji} = {a_{ft}} \Big/ {\sum_{t=1}^{m} a_{ft}}$$

The actual objective of each criterion is needed to distinguish between various web services which have the same value for a specific parameter.

The expected information content can be measured using the entropy value. When the entropy value increases the information express quality decreases and thus the entropy method serves as an efficient way to achieve an overall assessment of the information quality.

The entropy weight is used for fuzzy matrix to obtain the quality of information effectively.

$$E_{w_j} = {(1-E_j)} \Big/ {\sum_{j=1}^{m} (1-E_j)} \qquad (3)$$

This entropy method serves as an efficient way to achieve the overall assessment of the information quality

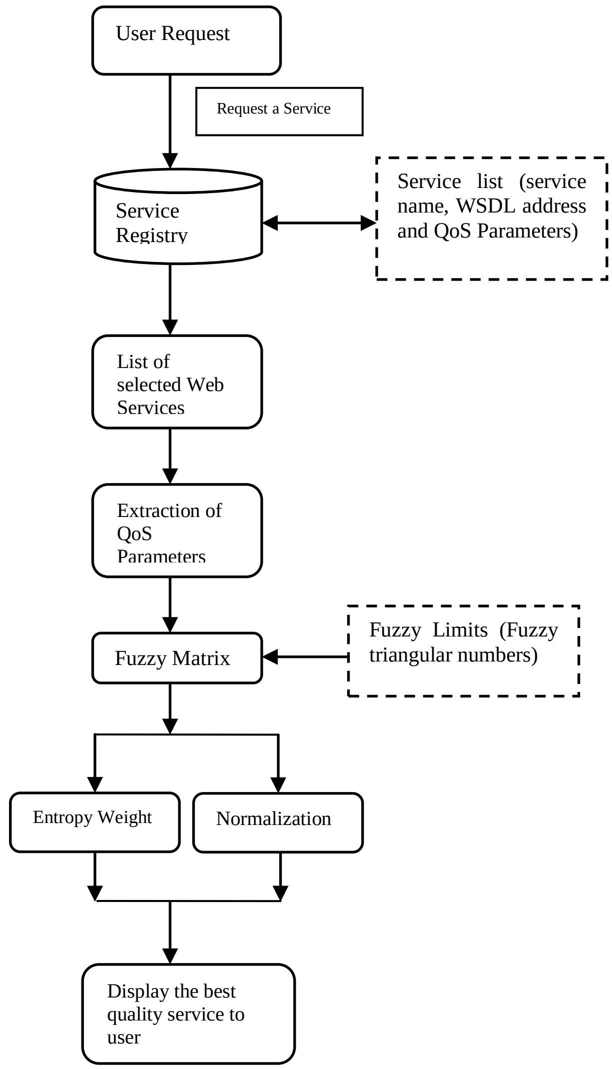

Figure 2 Ranking the QoS –Aware Web Service

3.2 Normalization

Each QoS attribute may vary in terms of its units and magnitude. It is an essential step as certain values should be high and certain should be low in order to get best results. To obtain the exact score, QoS parameters should be normalized. For evaluation, all data needs to be normalized into a common range between 0 to 1. Normalization helps to achieve uniform distribution over the QoS parameters. The normalized value q_i is calculated according to the following equations:

- If the tendency of the quality attribute is negative:

$$q_i' = (q_{max} - q_i)/(q_{max} - q_{min}) \qquad (4)$$

where $q_{max} \neq q_{min}$

- If the tendency of the quality attribute is positive:

$$q_i' = (q_i - q_{min})/(q_{max} - q_{min}) \qquad (5)$$

where $q_{max} \neq q_{min}$

Normalization method takes the fuzzy matrix and performs the evaluation based on the constraints of QoS parameters. Finally, the Web Service Ranking is computed using the normalized value and entropy weight.

$$score(ws_j) = \sum_{i=1}^{m} a_{ij} * w_i \quad (6)$$

The highest web service relevancy score is ranked first. Hence there is a real performance improvement in service discovery.

4. RESULTS AND DISCUSSION

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In web service discovery, there are 'n' available web services with similar functionality and 'm' QoS attributes for each web service. The user request is send to search engine, it displays the related services.

Figure 3 Service Discovery

Each service displays the web service name, WSDL address and its QoS parameters such as response time, availability, throughput, success rate, reliability and latency. The conventional ranking method is performed and displays the service to the user with its execution time. In Figure 5, the upper, medium and low values are considered according to the WSDL file in the benchmark dataset. By applying the membership function, Fuzzy matrix is evaluated which allows wide number of services with similar functionality is taken into account. In Figure 6, the entropy value is based on fuzzy matrix and the QoS matrix. It transforms the different scales and units into common measurable units for different QoS criteria.

In co-variance based ranking approach, the basic ranking method will perform to obtain the result. In min-max normalization methodology, the user provides the minimum threshold value for the requested service. Ranking will be performed on the user requested.The hybrid ranking selects the best service by fuzzification and entropy weight method. The quality score is calculated using the normalized value and information gain to obtain the better service than existing approaches.

SELECTED WEB SERVICE

S.NO	SERVICE NAME	LATENCY	AVAILABILITY	RELIABILITY	RESPONSE TIME	THROUGHPUT	SUCCESSABILITY	EXE TIME
1	GBNIRHolidayDates	22.77	98	67	126.17	12	100	0 ms
2	GBEAWHolidayDates	20.8	91	67	128.31	12.4	97	0 ms
3	GBNIRHolidayService	50.2	98	73	161	17.6	100	0.004 ms
4	HolidayService	19	99	73	123.83	16.9	100	0.0041 ms
5	USHolidayDates	33.29	87	67	148.5	11.1	95	0.00405 ms
6	USHolidayService	34.4	98	73	143.6	16.7	100	0.004053 ms
7	USHolidayService	27.2	91	73	144.8	18.8	97	0.0040531 ms
8	USHolidayDates	21.16	95	67	130.08	13.1	99	0.00405312 ms
9	HolidayService	16.5	97	73	128.5	17	99	0.004053116 ms
10	GBSCTHolidayService	48.8	90	73	157.2	17.3	97	0.0040531158 ms

Figure 4 Selected web service, QoS Parameters and its execution time

FUZZY MATRIX

S.NO	SERVICE NAME	LATENCY	AVAILABILITY	RELIABILITY	RESPONSE TIME	THROUGHPUT	SUCCESSABILITY	EXE TIME
1	GBNIRHolidayDates	0.2204	0.9619	0.4408	0.3593	0.3023	0.9615	50.7 ms
2	GBEAWHolidayDates	0.191	0.4524	0.4408	0.3712	0.3209	0.4829	50.77 ms
3	GBNIRHolidayService	0.7294	0.9619	0.9481	0.8895	0.8545	0.9615	50.783 ms
4	HolidayService	0.1642	0.9429	0.9481	0.3463	0.9182	0.9615	50.796 ms
5	USHolidayDates	0.3775	0.4143	0.4408	0.4833	0.2605	0.4634	50.80795 ms
6	USHolidayService	0.394	0.9619	0.9481	0.4561	0.9364	0.9615	50.820112 ms
7	USHolidayService	0.2866	0.4524	0.9481	0.4628	0.7455	0.4829	50.8320332 ms
8	USHolidayDates	0.1964	0.4905	0.4408	0.381	0.3535	0.9808	50.84395409 ms
9	HolidayService	0.1269	0.981	0.9481	0.3722	0.9091	0.9808	50.856113434 ms
10	GBSCTHolidayService	0.7706	0.4429	0.9481	0.9315	0.8818	0.4829	50.8849620819 ms

Figure 5 Fuzzy matrix

5	USHolidayDates	0.3775	0.4143	0.4408
6	USHolidayService	0.394	0.9619	0.9481
7	USHolidayService	0.2866	0.4524	0.9481
8	USHolidayDates	0.1964	0.4905	0.4408
9	HolidayService	0.1269	0.981	0.9481
10	GBSCTHolidayService	0.7706	0.4429	0.9481

ENTROPY WEIGHT

S.NO	ENTROPY WEIGHT	EXECUTION TIME
1	0.0487	53.6 ms
2	0.076	53.61 ms
3	0.1464	53.617 ms
4	0.1918	53.6251 ms
5	0.2407	53.63297 ms
6	0.2964	53.640127 ms

Figure 6 Fuzzy matrix and entropy weight

5. CONCLUSION

The proposed service discovery method extracts the QoS values of all services and constructs the hybrid matrix. The QoS matrix is transformed to fuzzy judgement matrix using fuzzy limits. An entropy weight is used as a normalization criterion to select relatively best service. The services are ranked using entropy weight and the normalized matrix. Finally, the best service will be placed at the top of the search results.

REFERENCES

[1] Thomas Erl, *Service-Oriented Architecture Concepts, Technology, and Design* (Pearson Education, 2007).

[2] Heather Kreger(2001), "Web Services conceptual architecture", *IBM software Group, web service overview*, pages 1-40.

[3] Pengcheng Xiong and Yushun Fan(2007.), "QoS-aware Web Service Selection by a Synthetic Weight", *ACM, FSKD '07 Proceedings of the Fourth International Conference on Fuzzy Systems and Knowledge Discovery* - Volume 03, Pages 632-637, IEEE Computer Society Washington, DC, USA.

[4] Vuong Xuan TRAN and Hidekazu TSUJI , "QOS-based ranking for web services: fuzzy approaches", ACM, NWESP '08 Proceedings of the 2008 *4th International Conference on Next Generation Web Services Practices*, pages 77-82, 2008, IEEE.

[5] R.Manoharan, A. Archana and Siddhika Nitin Cowlagi, **"**Hybrid Web Services Ranking Algorithm", *IJCSI International Journal of Computer Science Issues*, Vol. 8, Issue 3, No. 2, May 2011.

[6] Lu-Yi-Guo, Hao-Peng Chen, Guang Yang, Ruo-Yu-Fei, "A Qos-Evaluation Algorithm for Web Service Ranking Based On Artificial Neural Network", ACM, CSSE *'08 Proceedings of the 2008 International Conference on Computer Science and Software Engineering* - Volume 02, Pages 381-384, IEEE,2008.

[7] Xiaodi Huang, **"**Wsrank: A New Algorithm for Ranking Web Services**"**, *Springer*, New Technologies, Mobility and Security, 529–539, 2007

[8] Vuong Xuan Tran, Hidekaza Tsuji, Ryosuke Masuda, "A New QoS Ontology and Its QoS-Based Ranking Algorithm for Web Services", Elsevier, *Dependable service-oriented computing systems*, Volume 17, Issue 8, Pages 1378–1398, September 2009.

[9] Mojtaba Khezrian, Wan M. N. Wan Kadir, Suhaimi Ibrahim and Alaeddin Kalantari, "Hybrid Approach For Web Service Selection", *International Journal Of Computational Engineering Research*, ISSN: 2250–3005, Vol. 2, Issue No.1, 190 – 198, Jan – Feb 2012.

[10] Angus F.M. Huang, Ci- Wei Lan, Stephen J.H.Yang, "An Optimal QoS Based Web Service Selection Scheme", *Elsevier*, Information Sciences, Volume 179, Issue 19, Pages 3309–3322, September 2009.

[11] Tajudeen Adeyemi Ajao, Safaai Deris, Isiaka Adekunle Obasa "Qos-Based Web Service Selection Using Filtering, Ranking And Selection Algorithm" *International Journal of Scientific & Engineering Research*, Volume 4, Issue 7, ISSN 2229-5518, July-2013.

[12] Delnavaz Mobedpour · Chen Ding, "User- Centered design of a QoS –based web service selection system", *Springer, Service Oriented Computing and Applications,* Volume 7, Issue 2, pp 117-127, June 2013.

[13] Makhlughian, Seyyed Mohsen Hashemi, Yousef Rastegari and Emad Pejman, "Web Service Selection Based Ranking On Qos Using Associative Classification", *International Journal on Web Service Computing (IJWSC),* Volume 3, Number 1, IEEE, March 2012.