Quality Driven Web Service Selection and Ranking

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Abstract

The increasing number of Web service providers with numerous functionally similar or same Web services produced a new problem of choosing a suitable Web service for the requester based on his expectations. The Quality of Service (QoS) can be used to select and rank functionally similar Web services. In this paper we define four Web service provider qualities to distinguish functionally similar and qualitatively competitive Web services. The main objective of this paper is to explore the mechanism which breaks the tie that may arise among functionally similar and qualitatively equivalent (competitive) Web services during Web service selection and ranking.

1. Introduction

The Web service is an interface that describes a collection of operations that are network accessible through standardized XML messaging [1]. Quality of Service (QoS) is a measure for how well a Web service serves the requester. QoS can be used to select and rank functionally similar Web services by extending standard service oriented architecture (SOA). The paper [2] proposes a QoS constraint based Web service selection mechanism which selects and ranks functionally similar Web services based on prospective levels of satisfaction of requester's QoS constraints and preferences. The problem with this mechanism is that, if the requester gives equal preference to all QoS properties present in the QoS constraint then there is a possibility of tie (Web services with same computed QoS score) which might return more than one Web service to a requester. The following illustration explains the problem.

Consider the example request for an article seller Web service where the requester is interested in best (good quality) service with the following QoS constraints: (a) Execution Price (E_P) < 12 OR Reputation (R_P) > 5 with an equal preference for E_P and R_P. Assume that the Web service registry returns 3 similar (article seller) Web services through functionality matching. The E_P and R_P values of these Web services are given in the format {Web service, E_P, R_P} as follows: {WS_1,40,7}, {WS_2, 90,4}, {WS_3,20,9}. Figure 1 depicts the QC tree (QCT) representation [2] for the buyer's QoS constraints.

The Web service selection mechanism as described in [2] selects only two Web services for the given request and computes the same score i.e. 0.5 for both WS_1 and WS_3. In this scenario, which Web service is to be selected for the requester? This paper finds the solution for this problem by defining four Web service provider qualities which are used to resolve the tie.

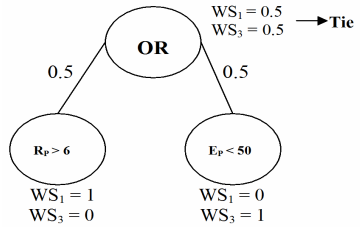

Figure 1. QCT for Requester's QoS Constraints

2. Web Service Provider Qualities

We define four quality attributes for Web service providers which include reputation, conformity, existence period and the provider size. These Web service provider quality attributes are to distinguish functionally similar Web services providing same QoS.

2.1 Reputation of Provider (R_{WSP})

As stated in UDDI data model [1], the Web service provider can publish number of Web services. Let N be the number of Web services hosted and published by a provider *WSP*. Let R_i be the reputation of i^{th} Web service WS_i. The Reputation (R_{WSP}) of Web service provider *WSP* is given by the average of Reputation

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(R_i) values of N Web services. The reputation value of Web service can be computed as described in [2]. The value of R_{WSP} is computed as:

$$R_{WSP} = \frac{1}{N} \sum_{i=1}^{N} R_i$$

2.2 Conformity of Provider (C_{WSP})

Let C_i be the conformity of Web service WS_i which is computed as the average of compliance [3] values of all QoS properties. The conformity of Web service provider (C_{WSP}) is estimated as the average of conformity values of N Web services that are published by the provider *WSP*.

$$C_{WSP} = \frac{1}{N} \sum_{i=1}^{N} C_i$$

2.3 Existence Period (E_{WSP}) and Web Service Provider Size (S_{WSP})

The *Existence Period* (E_{WSP}) of Web service provider can be measured in terms of months or years. The *Provider Size* (S_{WSP}) of Web service provider is defined as the total number of Web services (N) hosted and published by the Web service provider.

3. Web Service Ranking Mechanism

The Web service selection and ranking mechanism uses the QoS broker based architecture [2]. The QoS broker is responsible for the selection and ranking of functionally similar Web services. The Web service selection mechanism [2] ranks the Web services based on prospective levels of satisfaction of requester's QoS constraints and preferences. The algorithm takes QCT T of height H and the functionally similar Web services as an input and results in a ranked list of Web services. The algorithm traverses QCT in a bottom-up fashion (level 0 to level H) and treats leaf and internal nodes in a different manner. At leaf nodes the algorithm performs the following *three* actions: (1) *Filtering* (2) *Scaling* and (3) *Ranking*. In filtering phase the Web services that satisfy simple QoS constraint defined at the leaf node are selected. The scaling phase normalizes the QoS values of selected Web services to a non-negative real valued number in an interval [0,1] using min-max normalization technique [2]. In ranking phase the normalized values are multiplied with the weight to get new values representing scores for the Web services. At internal nodes the algorithm performs *two* actions: *Filtering* & *Ranking* which are dependent on the type of node (*AND*/*OR*). In filtering phase if the node is *AND* then the Web service present in *all* its child nodes is selected. If the node is *OR* then the *distinct* Web services in the descending order of their scores are selected from its child nodes. In ranking phase if the node is of type *AND* then the score for the selected Web service is computed as the sum of scores of that Web service at its child nodes multiplied with the weight of sub-tree rooted at *AND* node. If the node is *OR* then the score of selected Web service is multiplied with the weight of sub-tree rooted at *OR* node. After ranking Web services at the root node, the Web services are sorted in the descending order of their score. If the multiple Web services are found with the same computed score then the Web service provider quality attributes are used to compute the new distinct score for these Web services. The provider qualities are considered to compute new score in the order of R_{WSP}, S_{WSP}, E_{WSP}, C_{WSP} until all Web services are found with distinct score.

As an illustration consider the QCT (Figure 1). Assume that R_{WSP}, E_{WSP} and S_{WSP} values for WS_1, WS_2 and WS_3 are as follows: (6,5,1), (7,3,1) and (6,2,2). The WS_1 and WS_3 are found with same QoS score (i.e. 0.5). Now the algorithm uses R_{WSP} of WS_1 and WS_3 to assign the distinct rank. Since both WS_1 and WS_3 have same R_{WSP}, the algorithm uses E_{WSP} for ranking and it returns the Web service WS_1 as a best Web service.

4. Conclusion

The paper defines four Web service provider quality attributes reputation, conformity, existence period and provider size. The paper explores the mechanism of ranking the functionally similar and qualitatively competitive (Web services with same QoS score) Web services based on requester's QoS constraints and Web service provider quality attributes.

5. References

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