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A review of Fuzzy Based QoS Web Service Discovery

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ABSTRACT

Recently, web service has become an important issue for developers. Selecting a specific service is a crucial task. Some approaches develop extensive description and publication mechanisms while others use syntactic, semantic, and structural reviews of Web service specifications. It is very crucial for finding the most suitable web service from a large collection of web services for successful execution of applications. In many cases, the value of a QoS property may not be precisely defined. Recently, fuzzy is considered as the dominant approaches in Web services which can deal with fuzzy constraints have been proposed. Therefore fuzzy logic can be applied to support for representing such imprecise QoS constraints. In this paper, we will present an overview which focus on developing fuzzy-based approach for Web service discovery. This paper also describes the web service challenges on fuzzy mechanism that summarized and analyzed in order to assess their benefits and limitations.

Keywords: **Fuzzy logic, QoS, Web service, Discovery, Survey**

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1. INTRODUCTION

Web services have been emerging in recent years and are by now one of the most popular techniques for building versatile distributed systems. Web services are designed to be accessed by other applications and vary in complexity. Web service [2] framework brings in a new revolution in traditional computing. Through using service oriented architecture (SOAP) [3] based on web service technologies, enterprises can now address platform interoperability problems and therefore grasp ever changing business challenges and opportunities A Web services discovery model with QoS constraint has been developed in [4].

2. MOTIVATION

Publishing, discovering and invoking Web services are the key functions that a Web services platform needs to support. A Standard Web Service Brokerage Model illustrated in Fig.1, which is a standard picture in most web service literature, the idea of bringing together web service providers and users via some form of brokerage service has been a core part of the web service vision right from the start. Further, to provide a discovery technology that allows easy and precise service discovery by businesses or consumers all over the Internet is among several basic issues the platform designer needs to consider. Discovery methods can range from manual to automatic [1] has summarized the discovery methods.

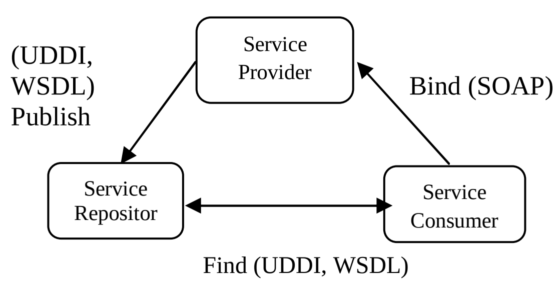

Fig 1: Web Service Discovery

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3. FUZZY BASED MATCHMAKING

Matchmaking is considered as one of the crucial factors to ensure dynamic discovery and composition of web services. Current matchmaking methods are inadequate given their inability to abstract and classify the underlying data of web services. Matchmaking is considered as a search or discovery problem wherein service consumers attempt to locate required web services in order to accomplish their tasks. UDDI is developed in order to advertise and discover web services [5]. Current matchmaking techniques do not abstract and classify the underlying data associated with web services. Fuzzy logic enables data representation with linguistic variables and fuzzy values. The proposed fuzzy matchmaking framework aims to abstractly represent the underlying data of web services using fuzzy logic and semantic web technologies in order to optimize the discovery process.

4. MULTI-ATTRIBUTE DECISION

One of the challenging problems that Web service technology faces is the ability to rapidly locate useful on-line services based on their capabilities. With the increasing popularity of Web services, a wide variety of services are offered that can satisfy the functional requirements of a special task, therefore there is need for mediation infrastructures able to support humans or agents in the eventual selection of appropriate services. To address this problem, a fuzzy multi-attribute decision making algorithm for Web services selection based on quality of service is proposed, which can select the most appropriate one with the highest degree of membership belonging to the positive ideal solution.

5. FUZZY-SYNTHETIC WEIGHT

Web service [6] framework brings in a new revolution in traditional computing. Besides modeling the web service selection problem as FMCDM (Fuzzy Multiple Criteria Decision Making), we introduce a synthetic weight which combines both the subjective and objective weights. For subjective weights defined by human preference, we apply linguistic variables and fuzzy numbers. For objective weights, we investigate entropy concepts to improve the judgment consistency. The larger the entropy value, the lower the information express quantity, the entropy weighting is an effective measurement for the average essence of information quantity.

6. FUZZY LOGIC BASED SAWSDL

Web services with different non-functional characteristics are developed and each web service is semantically annotated with their non-functional properties by using the Semantic Annotations for Web Services Description Language (SAWSDL).The World Wide Web (W3C) defines a Web service as a software system designed to support interoperable machine-to-machine interaction over a network [7]. There are three main stakeholders in the Service Oriented Computing (SOC), which are the service producer, service broker and service consumer [8]. A service broker is an important part of the web services paradigm of modern computing, which handles queries about the available services and mediates the results for the consumer [9].Web services are described with the help of Web Services Description Language (WSDL) document (also called 'wsdl' file) [10]. We use SAWSDL to add semantics to the web services, which provides simple and lightweight semantics [11].

7. FUZZY LOGIC MAPPING FOR QoS

FQ (*F*uzzy-*Q*oS), a complete architecture for including user preferences and quality of service characteristics in the selection process of web services. A service is defined as "a loosely-coupled, reusable software component that encapsulates discrete functionality which may be distributed and programmatically accessed over standard Internet protocols" [14],[15].While many approaches remain theoretical investigations of selection algorithms or modeling of QoS concepts, a few researches give full solutions that are integrated with the current standards for web services, as for example in [16] [17].Proposed FQ (*F*uzzy-*Q*oS), a complete architecture for including user preferences and quality of service characteristics in the selection process of web services.

8. DYNAMIC SERVICE DISCOVERY

Discovery mechanism is not only used to find a suitable service but also provides collaboration between service providers and consumers by using standard protocols. There are two drawbacks of semantic web services discovery approach. First, it is impossible for all service providers to publish their services in same ontology. Second, already existing web services does not have associated semantics and it is not possible to convert all of them into same ontology [18][19] Proposed the discovery

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mechanism based on web services composition and service profile.

9. QUANTATIVE FUZZY QoS

Quality-of-Service (QoS), which is usually employed for describing these non-functional characteristics, has become an important differentiating point of different Web services. The selection of web services according to different quality of service (QoS) is one of the most important decision issues for which complex completions are involved. Moreover; it is also not easy to accurately quantify the weight of each QoS criterion since human judgments including preference are often vague. QoS is a combination of several qualities or properties of a service [20]. The indices are classified into two classes: non-runtime indices, such as *price*, and runtime indices, such as *availability*, *meanresponse time*, *trustworthy* and *performance*. A Web services discovery model with QoS constraint has been developed in [21].

10. SERVICE COMPOSITION

Service composition has been a main problem in service based environment during recent years, and still is being concentrated by many researchers. Up to now, the diverse techniques have been presented based on different points of view for performing service composition [23, 24, 25, and 26]. These services are of course different with regard to quality factors such as response time, availability, throughput, security, reliability, execution cost and etc. A composite service is an umbrella structure aggregating multiple other elementary and composite web services, which interact with each other according to a process model [27]. In the system space, many candidate services are existed by different providers for each operation, that it is difficult and almost impossible to select suitable service from them by user [28] [29].

11. FUZZY MULTI-GROUP QCMA

FMG-QCMA (Fuzzy Multi-Groups based QCMA), an extension of QCMA framework by incorporating a fuzzy clustering mechanism, attempts to provide an effective architecture/mechanism for fuzzy multi-groups based web service selection and service provider's market segmentation.FMG-QCMA is capable of clustering service consumers (fuzzy opinions) into a number of sub-groups according to consumers' similar dispositions on pre-determined web services QoS attributes and focuses on the assessment of a specific collection of recommended web services for each clustered sub-group.QCMA (QoS Consensus Moderation Approach) is employed to obtain and moderate group consensus on QoS in selecting web services [30].

12. QUALITATIVE FUZZY QoS

A QoS attribute can be evaluated by one or more metrics, and a metric in turn can be measured by several units. In many cases, the values and the important weights of QoS attributes are not easy to be precisely defined. A probable way to solve the problems above is to apply fuzzy numbers (like Interval number or Triangular fuzzy number) or linguistic variables [31][32]. Besides the Qos model, current existing web service selection mechanisms lack the capacity to deal with the fuzzy QoS information. Ran developed a service discovery model in where QoS requirements are considered to evaluate a service performance [33].

13. ENTROPY DISCRETIZATION

Using search engines (e.g. Google), service registries (UDDI), peer-to-peer networks, service portals, and various other sources, Web service interfaces can efficiently be searched. Discovering Web services all over diverse environments is becoming a difficult task and elevates a lot of anxieties such as performance, consistency, and sturdiness. Initially, the range of a continuous variable, from a database sample, is divided into intervals which contain at least one case each. This is done after sorting on the variable values. Entropy, or information, is maximized when the frequency probability distribution has the maximum number of values [49].

14. COOPERATIVE APPROACH

Searching a specific service within service repositories becomes a critical issue for the Success of these architectures. This issue has recently received much attention and many approaches have been proposed [34, 35, 36]. The above fuzzy approaches only consider the preference satisfiability and ignore the structural similarity of complex web services. Starting from the work done in [37], we suggest a cooperative approach for handling user's process queries where both behavior specification and QoS preferences are specified inside these queries. User preferences on QoS properties are modeled by means of fuzzy sets as they are more suitable to the interpretation of linguistic terms.

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15. FUZZY DYNAMIC AND BINDING

As more and more Web services are available, web-based dynamic collaboration enables consumer to search for service providers in a wider range [38]. In such situation QoS becomes an important factor for web service choice making [39].Various methods have been proposed for specifying fuzzy QoS constraints and for Web services by basing on their fuzzy representation. In [40], the service selection for a Web service composition problem is formalized as a fuzzy constraint satisfaction problem. Each QoS criteria have five fuzzy sets describing its constraint levels: Poorly Acceptable (PA), Almost Acceptable (AA), Acceptable (A), Very Acceptable (VA), and Extremely Acceptable (EA).

16. ARTIFICIAL NEURAL NETWORK

Neural network adjusts the weight of each node in the network by the trial and error method. Due to their parallel computing nature of neurons, it can perform computations at a higher rate compared with classical method. The output of one node will be the input of another node and the final result or output depends on the complex interaction of all nodes. The effectiveness of the system is improved by means of neural network. The system will discover the service based upon their consumer input. It helps to provide matching services to consumer by eliminating irrelevant services. Intelligent search is performed using Artificial Neural Network.

17. FUZZY MULTI-PHASE MATCHING

Web service discovery has become increasingly more important as the prevailing use of web service. The similarity between service consumer's request and services in terms of software signatures, the capabilities, and syntax and semantics of services is a common measurement for matching [41].The service multi-phase matching is divided to two-stage filtering as Category Filtering and Area Filtering, and two-level matching as Capability Matching and Fuzzy Matching. Matching is an important mechanism for automation of web service composition. The main advantages of the proposed discovery method and matching mechanism are: (1) It can formally describe not the capability information, but the vague information of web service, and implement approximately reasoning based on ontology semantic, linguistic variable and fuzzy logic; (2) The multi-phase matching are executed on different service abstract level, which can improve the efficiency and accuracy of service discovery.

18. FUZZY TOPSIS SERVICE

Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) helps service consumers and providers to analyze available web services with fuzzy opinions. Efforts in this area focus on providing rich and machine-readable representation of service properties, capabilities, and behaviors as well as reasoning mechanisms to support automated discovery [42].The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method, which is initially proposed by Hwang et al [43], is one of the well-known multiple criteria decision making (MCDM) methods. TOPSIS method has become a popular multiple criteria decision technique due to (1) its theoretical rigorousness [44], (2) a sound logic that represents the human rationale in selection [45], and (3) the fact that it has been proved in [46] as one of the most appropriate methods in solving traversal rank. Recently, some researchers have focused on developing fuzzy TOPSIS methods to deal with imprecise information. Sun et al [47] applied fuzzy the competitive advantages of shopping websites.

Table1: Fuzzy QoS Analysis

Sl.No	Fuzzy Representation	Strength	Limitations
1.	Match making	It enables proactive and reactive Compositio n of web services.	It is based on context rather than the data of services.
2.	Multi-Attribute	Eventual support for selection of appropriate services.	QoS Varies and difficult to deliver.
3.	Synthetic Weight	Solves platform interoperabi -lity problems	QoS based measures web services fluctuate continuousl y
4.	SAWSDL	Increases the consumer satisfaction	Fetching information directly from web

			service is difficult.
5.	Logical Mapping	Does not need any modification to the existing UDDI	Increase in response time.
6.	Dynamic Discovery	Discovery process totally depends on properties of component	If local cache is absent service takes more time.
7.	Quantative QoS	non-functional QoS characteristics	Quality parameter normalized to a non-negative real-valued number.
8.	Multi-Groups QCMA	It improves system efficiency.	The perception handling of service selection is less.
9.	Entropy Discretization	The requester could choose the suitable web service	Many features of entropy are irrelevant.
10.	Artificial Neural Network	Eliminates irrelevant service	Difficult to test the performance of the system.
11.	Multi-phase Matching	Automation of web service composition	Does not consider the underlying data of web services
12.	TOPSIS Service	It reduces computation complexity in decision making process.	Suitable only for online applications.
13.	Service composition	Services have different quality properties.	User's point of view has had a determinative role in the process of service composition.

19. CONCLUSION

As web service discovery requiring manual interference may take more time, solutions for automatic discovery are drawing more attention. In this paper, we present an overview of fuzzy-based approaches for Web service discovery and selection. Fuzzy logic has been widely used in real world especially in automation and process control, fuzzy logic is best solution and much appropriate for work with indefinite information. Various methods have been proposed for specifying fuzzy QoS constraints and for ranking Web services by basing on their fuzzy representation. This paper also describes the web service challenges on fuzzy mechanism that summarized and analyzed in order to assess their benefits and limitations.

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