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QoS-Based Collaborative Filtering for Web Service Mining

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ABSTRACT

Stored information in the databases is heterogeneous, from various sources, and of large volumes. The web service selection becomes nontrivial, as the users are easily overloaded by vast amount candidates. Using the keyword-based search method, users are struggling to choose the best web services among those having similar features. In the traditional methods, the users set different constraints and QoS parameters of a web service from what's claimed by the provider. Moreover, different researches challenge this problem, introducing semantic discovery process to enable relevant and desired search results. These approaches don't give importance to users' opinions and the selection history. The classical development of the ontology is typically entirely based on high human participation. In this paper, the authors use ontology-based querying, user profile to know the history, new collaborative filtering to calculate user, and query similarity and QoS as the final step for web service selection. The approach combines the syntactic and semantic methods to increase the selection precision.

KEYWORDS

Collaborative Filtering, EXTRACT Algorithm, Ontology, QoS, User Profile

1. INTRODUCTION

The Web service (Nuri et al., 2019) is defined as an internet based application, supplied by the provider and accessed by the consumers. It allows the companies to do more efficient operations via the Web and improves their business opportunities. In recent years, the number of Web services has dramatically increased, it's complicated for the users to find the best Web services from many different types of Web services. Many studies (Weidong et al., 2018) put emphasis on the Web service selection problem. A new concept is introduced to help users for select the best Web services, is the Quality of Service (QoS). The Quality of Service (QoS) is implied to help the users select the best Web services, it is usually employed to describe non-functional attributes, it includes the information about Web services such as performance (in terms of response time, latency, etc.), accessibility, availability, throughput, and security. However, the selection of Web services encounters some

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problems in terms of QoS; mainly the inaccuracy of the QoS information, non-reliability or the unavailability of some Web services.

The ontology (Cristine et al., 2019) provides a vocabulary and a taxonomy of a particular domain, it defines objects, classes, attributes, and relationships. Moreover, the ontology provides a structural framework for representation of information about a domain or part of a domain. It adds the semantics terms in the Web services representation and its properties and it can dramatically improve the methodologies discovery. Many approaches (Sana et al., 2017; Uma & Saraswathi, 2016; Mahboubeh et al., 2020) use the ontology to solve the Web service selection problems. However these approaches have many disadvantages, mainly the difficulty of the acquisition of knowledge based on both functional and non-functional requirements when using many data sources.

However, the recommender systems (Venkateswara et al., 2017) are increasingly used to find and to recommend the desired Web services. The recommender system can be classified into Content-based, Collaborative Filtering, Knowledge-based, Demographic-based and Hybrid Recommendations. In this paper, we focus on the Collaborative Filtering (Aanchal et al., 2020), we can define the collaborative filtering as a process that selects the desired Web services based on similar users or services. In fact, the traditional methods of the Web services selection are made to satisfy the users' functional requirements and ignore the users' non-functional requirements. So they need a more dynamic ontology that have the ability to manage many concepts that humans cannot achieve alone.

Therefore, the objective of this paper is to resolve the following problems for Web service selection: (1) they ignore the user's history of Web service selection and marginalize the user's opinion. (2) The QoS attributes values are highly related to geographical location, service time and network condition, and they are variable. (3) The traditional collaborative filtering approaches are unable to recommend the Web services that match the QoS required by users using the relational databases.

This paper proposes four phases of Web service mining based on Ontology, User profile, collaborative filtering and QoS. The first phase allows to select the domain and the QoS request by the user using the ontology. The second phase phase is dealing with the Web service selection based on EXTRACT algorithm and user profile. While the third phase is employed to recommend the Web services based on the hybrid collaborative filtering. The final phase is destined to select the best Web services using the QoS values. Therefore, our objective in this paper is: (1) to recommend the Web services corresponding to Web services' functionalities, non-functional requirements and users' QoS requirements, (2) to select the Web services with the hybrid collaborative filtering and (3) to propose a trustworthy platform for Web service mining.

The organization of the paper is as follows: Section 2 discusses the related works and presents some typical prior studies related to the topic of this paper on Web Service mining. Section 3 depicts a new approach for Web Service mining based on ontology, user profile, collaborative filtering, and QoS. Section 4 presents experimental results and analysis of them. Finally, the conclusion and future works of this paper are summarized in section 5.

2. RELATED WORKS

In this section, we discuss the related works on the basic framework and development of the Web service mining methods based on QoS, collaborative filtering and ontology.

2.1 Web Service Mining Based on QoS

The QoS has an important role to classify the Web services, Ran, (2003) presents a new approach, which gives confidence to Web service consumer opinions on quality of Web service. Functional and non-functional requirements are taken into account for Web service selection in presented work. The disadvantage of this approach lies in the complexity in determining the matching algorithm between desired and provided QoS.