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Research on Robust Model for Web Service Selection

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***Abstract*—Most existing service quality models use defined Quality of Service parameters for service selection. Since a large number of uncertainties exist, the QoS performance indicators in the runtime of the composite services obtained through the model and method based on the determined QoS will be worse even beyond the range acceptable to the users. Web services can solve this problem and become the most reasonable solution in the current application environment. In the process of actual service delivery, the key to the failure of the service composition to meet the requirements is caused by uncertain factors. In order to solve the above problems, this paper first proposes a local optimal selection model based on uncertain QoS. The Web service selection method based on uncertain QoS has been progressing in recent years. Second, in order to reduce the time spent on selection, a redundant service selection result is given. The experimental results on the data set show that the proposed model and method can effectively select more robust services for users.**

Keywords-Web Service; Quality of Service; Model Robust

I. INTRODUCTION

The service-oriented model must have three parts, the service provider, the client of the service, and the aggregator generated by the implementation service. It is well known that the tasks performed by the service provider usually provide not only the realization of services, but also the support for related technologies. The service client is a terminal organization that specifically utilizes the application service. In practice, it is the user. Compared with the services, it is possible to integrate all services into a new service and the goals are achieved. This is usually called business process. Services must remain technically neutral and need to follow some of the internationally recognized standards as much as possible. When calling a service, you must use standardized techniques.

In this article, the focus is on the in-depth discussion of the characteristics of Web services. He is a self-describing, self-contained software module that can be used over a network.

The software module not only can complete the tasks and solve the problems, but also can fully represent the user and the application program to handle the transaction. As defined in the definition, the current known Web services, the main structure is to establish a more application-oriented distributed computing infrastructure. The main content of a distributed infrastructure consists of many different application modules or interacting with each other to form a virtual logic system by communicating with the network or the public network.

For the current research at home and abroad, QoS-based Web service selection algorithms mainly include: exhaustive, greedy, genetic, particle swarm optimization, ant colony optimization and algorithms. What this article uses is a robust QoS-aware, reliable Web service composition algorithm that is designed using robust algorithms.

This paper mainly studies how to ensure that service portfolios are robust under uncertain conditions, thus avoiding the re-planning of portfolio services to some extent. The application of robust optimization method to service selection model based on uncertain QoS is described in detail.

II. WEB SERVICES DISCUSSION AND ROBUST OPTIMIZATION

A. Web service features

Web services are mainly distributed computer technologies, which are based on XML and Internet technologies. Platform-independent, loosely-coupled, self-contained, programmable Web-based applications are used for development-oriented, interoperable applications that can use open XML standards to describe, publish, and discover. Coordinate and configure these applications, these are all part of the full definition of Web services. The basic architecture of Web services consists of 3 participants and 3 basic operations for example, Figure 1.

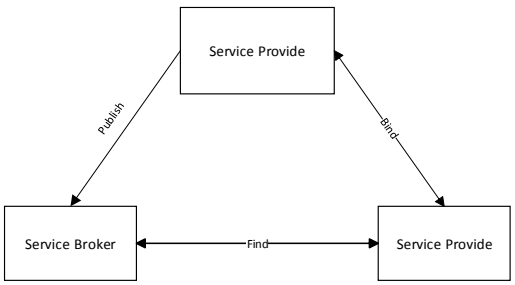

Figure 1. The basic architecture of Web services

The combined strategy of Web services provides a global-wide information infrastructure for the development of Internet technology.

This continuously expanding infrastructure forms a resource-rich computing platform and forms the basis of

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human society's information . Therefore, a single atomic Web service can no longer satisfy the diversified and personalized needs of users. The existing Web services have become the most effective and direct resources to solve the current problems encountered. From the perspective of Web properties, Web services are loosely coupled and highly integrated. These two features are Web services. The combination offers possibilities.

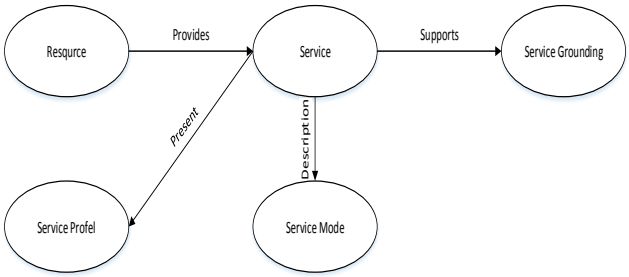

Figure 2. Describing the relationship of information services

B. The role of QoS in service selection

QoS is actually a kind of ability to express Web services. If you can achieve the requests needed to respond to expectations in the application process, not only can you complete related tasks, but also the quality of service provided by different users of service providers. Introducing QoS into Web services and using QoS of Web services to distinguish Web services with similar functions are the mainstream technologies currently applied in society. QoS-based Web service selection is gradually playing an increasingly important role in service composition.

The increasing complexity of component-based Web services building services in the current development and the increasing trend of their associated systems is due to the development of Web composition technologies. The problem of Web service composition is a well-known issue in mainstream development. On the one hand, Web services that run on different platforms in their heterogeneous systems can be created in different ways, or can be implemented in different languages. Or it can be provided by different suppliers, and its source and structure are various. How to choose the right Web service composition system to build the required composite service is an important research direction.

C. Robust optimization overview

Robust optimization has a wide range of application bases, and most of the studies on traditional optimization problems are deterministic. Establish a rationalized model in the process to ensure that it is essential for every aspect of the entire Web service process. The goal of robust optimization is to find a solution that can handle all possible uncertain data. The robust optimization proposed by Soyster is to consider the "worst case" when the disturbance is maximum, that is, to consider the most unfavorable situation, transform the uncertainty plan into a deterministic corresponding model, and obtain a robust optimal solution by solving the deterministic correspondence model. Since this model only considers the worst case, the result obtained is too "conservative", which means that this result is only a better solution for the possible realization of all uncertain data. The later research focuses on how to keep the solution optimal while maintaining the optimality of the solution. At the end of the last century, Ben-Tal and Nemirovski gave the robust equality problem of converting the linear programming to the secondary cone programming under the "ellipsoidal" uncertain set. However, after the conversion, the problem is more complicated and difficult to calculate.

In 2003, Bertsimas and Sim proposed a new robust model and obtained the solution considering both optimality and robustness. At the same time, the probability of the solution violated the constraint was analyzed. Then the uncertain discrete problem was studied to solve the network flow problem. A discrete robust model is given for the object. Based on the above two theoretical methods, domestic scholars apply robust optimization to supply chain planning, network flow, and logistics planning. Generally, in the service selection process based on QoS determination, it is often necessary to aggregate different QoS attribute values of the same service as the value for calculating or comparing the same service, or to determine the same attribute of different services according to the determined combined service workflow. The aggregate becomes a global property value. However, in the case of uncertain QoS, because the description methods of QoS attributes themselves are not the same, there are differences in the description of the uncertainty of different QoS, it is difficult to use different methods of the same service to determine the value of different attributes of the same service. Get together. For example, suppose that the response time fluctuation range is [rt1, rt2] and the throughput fluctuation range is [tp1, tp2]. The smaller one is, the better, and the bigger the other is, the better is the different types, the units are different, and the numerical quantities are different. It is difficult to aggregate two attributes with uncertainty in a way that determines the model using 0-1 normalization combined with a weighted sum. At the same time, because of the uncertainty of QoS, it is difficult to obtain the uncertainty of the global QoS in the solution process according to the superposition (such as response time superposition) or continuous multiplication (such as reliability multiplication) without affecting the solution result.

Therefore, this article will establish local optimization service selection model for a single QoS attribute. Assume that there are n tasks in the workflow of a composite service, and there are a large number of Web services in each task. These services can complete the task and they have different functional attributes. This article discusses the service selection under the local optimal strategy. We mention that the local optimal strategy is to select individual service classes and examine the candidate atomic service sets of each abstract service class. Workflows have control structures such as sequence, selection, loop, and parallel. Without losing the generality, it is assumed that a sequential process with 4 tasks is used as the combined service process model in this paper, and service selection is performed for the first task in the process.

III. EXPERIMENTS

A. Experiment analysis

The environment used in this experiment was TensorFlow-gpu 0.12.1 open source software library, Windows 7In order to verify the effectiveness of the proposed method, a prototype system of Web service test and selection management was developed in the early stage of the research. In the past, researchers usually used solving data to determine the model, using data to measure the service QoS alone, or randomly generating some values within a range for simulation. In this paper, researches and calculations are conducted on uncertain data. Uncertainty in the use of the service description cannot be confirmed by a single test or a randomly generated value.

The minimum response time of the service call can reflect the level of its optimality; the maximum response time reflects the level of robustness; the expectation reflects the average response value of the response time; the variance mainly reflects the response time of each call. The deviation from the expected response time of the service, that is, the smaller the variance, the smaller the response time of service invocation and the more stable.

B. Experiment Datasets

Adjust the value of Γ. In the experiment, since Γ can only take values between [0,1], six values of $\Gamma \in \{1,0.5,0.2,0.1,0.05,0\}$ are chosen for solving. The specific results are shown in Table 1.

TABLE I. SOLVING THE RESULT

T values	1	0.8	0.5	0.4	0.2	0.3	0.05	0
service number	892	892	892	892	892	551	350	941
Z*(T)	0.5460	0.4268	0.3130	0.1732	0.1058	0.0594	0.0050	0.0563

IV. CONCLUSION

This paper presents the application of robust optimization method in the selection of Web services based on uncertain QoS. On the basis of determining the QoS-based Web service selection method, considering the uncertainty of QoS, a single uncertain QoS service selection model based on the local optimal strategy is established. After the redundant service is removed, the robust optimization of the uncertain processing problem is used. The method converts and solves the service selection model based on uncertain QoS and obtains a solution that takes both robustness and optimal solution into account. In the final experiment, the paper verifies the validity of the proposed model and method, and verifies the effect of redundant service culling strategy on the efficiency of the solution.

The Web service composition based on uncertain QoS has the following advantages: first, for software developers, paying attention to personalized Web service composition can improve user acceptance, enhance product competitiveness and enhance corporate reputation efficiency. Second, for users and users, the importance of personalized Web service composition can improve user productivity, reduce training and technology support costs, improve user comfort and satisfaction, and increase investment efficiency and efficiency of system construction. Third, personalized research under uncertainty will improve the accuracy of service provision, give full play to the potential of every service and the effect of other services cooperation.

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