Global Journal of Computer Science and Technology
Network, Web & Security
Volume 12 Issue 10 Version 1.0 May 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

QoS-Aware Web Service Selection Using SOMA

By Krithiga R.

Engineering and Technology Pondicherry University Pondicherry India

Abstract - It is important to deliver appropriate services to requested users. In case of unavailability of a user requestedcomposite service, enforces the system to invoke service selection that involves choosing individual concrete services towards service composition. The services are selected based on two criteria: i) functional based and ii) non-functional based. The former entails selection of services based on functional property that the service is dedicated to do and the latter elite selection of services based on the QoS attributes such as reliability, availability, cost, and response time. Several population-based and swarm-based optimization algorithms are widely used for the process of web service selection. In this work, we employ a stochastic optimization algorithm called Self Organizing Migrating Algorithm (SOMA) and compare its performance with GA and PSO. The comparative study evidences that SOMA produces promising results and is therefore able to select user requested service in an efficient manner.

GJCST-E Classification: H.3.5

QOS-AWARE WEB SERVICE SELECTION USING SOMA

QoS-Aware Web Service Selection Using SOMA

Krithiga R.

Abstract - It is important to deliver appropriate services to requested users. In case of unavailability of a user requestedcomposite service, enforces the system to invoke service selection that involves choosing individual concrete services towards service composition. The services are selected based on two criteria: i) functional based and ii) non-functional based. The former entails selection of services based on functional property that the service is dedicated to do and the latter elite selection of services based on the QoS attributes such as reliability, availability, cost, and response time. Several population-based and swarm-based optimization algorithms are widely used for the process of web service selection. In this work, we employ a stochastic optimization algorithm called Self Organizing Migrating Algorithm (SOMA) and compare its performance with GA and PSO. The comparative study evidences that SOMA produces promising results and is therefore able to select user requested service in an efficient manner.

I. Introduction

Service Oriented Architecture (SOA) enables enterprises to quickly respond to business needs by rapidly developing required web services in anagile manner. Web services catch attention due to its wide applicability with the advent of new technologies. It stimulates dynamic, configurable software applications to improve the aggregated yield and promote reusability. The features of web service technology include interoperability, decoupling and just-in-time integration [9]. It is important to deliver appropriate services to requested users. When a user request cannot be addressed by a single service, enforces the system to invoke service selection, which involves choosing individual concrete services towards service compositionso as to deliver a composite service. Web service selection constructs new value-added utility through the integration of available concrete services. Each abstract task is an abstract representation of a service's functionality and contains many instances of concrete services dedicated for each abstract representation. A set of abstract tasks thereby constitutes the abstract functionality of a composite service and a set of concrete services each from an abstract representation constitutes the composite service.As many service providers offer services of similar functionalities, the existence of services incredibly increases and the implementation of those services considerably varies from each other. An implementation of a service may be better than other implementation in terms of some QoS criteria and may not be as good as of a service in terms of other QoS criteria. The service selection is an*np-hard* decision problem [7], on which concrete services should be selected such that the user's functional and non-functional requirements are met. Therefore, an efficient mechanism is needed to effectively choose appropriate services. Traditionally, two criteria are followed for web service selection: i) functional based ii) non-functional based. The former entails selection of services based on functional property that the services areintended to do and the latter elite selection of services based on the QoS attributes such as reliability, availability, cost, and response time [2]. It is difficult to select services from service registries in the case that the selection is solely based on functionality as thousands of services offer same functionality. The QoS is an important element of web services that determines the success or failure of a composite service and facilitates users to quantify the quality of the delivered service. Currently, most of the works use successive evaluation of different non-functional aspects in order to attribute a general "level of quality" to different composite web services and to select the best one from these services. The QoS of a web service may be defined and offered by different Service Level Agreements (SLA) between service providers and clients. In the Internet-based environment, the QoS of composite service is fluctuated due to the quality of concrete services, which are subjected to change with various factors [10]. In order to satisfy both functional and non-functional constraints, suitable concrete services need to be selected for service composition. The malfunction of a concrete service may cause flaws to the final product composite service. The concrete services are to be loosely coupled in order to co-exist with a range of other services that lasts for a session of period. The pre-requisites of web service selection mechanism typically comprises of service discovery, service orchestration and is to be done in such a way that the overall QoS is improved in the composite web service. The objective of the web service selection problem is to select an implementation for each of the abstract class in the composite web service such that the overall QoS is maximal. This type of web service selection problem is also called QoS-aware web service selection [9], which aims at finding the best combination of web service candidates in order to fulfill a given SLA. The fitness function includes a set of system-specific parameters to achieve user requested goals. The performance of service selection algorithm

Author : Department of computer science School of Engineering and Technology Pondicherry University Pondicherry India.
E-mail : rkrithiga.17@gmail.com

can have a great influence on the overall performance of the composed system.

In the literature, many researchers have proposed various techniques and employed it for web service selection problem. Techniques also have been modified or improved to be able to deploy for the problem-specific issues. Zongkai YANG et al proposed a dynamic web service composition technique that integrates the ant colony optimization and the genetic algorithm [12]. Jong MyoungKoet al proposed a constraint satisfaction based web service composition algorithm that combines tabu search and simulated annealing [4]. QoS is an important criterion for web service selection. Sathya et al explored various techniques of Quality of Service based Service Selection (QSS) and identified a number of QSS specifications and descriptions for service selection [8]. LailaTaher et alproposed a frame work based on QoS-IC (Information and Computatuion) that extends the functionality of QoS Manager Component of QoS-IC framework with QoS constraints [5]. Many issues and dimensions of web service selection problem have been focused. *Heejung Chang and kangsun Lee* [3] proposed a quality driven web service composition methodology for ubiquitous services using a multi-criteria quality model which involves quality of services (QoS), quality of contents (QoC) and quality of devices (QoD) that addresses transparency by the use of Event-driven Web service Composer (EWC) tool. *Okkyung Choi* and *SangYong Han*[6] introduced a novel intelligent web services algorithm for service discovery and execution called Integrated Matchmaking algorithm, which associates rule based and semantic based search for the effective construction of web services.

This paper introduces an efficient QoS-aware web service selection approach based on evolutionary computingand makes use ofspecially designed Self-organizing migrating algorithm (SOMA) for web-service selection problem. Among the existing four versions of SOMA, the *All-To-One* standard version is being considered for our work. This paper first presents a QoS-aware service selection model that incorporates weighted sum model for decision making process and employs SOMA to find the optimal solution. Further, in order to make the algorithm more appropriate for WSS problem, we redefine the parameters of SOMA and compare the performance with GA and PSO. The experimental results indicate that the proposed service selection approach based on SOMA significantly outperform the other algorithms in terms of efficiency and effectiveness.

The structure of the paper is as follows: In the preceding section, we firstly introduce the QoS Aware web service selection model. Section 3 discusses the service selection scheme based on SOMA. The experimental evaluations and performance comparison with GA and PSO are presented in section 4. Finally, section 5 concludes the paper.

II. Problem Formulation

In this problem formulation, we follow the conventional terminologiesused by the web service community. In the rest of paper,when we say abstract web service, we refer to the abstract functionality of a web serviceand when say concrete web service;it refers to the implementation details of an abstract web service. Further, in the section, we restrict our system model by consideringfour most popular QoS attributes. However, it can be easilyextended to include or excludeas many QoS attributes.

- A Composite Service (CS) is a collection of abstract services {S_1, S_2 …Sn}that encompasses the overall functionality of a CS, where *n* represents the number of services required to construct a CS.
- An Abstract service is defined as an abstract representation of a service functionality and possess m instances of concrete services $\{s_{ij}\}\ (1 < i < m)\ (1 < j < n)$, where m represents the number of implementations or instances of an abstract service.
- A Concrete service s_{ij} is an instantiation abstract service and represents a functionality of a CS.

Each service provider must define the QoS model before delivering QoS aware service []. In our current study, four qualities attributes namely reliability, response time, availability and cost are considered as part of theWeb service parameters. These QoS attributes can also beapplied to evaluate QoS of the constructed business process. The values of these QoS parameters range between 0 and 1. The service provider holds a value for each QoS parameter. The customer requests a service provider for a service by specifying an upper and lower bound value for each QoS parameter. In particular, the lower bound is suggested for negative attributes such as execution price and execution time, and the upper bound is suggested for positive attributes such as reliability and availability. In order to evaluate the multi-dimensional quality of a given web service composition, we employ autility function called a Simple Additive Weighting technique (SAW), a weighted sum of each attributes for the QoS of a composite web service, which was introduced in the context of Multiple Criteria Decision Making (MCDM) [1].Before evaluating web services with the objective function, the QoS attributes need to be normalized and uniformly scaled using the (1) and (2).

$$q_i = \begin{cases} \frac{q_i^{max} - q_i}{q_i^{max} - q_i^{min}}, & \text{if attributes are negative} \\ 1 & \end{cases} \quad (1)$$

$$q_i = \begin{cases} \frac{q_i - q_i^{min}}{q_i^{max} - q_i^{min}}, & \text{if attributes are positive} \\ 1 & \end{cases} \quad (2)$$

Where q_i^{max}, q_i^{min} represents the lower and upper bounds provided by the user for a particular QoS attribute. $q_i$is the QoS value provided by the service provider. The overall objective function can be formulated as,

$$f(x) = \frac{1}{n}\sum_{i=1}^{n} q_i w_i$$

Where $\sum_{i=1}^{4} w_i = 1$ and denotes the interpretation user preferences in terms of weights for each attribute and $n$represents the number of QoS attributes involved. As end users specify the lower and upper bound values for QoS, services are declined if the user's constraints and requirements are violated.

III. Optimal Service Selection Using SOMA

The Self Organizing Migrating Algorithm (SOMA) is a novel stochastic optimization technique (Zelinka, 2004) [SOMA], devised on the self-organizing, cooperative, competitive behavior of social group of animals searching for the best living condition. This algorithm which has been proved to converge towards the global optimum works on a population of candidate solutions and is initialized by a random distribution over the search space. The group of animals competitively searches for the best living condition and they cooperatively organizes their movement and migrates to a better living condition. In this algorithm, during a migration loop, no new generations of individuals are created but only the positions of the individuals in the search space are changed based on the two parameters, *perturbation* and *migration*.

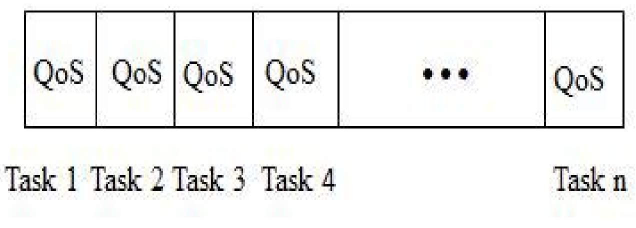

Fig. 1: Individual representation of a composite service (CS)

The SOMA is applied to WSSP and therefore firstly, the problem has to be encoded. Fig.1 shows the individual representation of a composite service. Each individual is represented by an array with the number of dimensions equals to the number of abstract tasks involved. Therefore, each individual is encoded as a composite service, which contains a combination or sequence of concrete services and dimension of the algorithm corresponds to concrete web services. The dimension holds appropriate QoS value of a particular concrete service that implements the functionality of the congruent abstract representation. SOMA holds the same initial population throughout the migration process and only the positions of the individuals are changed. Similarly, the problem does not change and evaluate concrete services during iterations. It just deals with the QoS values; Instead of the changing and trying out other combination of services, the system simply changes the values of the services. The change in the values of concrete services is homologous to the change of positions of individuals. After each migration, a configuration is selected by SOMA. The average QoS value of selected configuration is then calculated. The services are evaluated using the fitness function and may involve some constraints based on the user preferences. The problem can be a maximization or minimization and in our work the latter is employed. When user or domain specific non-functional attributes are used, the specification of the fitness function is left to the workflow designer.

The perturbation operation decides which values of services are subjected to change and which are not. The PRT vector that consists of 0's and 1's is responsible for this mechanism. A number 0 indicates that the values are not changed for a particular service and a value 1 indicates that the values are subjected to changes. This mechanism of deciding upon the formation of a composite service by retaining some of the QoS values of services while letting other services undergo change is done randomly. The randomization processes are always believed to lead to a better solution. The migration operation promises in drifting the values to an optimum solution by making it traverse in the direction of the leader (optimal solution). The output of the algorithm is a sequence of real number values that specifies the expected metric value of individual concrete services. The relevant services are chosen from the service registry, which makes up a composite service.

Algorithm WSS-SOMA

```
Randomly create an initial population of Pop Size
For n migrations do
Generate PRT vector
Evaluate population using fitness function
Select leader
For each individual j in population do
        store best solution of j into best fitness
        for k steps (k<= pathlength)
                migrate individual j towards leader
                Evaluate QoS at new position
        If new position is better than the best fitness
then
        new position becomes he best fitness
                end
end
move individual j to best position
end
```

end
output best.

IV. Experimental and Resultanalysis

SOMA is applied to detect the optimal configuration that satisfies service selection constraints and requirements. In order to show the performance of the proposed QoS aware WSS using SOMA, a test has been conducted. The experiment is conducted on a desktop computer with 2.80 GHz CPU and 2 GB RAM. In the experiment, we intend to create a composite service with 30 abstract tasks. Therefore, the searching process is done in 30-dimensions and the number of instance services available for each abstract task is set to 50. Several stopping criteria are employed to terminate the execution. In our work, the algorithm is executed for 25 runs and the maximum number of function evaluations is set to 12000. Similar setting is done for all algorithms for the purpose of comparison. An aggregation is then performed for each of the QoS parameters and the values are normalized using the fitness function. The PRT vector of SOMA is set to 0.1. The step size and the path length, which greatly affect the search process, are set to 0.11 and 2.2 respectively. The results of the experiment are show in the form a graph Figure: 2 that depict the performance of the proposed technique for 25 runs. Further comparing with GA and PSO, the advantages of SOMA are that SOMA is easy to implement and there are few parameters to adjust and the information sharing mechanism in SOMA is significantly different compared to GA and PSO.

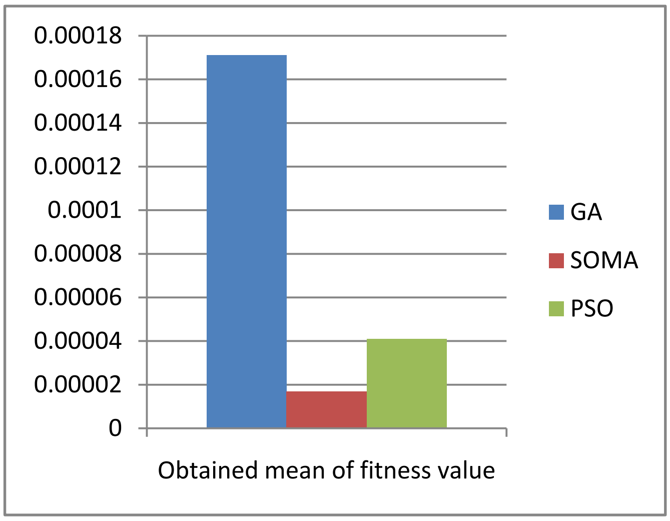

Fig. 2: The average fitness value on GA, SOMA and PSO

The experimental results indicate that the QoS optimization of service selection can be achieved by using SOMA. Along with the increase of migrations, the service configuration selected by SOMA gradually tends to an optimal configuration. The experimental result is shown in Fig 2. As our problem deals with minimization, it can be seen that SOMA has generated accurate results, comparatively. Although PSO almost perform in a better way, the difference between the performance of GA and SOMA is significant. The overall performance for WSSP can be written as SOMA>PSO>GA.

As it can be seen from the graph, the cost values obtained by SOMA are very close to the desired value, it is obvious that the proposed scheme QoS aware service selection is not only interoperable efficiently chooses the concrete services that satisfy the goals.

V. Conclusion

In order to satisfy multiple functional and non-functional constraints, suitable concrete services need to be selected for web service selection. Due to the complexity involved in the problem, we have presented an algorithmic approach for solving the optimal service selection problem by considering a stochastic optimization algorithm called SOMA and specially designed it suitable for WSS. Our approach is designed to accelerate the detection of optimal configuration at rapid convergence. The algorithm guarantees the resulting composite web service with maximal overall QoS that strictly conforms to the QoS constraints and user requirements. As a part of our future work, the algorithm has to be improved in order to survive in a ubiquitous environment. The mobility, adaptability and user preferences are to be formulated automatically as constraints.

References Références Referencias

1. Ching-Lai Hwang and K. Paul Yoon, editors. Multiple Attribute Decision Making: Methods and Applications, volume 186 of Lecture Notes in Economics and Mathematical Systems. Springer-Verlag, March 1981.
2. R. Dinesh Kumar and Dr.G. Zayaraz, “A Qos Aware Quantitative Web Service Selection Model”, International Journal on Computer Science and Engineering (IJCSE), 2011.
3. Heejungchang and kangsunlee, “A Quality-Driven Web Service Composition Methodology for Ubiquitous Services”, Journal of Information Science and Engineering, 2010.
4. JongMyoungKo et al, “Quality-of-service oriented web service composition algorithm and planning architecture”, The Journal of Systems and Software, 2008.
5. LailaTaher et al, “Establishing Association between QoS Properties in Service Oriented Architecture”, Proceedings of the International Conference on Next Generation Web Services Practices, 2005.
6. Okkyung Choi and SangYong Han, “Ubiquitous Computing Services Discovery and Execution Using a Novel Intelligent Web Services Algorithm”, Sensors 2007.

7. Palanikkumar, D. and G. Kousalya, "An Evolutionary Algorithmic Approach based Optimal Web Service Selection for Composition with Quality of Service", Journal of Computer Science, 2012.
8. Sathya et al, "Evaluation of QoS Based Web-Service Selection Techniques for Service Composition", International Journal of Software Engineering (IJSE), Volume (1): Issue (5).
9. Tang, Maolin and Ai, Lifeng, "A hybrid genetic algori-thm for the optimal constrained web service selection problem in web service composition". In: Proceeding of the 2010 World Congress on Computational Intelligence, 18- July 2010, Centre de Convencions Internacional de Barcelona, Barcelona.
10. Xue-long Wang et al, "Service selection constraint model and optimization algorithm for web service composition", Information Technology Journal, 2011.
11. I. Zelinka, "SOMA—self organizing migrating algorithm," in New Optimization Techniques in Engineeri*ng*, B. V. BabuandG. Onwubolu, Eds., pp. 167–218, Springer, New York, NY, USA, 2004.
12. Zongkai YANG et al, "A Dynamic Web Services Composition Algorithm Based on the Combination of Ant Colony Algorithm and Genetic Algorithm", Journal of Computational Information Systems, 2010.

This page is intentionally left blank