ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 6, June 2015

Efficient Web Service Retrieval Using Adaptive Genetic Algorithm

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ABSTRACT: The rapid development in the web applications has increased the research attention towards service computing through which the web services can be retrieved based on the user requirement. However, invoking service details is a challenging task due to voluminous availability of web services and the need to enable quality assisted web services. Literature has focussed on addressing these two challenges. This paper reports a procedure of web service composition by selecting various services using service selection criterion based on the user request. The proposed method is comprised of a service selection model, which is the cost optimization model solved using adaptive genetic algorithm, and web service composition procedure. The service selection intends to select the expected services by solving the cost model without considering other technical constraints. The adaptive genetic algorithm enables relatively quick convergence to select the appropriate services using the genetic operators.

KEYWORDS: Web; service computing; optimization; adaptive genetic algorithm; web service composition

I. INTRODUCTION

The major benefit of web service composition is the mastering of complexity. The motivation behind the choice of services is the major concern to be taken into consideration when updating a procedure by altering the service bindings. WSDL, UDDI, and SOAP are the main technologies comprise the framework of web services [2-4]. There are diverse lines of attacks to generate a web service composition. These methodologies facilitate various organizational components to inter related to their applications and to distribute data in scattered surroundings by means of a grouping of web services. These tactics consist of BPEL4WS, OWL-S, Petri nets, Model checking/Finite state machines, π-calculus, and Web-components [5]. There are still challenges in the web service composition field that are to be tackled and examined. For instance, there is a general lack of methodology and tools which facilitate the semi-automatic composition and examination of web services by considering their semantic and behavioural characteristics [1]. These are essentially associated to the question how to help non expert users to accomplish goal oriented service composition. A necessary concern is how accessible semantic services can pool resources and make use of domain knowledge and user inputs to assist in attaining semi-automatic service composition for dynamic adaptation to varying business necessities [15].

This paper presents a web service composition framework offering comprehensive query and optimization facilities over Web services. The proposed framework provides an integrated architecture for web service selection and composition. Initially, Users formulate declarative queries at the query level and the query is given to service registry to select the suitable services desired by the users. Here, service selection should compensate the user requirement along with the quality details. Accordingly, genetic algorithm is used in this framework which selects the service fulfilling both the objectives. The proposed work considers the different quality parameters such as Response time, Availability, Reliability, Cost, Reputation, Encryption, Authentication, Non-repudiation and Confidentiality. The second phase instantiates the service composition of different service select from the optimization model. The basic organization of the paper is given as follows: Section 2 presents the existing work and section 3 proposes the genetic algorithm-aided optimization strategy for web service selection and composition. Section 4 concludes the paper.

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II. LITERATURE SURVEY

Numerous methodologies on web service selection and composition have been reported in the literature [6-13]. In [6], an integrated service query framework has been introduced to assist users in accessing their required services. The method is comprised of a service query model and two – phase optimization strategy. The service communities have been defined by the query model so that voluminous and heterogeneous service space can be exploited well. In the second phase, feasible service execution plans are automatically generated using two – phase optimization strategy followed by selecting the best user – desired quality using evolutionary algorithm. Since evolutionary algorithm is classic and the probability of sticking with local optima is high here. Hence, in our earlier method, we have proposed genetic algorithm to replace the evolutionary algorithm. This had adequately improved the searching efficiency and selecting the best plan. Moreover, the additional service call along with the composition of selected plan had also been done [14].

III.OUR METHOD

Our method is the improved version of earlier method [14] that exploited genetic algorithm for selecting the service execution plan. The components of our method with the description are given below.

2.2.1 Web services: The web services provide adequate interactive environment among the software applications that are executed in diverse frameworks and platforms. It can be defined as an interface represented in machine understandable format. The general definition about the web services can be said as the integrated XML provided from the web resources. A web service is constituted by two parts namely, XML and WSDL (Web Service Definition Language) as well as two entities namely, Requester Entity and Provider Entity. Requester entity considers and processes the user request to ensure the instant availability of the web service, whereas the provider entity processes the user request and provides the corresponding web service to the user. The web service schema well defines the functions of these two entities. The basic structure of the web service is illustrated in Figure 1.
As per Figure 1, the user request constitutes WSD that is in connection with the service broker. The commonly used service broker is Universal Description Discovery and Integration (UDDI). The service broker responds the user by processing the user request based on the instruction from the service provider.

2.2.2. Cost Model: The cost model aggregates the quality parameters obtained from multiple operations caused due to service execution plan. As the users are given options for the answering procedures for their queries, they may state the profile elements based on the significance of the quality parameters. The significance of each quality parameter is defined by a weight within the interval [0, 1]. We exploit the objective model used in [6] in which the possible service execution plan is selected when a query is given. The problem model is given as follows.

$$F = \sum_{Q \in neg} \left(W_i * \left(\frac{Q_i^{\max} - Q_i}{Q_i^{\max} - Q_i^{\min}} \right) \right) + \sum_{Q \in pos} \left(W_i * \left(\frac{Q_i - Q_i^{\min}}{Q_i^{\max} - Q_i^{\min}} \right) \right) \qquad (1)$$

where, neg and pos represent the sets of negative and positive quality service, respectively. Higher the negative parameter, lower the quality and vice versa. W_i, Q_i, $Q_i^{\min}$ and $Q_i^{\max}$ are the user defined weights for every parameter, i^{th} quality of service of the service execution plan obtained through the aggregation functions, minimum and maximum limits of i^{th} quality parameters, respectively. $Q_i^{\min}$ and $Q_i^{\max}$ are used for normalizing the wide range of quality attributes so that they can be relatively studied with each other. Few quality attributes are response time, availability, reliability, cost, encryption, authentication, non-repudiation, reputation and confidentiality.

2.2.3. Web service composition: The ideology behind the web service composition has considered, since the increased network traffic has increased the necessity of combination of multiple web services. Certain circumstances refer web service functioning requires invoking other web services and hence a service with the combination of multiple services have been developed. Such combined services can be referred as composite web services and the process that develop such composite web services are called as web service composition. The process of web service composition can be

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illustrated in Figure 2. Based on the selected web services, the web service broker configures the web service composition definition.

IV. ADAPTIVE GENETIC ALGORITHM FOR SOLVING COST MODEL

This paper solves the cost model given in equation (1) using adaptive genetic algorithm. The adaptive genetic algorithm differs from the traditional genetic algorithm in terms of the crossover rate and the mutation rate. In the standard genetic algorithm, the crossover and mutation rates are static, whereas in the adaptive genetic algorithm, they are dynamic with respect to the performance of the algorithm. The remaining operators such as initialization, selection, crossover and mutation are same as like genetic algorithm.

By solving the cost model, the adaptive genetic algorithm is able to select the web services optimally based on the quality parameters. Initially, arbitrary population is generated in which the chromosome (candidate) refers to selected service. The set of chromosomes are obtained for each web service combination. From the initial population, more number of candidates is generated. Crossover and mutation are the genetic operators that are highly used to generate large set of candidate solutions. From these huge set of candidates, iterative process is performed. In every iteration, best candidate solutions are selected followed by generating next generation of candidates using crossover and mutation. The crossover and mutation are performed using adaptive crossover and mutation probabilities, respectively, rather than traditional crossover and mutation probabilities.

A. Adaptive Probabilities
We refer adaptive crossover and mutation probabilities proposed in [14].

$$P = \begin{cases} \left(P^{\max} - P^{\min}\right)\arctan\left(K\phi(f)\right) + P^{\min}; \ f_{avg} \le f \\ P^{\min}; \ otherwise \end{cases} \qquad (2)$$

$$\phi(f) = 1 - \frac{2\left(f - f_{avg}\right)}{f_{\max} - f_{avg}} \qquad (3)$$

In equation (2), P, $P^{\max}$, $P^{\min}$ and K are the probability rates, minimum probability rate, maximum probability rate and the constant, respectively. $\arctan(\bullet)$ and $\phi(f)$ are the arctangent function and fitness based scoring function, respectively. In equation (2) and (3), f, f_{avg} and $f_{\max}$ refer to the fitness of the candidate solution, average fitness of the solutions till the current iteration and the maximum fitness value obtained till the current iteration, respectively.

According to the adaptive genetic algorithm, new crossover and mutation probabilities are obtained using the equation (2). Based on the new probabilities, the crossover and mutation are performed. A brief description about the other operators is given below.

B. Genetic Operators
3.2.1. Selection: The operator is used to select candidate solutions from the large pool of solutions. Here random selection process is adopted that generates two arbitrary integers. The chromosomes that are indexed by the integers are retrieved as selected solutions and they are forwarded for the subsequent processing stages.

3.2.2. Crossover: This paper recommends single point crossover although numerous crossover operators exist. According to the single point crossover, a single point is selected based on the obtained crossover probability. The genes that are beyond the crossover point is exchanged among the two parent candidate solutions.

3.2.3. Mutation: The children solutions obtained from the chromosomes are subjected to the mutation process in which a mutation points are fixed over the genes, based on the newly obtained mutation probability. The genes that are pointed by the mutation points are replaced by a new arbitrary gene that best suites the gene element.

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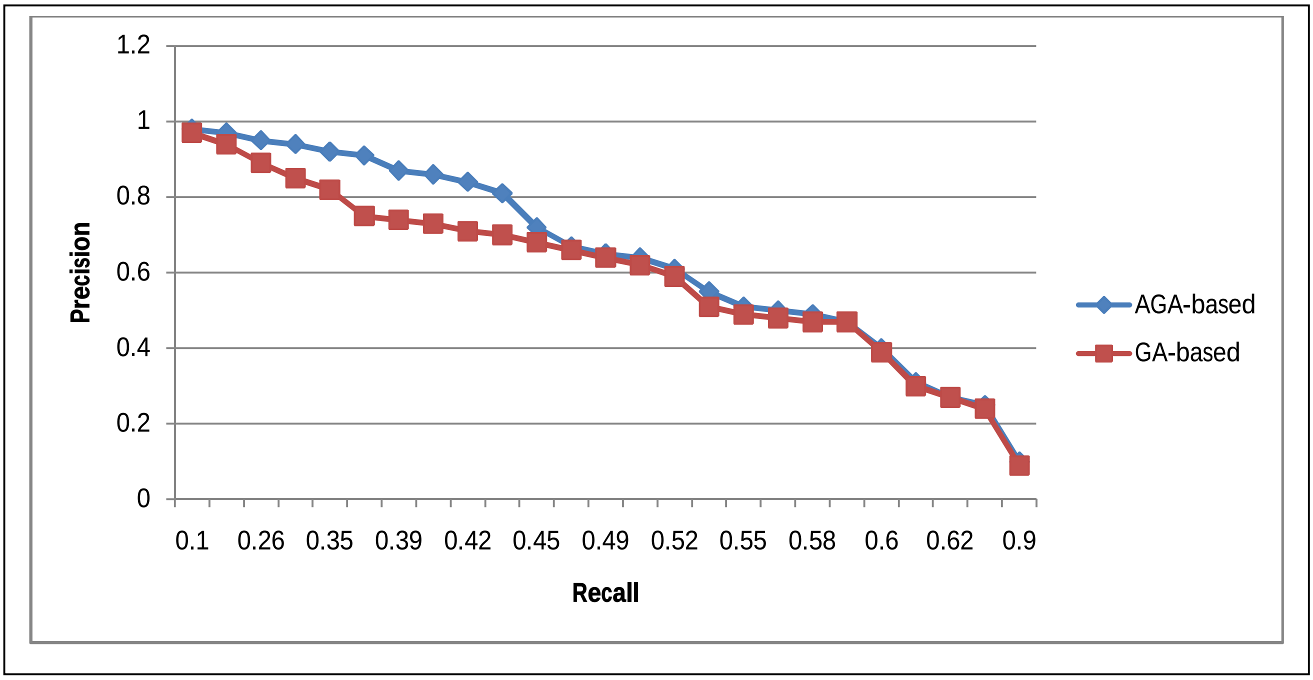
3.2.4. Termination: Since it is an iterative process, the terminating the iteration is based on the number of iterations being executed so far. When the number of iteration reaches a required or desired count, the entire process is terminated. The best candidate solution obtained so far is retrieved where the web services are indexed. These web services are selected for further processing of web service composition.

V. RESULTS AND DISCUSSION

The method is experimented and the results are observed. The retrieval efficiency in terms of precision and recall is determined and plotted in Figure 1. It includes the performance comparison with GA-based web service retrieval.



VI. CONCLUSION

This paper reported a framework for service composition so that the users can comfortably access the required services without any compromise on their service quality. The proposed framework has two processing stages. In the first stage, web services are acquired from the service registry based on the user request in such a way that the acquired services meet all the quality constraints. Hence, adaptive genetic algorithm has been used to optimally select the web services to be retrieved with proven convergence speed. The adaptive genetic algorithm has attempted to solve the cost model and hence the purport of extracting the web services without compromising the quality constraints has also been accomplished. Hence, acquired services have been subjected to the web service composition to compose all the service details precisely.

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BIOGRAPHY

Dr. Poonam Yadav obtained B.Tech in Computer Science & Engg from Kurukshetra University Kurukshetra and M.Tech in Information Technology from Guru Govind Singh Indraprastha University in 2002 and 2007 respectively. She had been awarded Ph.D in Computer Science & Engg from NIMS University, Jaipur. She is currently working as Principal in D.A.V College of Engg & Technology, Kanina (Mohindergarh). Her research interests include information retrieval, web based retrieval, Semantic Web, etc. Dr. Poonam Yadav is a life time member of Indian Society for Technical Education and her email id is poonam.ir@gmail.com.