Adaptation of Bees Algorithm for QOS-based Selection and Replacement of Web Services

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Keywords: Web Services, Quality of Service, Replacement, Bees Algorithm, Optimization.

Abstract: Web service is a new paradigm of internet software and distributed computing. With the growth of web services number, the capability to find the optimal service which can substitute the fault service from different communities represents a very hard operation. The researched service must have the same functionalities of the fault service and the highest quality of service scale. In this paper, we propose heuristic method based on Bees Algorithm to find the optimal service which can substitute the fault service. In our approach, we design a distributed environment based on Peer-to-Peer architecture in order to present distributed communities which are considered as flowers and research requests as bees.

1 INTRODUCTION

Web services are used in various domains such as business to business integration and web-based systems thats why the number of service webs consumer is increasing. Therefore, the fault tolerance of web services has become an active research domain in order to make the use of this paradigm safe and improve the performance and reability.

In the same context, we propose a method for providing fault tolerance in services oriented architecture. Our approach focuses on building a distributed architecture in which fails are detected automatically and a suitable web service for substitution is found.

The selection of optimal service for substitution represents a very hard operation because the large space of solutions and multiple criteria of quality of service are considered at once such as performance, security, etc. Therefore, we propose the application of heuristic method called Bees Algorithm to facilitate research procedure of optimal service from a huge number of web services grouped in communities.

This new technique is inspired from the way bees forage the food and has been successfully applied to various optimization domains and problems. This paper is organized as fellow: the second section presents web services; the third section shows the details of our approach; in the firth section, we present the implementation and the conclusion is a subject of last section.

2 WEB SERVICES

2.1 Mechanisms of Discovered Web Services

The discovery of the Web services represents the process allowing the localization of the documents describing a service Web (WSDL file). However, with the permanent increase in the number of the Web services, the task of discovery becomes a difficult task.

To facilitate the discovery of the Web services, several approaches were defined. These various approaches can be classified in two main categories: discovered based on sequential algorithms and others based on the heuristic ones. Among approaches which tack part of the first type we found WSDA (Hoschek, 2002), Speed-R (Vu et al., 2005), PSWSD (Vu et al., 2005), LARKS(Sycara et al., 2002), OWL-S(Srinivasan et al., 2004), AASUD (Palathingal and Chandra, 2004), etc.). For the second type of algorithm, we found the approach (Jaeger and Mhl, 2007) which uses the genetic algorithm to select a Web service element of a composition while taking into account the maximization of the service quality of the obtained composition.

2.2 Community of Web Services

There are several services which have the same func-

Teyeb Jaouachi R., Ben Jemaa M. and Karray A..
Adaptation of Bees Algorithm for QOS-based Selection and Replacement of Web Services.
DOI: 10.5220/0004083804590462
In *Proceedings of the 7th International Conference on Software Paradigm Trends* (ICSOFT-2012), pages 459-462
ISBN: 978-989-8565-19-8

tionalities. However, these services are distinguished from/to each other by their non-functional properties such as the performance, the cost and the safety. Thus, in order to facilitate the research of the adapted Web service, the services are classified by categories or fields from where approach containing community (Ran, 2003).

The principal goal of the community of services is to facilitate the research and the selection of the Web services. A community is characterized by its abstracted interface, its model of quality and the various recorded Web.

Contrary to a directory UDDI, a community is characterized by a specific field i.e. it gathers a whole of services which are differed between them by the non-functional properties. Thanks to a model of quality specific to each community, these parameters are mentioned. A community is exposed through an abstract interface which makes it possible to define the interactions being able to begin with the community services.

3 THE PROPOSED METHOD

Our purpose is to propose a new approach which optimizes the time needed to replace the fault web service.

With growing and competing demands and invocations, the probability of fault increase and the use of fault tolerance mechanism become indispensable. So that, we build a new architecture based on communities of web services. To find the optimal service which can substitute the fault one, we use the Bees Algorithm as an intelligent way of research.

3.1 Architecture

Our architecture consists of:

- *A Layer for Semantic Clustering Web Services in Community*. Each community has a description file which indicates its business.
- *A Supervision Module*. This component controls the quality of service offered by different web services in execution. If this level is below a certain value, it will invocate a module to choose an equivalent service for substitution.
- *A Substitution Module*. This module is triggered after a fault detection of a web service. It ensures the selection of a web service offering the same functionalities offered by the failed one and having the highest level of quality of service.

  So it is used, in the first place, to find the community which has the same category with the failed web service, and to choose between different services web present in the community. The selection is based on quality of service.
- *A Cache of Equivalence*. This cache saves the web services and their Web services equivalent. It can make the search procedure faster than that performed by the substitution module if both (default web service, web service equivalent) exists in the cache. Each couple in this table has a period of validity. After the expiration of this period the associate couple will be removed.

3.2 Adaptation of Bees Algorithm in Substitution Module

When searching for an equivalent web service, the substitution module should choose from a wide range of services already developed. To reduce the research area, and to find the desired web service, we will use a new optimization technique called "Bees Algorithm".

3.2.1 The Bees Algorithm

As mentioned above, the Bees Algorithm represents a new optimization algorithm proposed by Pham et al (Pham et al., 2006). It is based on natural foraging behavior of honey bees.

Due to its successful results in various domains such as clustering problems, artificial neural network training. This algorithm is considered as one of the most important optimization algorithms.

3.2.2 Bees in Nature

The foraging process begins in a colony by sending scout bees to search for flower patches. They move randomly from one flower to another in order to exploit a large number of food sources. When they return to the hive, those scout bees deposed their nectar then they evaluate the various plots visited and sort them above certain quality threshold which can be measured as a combination of some constituents such as sugar.

They choose the (m) best patches and (e) top-rated patches.

After this step, Scout bees perform a dance called waggle dance.

This dance is essential for communication in the colony. It provides three types of information: direction of a flower patch, distance from the hive and a quality of nectar.

This information helps the colony to send its bees to collect nectar without the use of guide or

maps. More follower bees are sent to more promising patches in order to gather nectar efficiently and quickly.

3.2.3 The Basic Bees Algorithm

Listing 1 shows the pseudo-code of this algorithm. More details are described in (Pham et al., 2006). To execute this algorithm, a number of parameters must be initialize namely: number of scoot bees (n), number of sites selected out of n visited sites (m), number of best sites out of n visited sites, number of patches selected for neighborhood research (m), number of bees recruited for (m-e) selected sites (nsp) and stopping criterion.

The algorithm begins with placement of (n) scoot bees, randomly, in the search space.

3.2.4 Proposed Method for Substitution Module

The proposed method adapts the efficacy of the Bees Algorithm to optimize the research procedure. When searching for an equivalent web service having the same functionalities of failed web service, the substitution module should choose from a wide of web services already developed.

To minimize research area and to find a desired web service in the shortest period, we use this technique. We consider a bee as a web service query and a community of web services as a patch.

Our proposed approach based on Bees Algorithm consists of five steps.

- Step1: random exploration. This step consists to send search queries in parallel way to different communities of web services. The choice of communities at this stage is randomly.
- Step2: measure of similarity. In step 2, the algorithm evaluates the degree of similarity between business domain of failed service and visited communities. Each community has a value of fitness function which indicates the degree of semantic similarity.
- Step3 and step4: Sorting and selection of suitable community. In step 3, visited communities are sorted. according to similaritys degree collected from the second step.
- In step 4: A community having the highest degree of similarity is selected as elite community.
- Step5: Exploration of elite communitys neighborhood To explore the neighborhood of elite community, the algorithm sends research queries to community selected in step 4.

Obtaining maximal similarity between two areas of interests: area of fault web service and the selected community represent the stopping criterion.

4 IMPLEMENTATION

In order to implement our approach different tools are used.

4.1 JXTA Platform

JXTA (Vogel et al., 1995) is a project developed by Sun for the Peer-to-Peer (P2P). It used to facilitate the exchanges between peers on a network.

This platform offers several services such as:

- Dynamic search.
- Resource sharing (documents, files...).
- Creation of peers groups.
- Communication in a protected way.
- Collaboration with other applications.
- Etc.

Based on standards such as TCP/IP, HTTP and XML, JXTA is independent of any programming language, of any protocol of transport and any operating system. The choice of this platform is adequate for implementing our distributed communities network. Each community can be presented by a group of JXTA peer. To present a distributed community environment, we implement several peer groups, i.e., registry of education, sport, and travel.

4.2 WordNet

WordNet represents a semantic network of the lexical data bases. Its goal is to index, classify and connect the semantic contents and lexical of the English language (complete version).

WordNet was also developed for other languages like French (represents only 25

- Synsets: when the direction of a word is defined by a whole of the synonyms and a definition
- Lexical Relations: when the direction of a word is defined by a whole of the semantic relationships to other directions (Example chien/caniche, etc)

4.3 WordNet: Similarity

WordNet: Similarity is free software which measures the similarity between two terms. It uses three measurements of semantic similarity and six measurements of linguistic proximity

- *Measurements of Linguistic Proximity of WordNet:* is based on the analysis of the hierarchy WordNet " is a " Several methods using this principle of measurement such as measurements of WuP (De la Rosa, 2004).
- *Measurements of Semantic Similarity of WordNet:* is not based only on the relation " is a " of WordNet, but they use other non hierarchical relations
- *Three Measurements of Semantic Similarity Offered by WordNet:* is: Vector (Leacock and Chodorow, 1998) Hso (Patwardhan, 2003) Lesk (Hirst and St-Onge, 1997).

These two tools are used in order to Measure the similarity between business domains of failed web service and visited communities.

5 CONCLUSIONS

In this paper, we adapted a new technique of optimization called Bees Algorithm. This algorithm optimizes web services discover and the selection of suitable web service which can substitute fault one.

In our approach, we implemented a peer to peer environment in order to present distributed communities. Our method is based on two important steps. The first step is to find a community having the same/equivalent business domain of fault one with minimization of research procedures time. The second step is to calculate quality of services level for all web services present in founded community and to select the best between them offered the highest score.

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