Applying Bees Algorithm for Trust Management in Cloud Computing

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Abstract. Cloud computing is considered the new paradigm in computing that would make computing a utility. Once the cloud computing becomes available widespread, many service providers would market their services at different qualities and prices. When this happens, the customers would be required to select the right service provider who could meet their anticipated quality. A trust management system would identify the quality of service providers and help customers to choose the right provider. Designing a trust management system is a difficult task, as it requires the consideration of several attributes both local and external to the system. In this paper, the authors propose that the Bees Algorithm that was used to solve issues in diverse fields could be successfully adapted to address the trust issue in the cloud computing system. The authors justify their proposition based on the comparative study carried out on cloud computing and the bees environments.

Keywords: cloud computing, trust management, bees algorithm.

1 Introduction

Cloud computing has been considered the new paradigm that envisages to change how the computing resources including hardware, software and services have been purchased and used [1]. Until the development of cloud computers, computing resources have been either purchased outright or leased from data centres. Purchasing computing resources outright or leasing the resources from data centre providers require payments for these resources irrespective of their usage. Cloud computing changes all these and make computing a utility similar to electricity, water, gas and telephony where users would pay only for the resources consumed [1]. Currently there are several commercial cloud service providers selling their services to a wider audience and there will be many more in time to come. These providers market different services at different levels of quality and price. Hence it is necessary for customers to identify the right provider before making a commitment. Trust systems can play a major role in identifying the service providers and their quality. In this paper the authors propose that the Bees Algorithm that has been used to solve optimization problems commonly

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known as NP-hard problems can be adapted to solve the trust issue in cloud computing.

This paper consists of five sections where Section 1 introduces the paper and the topic while Section 2, and 3 concentrate n cloud computing and related Work respectively. Section 4 analyses the similarity between the environments where bees carry out their food foraging and the cloud computing environment. Finally Section 5 concludes the paper stating how the Bees Algorithm can be adapted to solve the trust management problem in cloud computing.

2 Cloud Computing

Cloud computing has created a new paradigm shift in computing by making the cloud resources available on the Internet as services. Consumers may be able to access computing resources like hardware, software, communication and services as utilities and pay for only what is used similar to other utilities. Hence cloud computing has now been commonly known as the 5th utility [1]. Cloud providers implement the services on virtualized platforms where these virtual systems can be brought up and destroyed based on user demand within short times [2]. Hosting systems on virtual servers helps the providers with the flexibility for selling the same resources to multiple clients reducing the cost of these resources per client while increasing the utilization of them. Purchasing cloud services in place of dedicated resources helps the businesses to move the capital expenditure on these resources to operational expenditure that can be spread over a longer period.

Cloud system can be divided into five layers in two groups as shown in Fig. 1 [3]. The physical hardware layer is the workhorce that powers the cloud system in terms of CPU, memory, storage, communication interface etc. The physical hardware layer can be implemented using clusters, data centres, work group or desktop computers [4]. The virtual hardware layer hosted on top of the physical hardware is the one that makes the cloud system different from other traditional hosting services. The virtualized systems can be brought up and down at the demand of the clients on the fly without affecting other virtual systems running on the same physical hardware. The middleware that virtualizes the physical hardware provides the necessary operating environment for applications maintaining isolation, quality of service and security [4]. Cloud service layers are divided into Infrastructure as Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) layers [4]. Provision of processing power, storage, database etc., on the virtual platform is known as IaaS. The virtual systems made available to clients as IaaS can be treated similar to real systems and users can install the operating system and applications of their choice on them. The PaaS installed on top of the IaaS provides the platform for complete software development life cycle. PaaS offerings usually comprises programming languages, testing tools and Application programming Interface (API) to access these tools. Thus complete

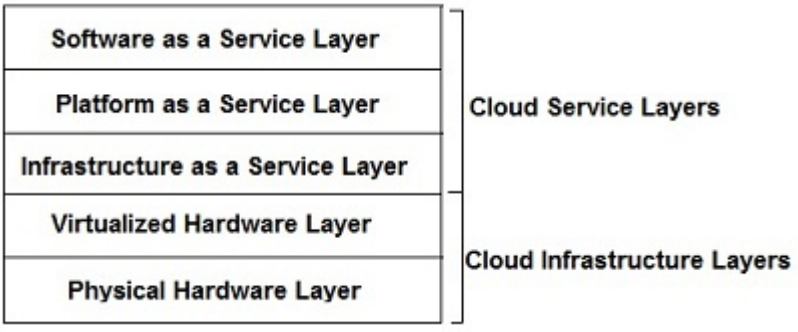

Fig. 1. Layered Architecture of Cloud Computing System [3]

applications can be developed, tested and deployed using PaaS. SaaS provides a radically new platform for marketing software tools and applications as services. This helps developers to focus totally on the application development without getting distracted by system installation and maintenance tasks. Applications developed and hosted on the Internet can now be purchased by clients and pay only for the services accessed based on the access time. This frees the customers from purchasing, installing and managing applications on site[5].

3 Related Work

3.1 Trust and Trust Management

Trust is considered to be an important factor when entities interact with each other involving uncertainty and dependency [6]. Trust has its origin in social sciences and studied by researchers in diverse fields such as psychology, sociology, economics and technology. As different researchers have approached trust from different angles depending on the field of specialization they are in, there was no common agreement or definition for what trust is? Though there are multiple definitions and approaches for dealing with trust, computer scientists can benefit from all these studies carried out on different fields [7]. Trust management systems have been implemented in distributed computing systems including peer to peer systems, grid computing, cluster computing, sensor networks and cloud computing [3].

3.2 Trust Management in Cloud Computing

Several researchers have attempted to build trust management systems for cloud computing [8,9,10,11,12]. Though most of these proposals had tried to address the trust in cloud computing, they lack a sound theoretical foundation. Firdhous et al. have proposed two trust models using Quality of Service (QoS) as the basis for building trust [3,13]. Though these two proposals lay a foundation

for computing and adapting the trust value by continuously monitoring the performance of the service provider, they are based only on one QoS parameter namely the response time of the server.

3.3 Bees Algorithm

The Bees Algorithm is a population based search and optimization algorithm developed based on the food foraging behaviour of honey bees. Honey bees are social insects similar to ants, termites and wasps that live in large colonies and carry out their jobs with precise coordination [14]. In a typical beehive there are 20,000 - 100,000 bees which are organized in a hierarchical structure with the queen bee on top followed by female worker bees and male bees [15]. The worker bees are responsible for collecting nectar to produce honey and bee wax. Honey bees travel long distances looking for flower patches suitable for collecting nectar [16].

At the beginning of the foraging process, scout bees go out searching for suitable flower patches. These scout bees travel randomly moving from one patch to another. On their return to the hive, the ones those found a flower patch above certain quality deposit the nectar and perform the waggle dance. This waggle dance conveys the required information to other bees for exploring the flower patches [17]. Depending on the quality of the flower patches, number of bees are assigned to each flower patch for foraging. Large number of bees are assigned to flower patches with large amount of nectar while smaller flower patches are foraged by fewer bees. The scout bees that discovered the flower patch will lead other bees to the patch for further foraging. The food level of the patch is continuously monitored during the harvesting process as it is important for future harvesting [18].

The Bees Algorithm starts by searching the neighbourhood along with random search that is suitable for both combinatorial and functional optimization [17]. Several variations of the Bees Algorithm have been developed and published for solving various complex optimization problems [18,19,20,21,22].

4 Adoption of Bees Algorithm for Cloud Computing

If a detailed comparison between the cloud environment and the natural environment where bees forage for food, it is possible to see a remarkable similarities between these environments. Table 1 presents a summary of such comparison.

From Table 1, it can be seen that there is a remarkable similarity between cloud computing and bees environment. So Bees Algorithm could be applied successfully to the cloud computing system to address the trust management issue. By applying the Bees Algorithm for the cloud system, the trust of a service provider can be computed combining multiple parameters of the system and the environment. Also, it could be possible to optimize the performance of the system using the same Bees Algorithm, by allocating suitable number of clients to each server system.

Table 1. Comparison of Cloud Computing Environment with Bees Environment

Bees Environment	Cloud Environment
Flowers patches	Server systems
Different flower patches	Different types of services
Number of foraging bees	Number of clients
Duration of foraging	Duration of service
Scout bees	Software agents
Information from waggle dance	Information from agents
Direction	Route
Distance	Access time
Quality of nectar	Quality of service
Size of the patch	Capacity of the server system
Monitoring food level	Continuous update

5 Conclusions

In this paper, the authors present the idea that the Bees Algorithm could be adapted to solve the trust management issue in the cloud computing. The authors also present a detailed comparison between the cloud computing environment and the bees environment. The findings of the comparison support the conclusion of the authors that the Bees Algorithm could be successfully adapted to use in the cloud computing systems.

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