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Energy Efficient Task Scheduling in Cloud Environment

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Abstract

Cloud computing is a style of computing in which dynamically scalable and other virtualized resources are provided as a service over the Internet. The energy consumption and makespan associated with the resources allocated should be taken into account. This paper focuses on task scheduling using Clonal Selection Algorithm (TSCSA) to optimize energy and processing time. The result obtained by TSCSA was simulated by an open source cloud platform (CloudSim). Finally, the results were compared to existing scheduling algorithms and found that the proposed algorithm (TSCSA) provide an optimal balance results for multiple objectives

1. Introduction

Cloud computing is the next generation computational paradigm. It is an emerging computing technology that is rapidly consolidating itself as the future of distributed on-demand computing [1, 2]. Cloud Computing is emerging as vital backbone for the varieties of internet businesses using the principle of virtualization. Many computing frameworks are proposed for the huge data storage and highly parallel computing needs of cloud computing [2]. On the other hand, Internet enabled business (e-Business) is becoming one of best business model in present era. To fulfill the need of internet enabled business, computing is being transformed to a model consisting of services that are commoditized and delivered in a manner similar to traditional utilities such as water, electricity, gas etc. Users can access services based on their requirements without regard to where the services are hosted or how they are delivered. Several computing paradigms have promised to deliver this utility computing [3]. Cloud computing is

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one such reliable computing paradigm. Cloud computing architecture typically consists of a front end and a back end connected by Internet or Intranet [4]. The main objective of cloud computing environment is to optimally use the available computing resources. Scheduling algorithms play an important role in optimization process. Therefore user tasks are required to schedule using efficient scheduling algorithm. The scheduling algorithms usually have the goals of spreading the load on available processors and maximizing their utilization while minimizing the total execution time [5]. Task scheduling is one of the most famous combinatorial NP complete problem problems [6]. The main purpose of scheduling is to schedule the tasks in a proper sequence in which tasks can be executed under problem specific constraints [7]. Many heuristic optimization algorithms have been developed and solved the task scheduling in cloud environment over the years [8]-[10]. Clonal Selection Algorithm (CSA) is a special class of Artificial Immune System which uses the clonal selection part of the Artificial Immune Systems as a main mechanism. This algorithm was initially proposed to solve nonlinear functions by De Castro and Van Zuben in 2000 [11,12].

This paper presents an optimization algorithm for user job scheduling to achieve optimization of energy consumption and overall computation time using Clonal Selection Algorithm (CSA). The rest of the paper is organized as, section 2 contains a literature survey about scheduling in cloud computing, section 3 describes about the model development. Section 4 discusses about Clonal Selection Algorithm (CSA) followed by Section 5 outlines the proposed task scheduling model based on Clonal Selection Algorithm (CSA). Section 6 discusses details about experimental setup and experimental results of the proposed model and the paper concludes with conclusion in Section 7.

2. Literature review

In cloud computing environment, user services always demand heterogeneous resources (e,g CPU, I/O, Memory etc.). Cloud resources need to be allocated not only to satisfy Quality of Service (QoS) requirements specified by users via Service Level Agreements (SLAs), but also to reduce energy usage and time to execute the user job. Therefore scheduling and load balancing techniques are very crucial to increase the efficiency of cloud setup using limited resources. Task scheduling in Cloud computing has been addressed by many researchers in the past [13-16]. In 2011, Hsu *et al*. [15] focused on energy efficiency in datacenter by using efficient task scheduling to physical servers. Heuristic based techniques have also been used in task scheduling in cloud environment. Mondal *et al*. [17] used Stochastic Hill Climbing algorithm to solve load balance in Cloud computing. Hu *et al*. [18] introduced the scheduling strategy on load balancing of PE resource in Cloud computing environment by using Genetic algorithm. It considered previous data and the current state of work in advance to the performance behavior of the system which can solve the problem of load imbalance in Cloud computing. In 2012, Wei *et al*. [19] presented Genetic algorithm for scheduling in Cloud computing to increase the system performance. Li *et al*. [20] proposed a Load Balancing Ant Colony Optimization (LBACO) Algorithm to reduce makespan in Cloud. Karaboga *et al*., [21] presented ABC algorithm to solve the problem and find the most appropriate parameters in changing environment. Bitam *et al*. [22] proposed Bee Life algorithm for scheduling in Cloud. Mizan *et al*. [23] also solved job scheduling in Hybrid Cloud by modifying Bee Life algorithm and Greedy algorithm to achieve an affirmative response from the end users. There are many toolkit available to simulated and measure the performance of scheduling and load balancing algorithm in cloud environment. Simulation-based approaches can evaluate Cloud computing system and application behaviors.. From the above discussion, it is found that most of the previous researches have focused on optimizing a single objective, but very few of them optimize more than two objectives at a time. Therefore it is a good idea to measure the effect of multiple objectives on cloud scheduling problem. To deal with these gaps, a multi-objective Clonal Selection Algorithm (CSA) is proposed to optimize the energy and time.

3. Model development

To solve the problem of resource optimization using Clonal Selection Algorithm within the cloud framework, a typical cloud computing model is proposed. The cloud system consists of many data center that are distributed geographically all over globe and are accessible using internet. Each data center consists of many computing and saving elements and other resources. Processing Elements (PEs) in each data center are connected by a high