A Study of Meta-heuristic based Techniques of Load Balancing in Cloud Computing Environment

Pooja Mangla
PhD Scholar, CSE Department, MMEC, Maharishi Markandeshwar University, Mullana
Dr. Sandip Kr. Goyal
HOD, CSE Department, MMEC, Maharishi Markandeshwar University, Mullana

Abstract
An important issue which had risen with the advent of the cloud computing is the task scheduling methods. Task scheduling plays an important role in the performance and efficiency of the service offered by the clouds. The main focus in task scheduling is to reduce the time needed to complete all the executing tasks i.e. to decrease the Makespan. In this paper we have focused on five Metaheuristic based techniques used for load balancing in clouds, namely: i) Genetic Algorithm (GA) ; ii)) Ant Colony Optimization (ACO) ; iii) Particle Swarm Optimization (PSO); iv) Simulated Annealing; and v) Artificial Bee Colony Optimization(ABC). It has been found that the results given by Metaheuristic based techniques are within the reasonable time and are optimal.

Keywords: *Cloud task scheduling; Metheuristic techniques; Ant colony optimization; Genetic algorithm; Particle swarm optimization*

Introduction

Distributed computing model has attained high attention in the last few decades. The features like reliability, cost reduction, data and information sharing, and scalability had made it very much popular. In the present scenario Cloud computing has emerged as the most promising distributed environment. In order to provide on-demand access from the shared pool of resources with high quality it is essential that tasks ought to be competently mapped to provided resources. If the preferred performance is not achieved, the users will hesitate to pay. Therefore scheduling is considered as a essential matter in cloud computing environments. The scheduling of tasks results into the optimal resource allocation in a fixed time period so as to provide the best quality of service.

Metaheuristic based techniques

1. Genetic Algorithm[1,3]

Genetic algorithm is a method of scheduling which uses the biological concept of generation of the population, a fast emerging field of Artificial intelligence. GA's are motivated by Darwin's theory regarding Evolution "Survival of the fittest". It is used as the technique of scheduling in which the tasks are assigned resources according to individual solutions. It tells that which resource will be assigned to which task.

2. Ant Colony Optimization (ACO)[4,5]

The aim of the Ant Colony Optimization algorithm is to assign tasks to the resources available at that time , in the distributed cloud based environments. The target of the cloud scheduler is to assign jobs to the vacant nodes. In order to find the best possible match the selection is to be done. It is done on the basis of the estimate of the computational power of the resource. The efficiency of the scheduler depends upon the flow time and makespan. ACO is a random search algorithm.

3. Simulated Annealing (SA)[2]

The simulated annealing technique (SA) was originally projected to resolve the typical combinational optimization problems by the controlled randomization by simulating the falling procedure of temperature of particular systems in thermodynamics. It is a method to discover a improved way out for an optimization problem by annoying random variations of the current solution. The key characteristic is that a poorer variant may be accepted as a new solution with a likelihood that results in the SA's major benefit over other searching methods, that is, the capability to evade becoming fascinated at local minima. Simulated Annealing finds poorer solutions than Genetic Algorithm

4. Particle Swarm Optimization (PSO)[11]

Kennedy and Eberhart gave this powerful optimization algorithm in 1995. The PSO looks for a fitness task. The system is initialized with a population of arbitrary solutions and looks for optimal solution by updating generations. Unlike GA, PSO has no evolution operators such as crossover and mutation. In PSO, the probable solutions, called particles, fly all the way through the problem space by following the present optimum particles. PSO has become popular due to its simplicity and its effectiveness in wide range of application with low computational cost.

5. Artificial Bee Colony Optimization[1,7,11]

Tereshko developed a model of foraging behavior of a honeybee colony which is based on reaction–diffusion. This model leads to the emergence of collective intelligence of honeybee swarms. It consists of three essential components: food sources, employed foragers, and unemployed foragers. It defines two leading modes of the honeybee colony behavior: recruitment to a food source and abandonment of a source. Tereshko explains the main components of this model as below:

1. **Food Sources:** In order to select a food source, a forager bee evaluates several properties related with the food source such as its closeness to the hive, richness of the energy, taste of its nectar, and the ease or difficulty of extracting this energy. For the simplicity, the quality of a food source can be represented by only one quantity although it depends on various parameters mentioned above.

2**. Employed foragers:** An employed forager is employed at a detailed food source which she is at present exploiting. She carries in order concerning this precise basis and shares it with other bees waiting in the hive. The information includes the remoteness, the path and the productivity of the food supply.

3. **Unemployed foragers:** A forager bee with the aim of looks for a food source to utilize is called unemployed. It can be either a scout who searches the surroundings arbitrarily or an spectator who tries to locate a food source by earnings of the in order given by the employed bee. The mean number of scouts is about 5–10%

Literature Review

[6] have proposed an algorithm as a solution to the load balancing problem in VMs. A combined approach is used by using the Genetic Algorithm (GA) and Gravitational Emulation local Searches (GELS). The aim of the proposed algorithm is to reduce the make span and also to decrease the count of VMs which miss their deadlines. The authors have observed that this combined approach is capable to

decrease the response time of VMs as compared to the other techniques. The priority of the job and fault tolerance issues is not considered in this study. The future work can be done to include these issues in the research.

A Load balancing algorithm has been proposed by [7] which relies on the Load Balancing Ant Colony Optimization (LBACO) algorithm. The focus of the work is on balancing the complete system as well as to reduce the make span of a provided set of jobs or tasks. It has been proved experimentally that the proposed algorithm can effectively balance the complete system not only in the situations where the size of the tasks is same but also when the size is varied. A comparative study with the ACO (Ant Colony Optimization) and FCFS (First Come First Serve) has been done. Two assumptions done in the study are that i) the tasks are mutually exclusive; and ii) they are intensive in computation manner. These assumptions are not feasible for the cloud based environments. So, in future theses assumptions should be removed.

[8] have given a method to solve the problem of load balancing in Cloud Computing by using the technique of IABC algorithm. The suitability of the algorithm is proved by the experimental results. The proposed algorithm is capable of boosting up the production of the systems and can also greatly affect the scheduling of the tasks to VMs. As future work the complete system design can be modified.

In order to give the benefits like efficient capability of communication, larger memory, more power of computation and energy savings the VMs are migrated from one physical machine to other. Only the overloaded VMs are moved. This method called Task based System Load Balancing method using Particle Swarm Optimization (TBSLBPSO) was proposed by [9]. A model with task migration optimization has been proposed which reduces the execution and task transfer time. This model uses the Particle Swarm Optimization (PSO) technique. The main advantage of this method is that during the process of migration the overloaded VMs will not be paused. This method abolishes the threat of loss of the last activity which was done by the customer and VM downtime. More aspects of the task scheduling optimization can be covered as future work.

An algorithm based on Genetic algorithm has been proposed by [10] , which uses the combination of Min-Max and Max-Min.. It is capable of scheduling multiple tasks on multiple jobs efficiently. This method has shown better results id cloud computing distributed environment and gives the capability to better utilize the resources.

References

1. Jeng-Shyang Pan, Haibin Wang, Hongnan Zhao, and Linlin Tang. Interaction artificial bee colony based load balance method in cloud computing. In Genetic and Evolutionary Computing, pages 49–57. Springer, 2015.

2. Zongqin Fan1, Hong Shen1,2, Yanbo Wu1, Yidong Li1, Simulated-Annealing Load Balancing for Resource Allocation in Cloud Environments

3. Dzmitry Kliazovich1, Sisay T. Arzo, Fabrizio Granelli, Pascal Bouvry and Samee Ullah Khan, “e-STAB: Energy-Efficient Scheduling for Cloud Computing Applications with Traffic Load Balancing”, IEEE International Conference on Green Computing and Communications and IEEE Internet of Things and IEEE Cyber, Physical and Social Computing e-STAB, 2013

4. Isam Azawi Mohialdeen, "Comparative Study Of Scheduling Algorithms in Cloud Computing Environment", Journal of Computer Science, 9 (2): 252-263, 2013.

5. Huang Q.Y., Huang T.L.,"An Optimistic Job Scheduling Strategy based on QoS for Cloud Computing", IEEE International Conference on Intelligent Computing and Integrated Systems (ICISS), 2010, Guilin, pp. 673-675, 2010

6. Santanu Dam, Gopa Mandal, Kousik Dasgupta and Paramartha Dutta ; Genetic Algorithm and Gravitational Emulation Based Hybrid Load Balancing Strategy In Cloud Computing; 978-1-4799-4445-3/15/$31.00 ©2015 IEEE
7. Kun Li, Gaochao Xu, Guangyu Zhao, Yushuang Dong, Dan Wang ;Cloud Task scheduling based on Load Balancing Ant Colony Optimization ; 978-0-7695-4472-4/11 $26.00 © 2011 IEEE

8. Jeng-Shyang Pan1, Haibin Wang2, Hongnan Zhao1, and Linlin Tang1; Interaction Artificial Bee Colony Based Load Balance Method in Cloud Computing; © Springer International Publishing Switzerland 2015

9. Fahimeh Ramezani · Jie Lu · Farookh Khadeer Hussain ; Task-Based System Load Balancing in Cloud Computing Using Particle Swarm Optimization ; © Springer Science+Business Media New York 2013

10. Pardeep Kumar*, Amandeep Verma Independent Task Scheduling in Cloud Computing by Improved Genetic Algorithm ; International Journal of Advanced Research in Computer Science and Software Engineering; Volume 2, Issue 5, May 2012

11. K.R. Remesh Babu and Philip Samuel; Enhanced Bee Colony Algorithm for Efficient Load Balancing and Scheduling in Cloud; © Springer International Publishing Switzerland 2016