

Load Balancing In Cloud Computing Using Optimization Techniques: A Study

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Abstract - Nowadays, cloud computing is emerging field in information technology, next generation of computing. It provides very extensive measure of computing and storage Service gave to users through the internet which follows pay-as-you-go model. Major problems faced in the cloud are resource discovery, fault tolerance, load balancing and security. Load balancing is one of the main challenges, important technique, critical issue and play an important role which is required to distribute workload or task equally across the nodes or servers. This paper provides a detailed summary of the load balancing optimization techniques of evolutionary and swarm based algorithms which will help to overcome the optimization problems or resource utilization.

Keywords - Cloud Computing; Load balancing; Optimization techniques; Evolutionary Algorithms; Swarm based algorithms.

I. Introduction

Cloud computing has become one of the exponentially growing technologies. Cloud computing provide computing as utility to meet needs of the users [15]. It encounters a fast advancement both in the academia and industry [17]. Cloud computing adopts widely by Industries which is social networking websites like facebook, Google doc etc [14]. Its popularity may because of the fact that it is a type of computing that Depends on sharing resources rather than having own servers or personal devices. With help of cloud computing resource of software and hardware could be shared reasonably to avoid shortcomings of knowledge redundancy occurred in early distributed network [2].

The cloud computing deployment models are broadly divided into four groups: public, private, Hybrid, Community [4]. These services are broadly classified into three types: (i) platform as a service (Paas) (ii) software as a service (Saas), and (iii) infrastructure as a service (Iaas) [3, 4, 9, 20].

The main objective behind load balancing is to distribute the local workload to entire cloud [1, 2, 13]. Load balancing can be centralized or decentralized [3, 18].

The remaining paper is organized as follows Section II Introduction of load balancing, Section III Literature Survey (Detailed Mechanism of Algorithm), and Section IV Different Techniques of load balancing, section V Conclusion

II. Load Balancing

It is the process of redistributing the total load of a distributed system into individual nodes to ensure that no node is overloaded and no nodes were under loaded or idle [1, 16]. So in a cloud environment load balancing ensures that no Vms are overloaded, where some Vms are under loaded or doing very little work [13]. Load balancing tries to speed up the execution time of applications. It additionally guarantees the system stability [2].

It is an optimization technique [2] in which task scheduling is NP hard optimization problem [9, 10, 12, 17]. In this technique traffic is divided to servers, so data can be sent and received without delay [1] [2]. For the proper load distribution a load balancer needed which received tasks from different location and then distributed to the data center. If load balancing used in correct way then it achieve optimal resource utilization which will minimize the resource consumption [13].

Load balancing challenges [12, 18, 19, 20, 21]

- 1) **Throughput:** it should be high for good performance and calculated execution time of process which is given to the processor.
- 2) **Overhead:** it should be minimum for good performance and it measured by the involved overhead at the time of implementation.
- 3) **Fault tolerance:** load balancing should be fault less for getting best performance.

- 4) **Migration time:** Time Taken By processor to transfer one process from one machine to another machine, it should be less.
- 5) **Response time:** it should be less and define as the time takes to the reaction of the process.
- 6) **Resource utilization:** full resource can be utilized by the machine and it should be high.
- 7) **Scalability:** ability to perform load balancing on Vm with more number of nodes.
- 8) **Performance:** it can be used to measure the performance of the process and it should be high.

There are mainly two types of techniques to resolve load balancing which is Static and Dynamic load balancing Algorithm. [18, 19, 20]

Here in this paper we will basically discuss about the evolutionary and swarm based optimization techniques for load balancing scenarios.

III. Literature survey

In [1], proposed an Algorithm is compare and balance which allocates the resource dynamically based on need and distribute the load between the servers based on xen cloud technology (hypervisor) and credit system (default scheduler for xen) . the Algorithm periodically checks the cpu utilization and ram utilization when the resource needed it will provide via scaling if the resources is not available then migration will take place they set threshold value to 10(lower) to 70-95(upper).

In [2], proposed an Algorithm is based on GA for solving load balancing problem among Vms through a combination of a GA and gel (gravitational emulation local search). GA has global nature towards the problem space where a gel searches. Authors find 2 fitness functions then apply mutation, crossover and selection.

In [3], proposed an Algorithm compare and balance based on sampling to reach an equilibrium solution which decreases the migration time of virtual machines by shared storage and fulfils the zero-downtime relocation of virtual machines by transforming them as red hat cluster services.

In [4], propose an Algorithm based on PSO which will allocate Vm in an efficient manner and improve the response time. They use cloudsim technology for the implementation It manages the load at the server and intelligently assigns it to all the available Vms by considering its status.

In [5], proposed an Algorithm based on ACO combination of ant colony and complex network theory for occf (open cloud computing federation) which has many cloud provider it improves many aspects of the related ant colony Algorithm which proposed to realize load balancing in distributed system ,to get max performance.

In [6], proposed an Algorithm based on GA for getting good performance, which is multi-agent genetic Algorithm (maGA) is a hybrid Algorithm combining GA and multi-agent techniques.

In [7], proposed an Algorithm based on ACO for load distribution of workloads among nodes of a cloud. The approach is ants continuously update a one single result set rather instead of updating their own result set so the solution set is gradually built on and continuously improved.

In [8], proposed an Algorithm based on bee colony optimization through imitation of behaviour of honey bees, it optimizes the amount of nectar (throughput) to reach the maximum throughput.

In [9], proposed an Algorithm is based on PSO and also using endocrine Algorithm which is inspired from behaviour of human's hormone system. LB achieve by applying self-organizing method between overloaded Vms. This technique is structured and depends based on communications between Vms. It helps the overloaded Vms to transfer extra tasks to another under loaded Vm by applying the enhanced feed backing approach using PSO.

In [10], proposed an Algorithm is based on ACO that is self adaptive ant colony optimization tasks scheduling Algorithm.PSO algo is used to make ACO algo self adaptive and they also improve the calculation and update of the pheromone.

In [11], proposed an Algorithm is based on ACO which is ACO-vmm (ACO based Vm migration) in this Algorithm local migration agent autonomously monitors the resource utilization and launches the migration. At monitoring stage, Algorithm takes both the old and new system condition to avoid unnecessary migrations. This algorithm adopts two different traversing strategies for ants to find the near-optimal mapping relationship between virtual machines (Vms) and physical machines (pms).

In [12], proposed an Algorithm is based on PSO Which is used by readjusting the definition of particle's position and velocity and rules for updating, correspondingly modifying its fitness value. This mechanism takes the characteristics of complex networks into consideration to establish a corresponding resource-task allocation model.

In [13], proposed an Algorithm is based on BCO for efficient load balancing, which is based on the foraging behaviour of honey bees to balance load across Vms. The method will be as tasks removed from over loaded Vms are treated as honey bees and under loaded Vms are the food sources.

In [14], proposed an Algorithm based on GA, based on double-fitness adaptive Algorithm which is job spanning time and load balancing genetic Algorithm (jlGA). The method not only works on tasks scheduling sequence but also tries to satisfy inter-nodes load balancing. Author's first adopted greedy Algorithm to initialize population and brings in variance to describe the load intensive among Different nodes, weights multi-fitness function.

In [16], proposed an Algorithm is based on ACO that improve the performance, maximum resource utilization, which detects overloaded and under loaded servers respectively and performs load balancing operations between identified servers of data center.

In [17], proposed an Algorithm is based on ACO which is cloud task scheduling policy algorithm based on load balancing ant colony optimization (lbACO). The method is to be used for balance the entire system.

In [18], proposed an Algorithm is based on ACO which reduce the Makespan balancing. It provide better processing time and total processing cost as compared existing Algorithm and used to obtain better resource utilization and performance .this method is concentrated only on tasks and resources.

IV. Various techniques and discussion in tabular form

Table 1 Techniques of various Genetic Algorithms

Algorithm	Authors	Key objective and type of load balancing	Application Area	Issue	Compare With
GA based Algorithm with combination of Gravitational local search Algorithm.	Dam S, Mandal G, Dasgupta K, Dutta P [2]	Search Under loaded Nodes to balance overloaded Nodes by and reduce the Virtual Machines. (VM load Balancing)	Minimize the Makespan by Two Fitness Function.	Improve the Response time of The Virtual Machines.	First come first serve, Stochastic Hill Climbing, GA, ACO
GA Based Hybrid algorithm(Combination of Multi agent Techniques and Genetic Algorithm).	Zhu K, Song H, Liu L, Gao J, Cheng G [6]	Design A load balancing Algorithm based on Virtualization Resource Optimization. (CPU Load Balancing)	Achieving High/Better/Good Performance.	Improves the CPU Utilization and Memory Utilization. And reduce the Failure Rate.	Min Min Strategy.
GA based Double Fitness adaptive algorithm .	Wang T, Liu Z, Chen Y, Xu Y, Dai X [14]	Design a algorithm OF GA with the greedy approach with Double fitness function for achieve Efficient task scheduling for better resource utilization. (Task Load Balancing)	Achieve the task scheduling with less Makespan and load balancing.	Good/Better Resource Utilization And Performance Of the cloud Environment.	Adaptive Generic Algorithm.

Table 2 Techniques of various Particle swarm Optimization Algorithms

Algorithm	Authors	Key objective and type of load balancing	Application Area	Issue	Compare With
PSO based Modified PSO Algorithm.	Ashwin Ts, Domanal Sg, Guddeti Rm [4]	Good Resource allocation of VM and Requests. (Server Load Balancing)	Allocating VM in Efficient Manner.	Improve the Efficiency of Performance, Resource utilization, Minimize Average Response	Round Robin, Modified Throttled.

				Time.	
PSO based Algorithm With use of Endocrine.	Aslanzadeh S, Chaczko Z [9]	Virtual machine Migration when Vm is full. (VM Load Balancing)	Define a self organizing method between overloaded VM Which is construct on the basis of Communication between Two Vms Which is Useful To migrate task.	Minimize Makespan and increase QOS.	-
PSO based algorithm Which is Improved PSO With complex Network Model .	Pan K, Chen J. [12]	Task scheduling between overloaded Vm to Under loaded Vm. (Network Load)	Design an algorithm Which will migrate the task From Overloaded VM to Under loaded Vm based on Complex Network Consideration.	Improve Resource utilization, Good Performance.	Min max, IABC

Table 3 Techniques of various Ant Colony Optimization Algorithms

Algorithm	Authors	Key objective and type of load balancing	Application Area	Issue	Compare With
ACO based Algorithm with complex Network theory.	Zhang Z, Zhang X. [5]	Efficient Distribution of workloads to the cloud federation. (Normal Cloud load Balancing)	Load balancing local Workload to the whole cloud federation Which Consist many Cloud Providers.	Improve the Performance and Get maximum resource utilization.	Search Max and search Min.
ACO based Modified ACO Algorithm.	Nishant K, Sharma P, Krishna V, Gupta C, Singh Kp, Rastogi R. [7]	Distributes the workload among the nodes. (Network Load Balancing)	Efficiently Distributes the workloads.	Improve the performance, get maximum resource utilization.	-
ACO based algorithm with the ability of self addictiveness of PSO.	Sun W, Ji Z, Sun J, Zhang N, Hu Y. [10]	Task scheduling on cloud environment. (Task Load Balancing)	Distribute the workload for the task scheduling on cloud environment.	Improve resource utilization, Minimize the Makespan. Good performance.	Period ACO scheduling algorithm
ACO based algorithm with Virtual machine migration(ACO-VVM).	Wen Wt, Wang Cd, Wu Ds, Xie Yy. [11]	Overload balance on Data centers. (VM Load Balancing).	Virtual machine migration when Datacenter is overloaded.	Resource utilization, Reduce the VM, Increase performance, Scalability.	(IQR RS) (MAD RS) (LR RS) (THR RS)
ACO based algorithm.	Gupta E, Deshpande V. [16]	Load balancing on Data center. (server Load Balancing)	Find the overloaded and under loaded servers and performance the load balancing operation on cloud data center.	Improve performance, Resource utilization, Reduce Makespan, Increase throughput.	With ACO and Without ACO
ACO based algorithm (Load balancing ACO).	Li K, Xu G, Zhao G, Dong Y, Wang D. [17]	Task Scheduling in cloud Environment. (Task Scheduling)	Task scheduling based on load balancing to get	Minimize Makespan,	FCFS, ACO.

			maximum utilization and minimize Makespan.		
ACO based algorithm improved modified max min ACO.	Kaur R, Ghumman N. [18]	Balance the total load of the System. (Normal Load Balancing)	Load balancing of the cloud environment to get maximum resource utilization and minimum Makespan.	Minimize total Makespan, Better processing time, better processing cost, improved performance and resource utilization.	Improved Max min

Table 4 Techniques of various Bee Colony Optimization Algorithms

Algorithm	Authors	Key objective and type of load balancing	Application Area	Issue	Compare With
BCO based improved Bee Colony algo.	Yao J, He Jh. [8]	Load balancing the server Which gets too many requests. (Server Load Balancing)	Server Gets too many requests and gets overloaded so load balancing is needed at that time.	Improved Throughput, Good stability.	ABC
BCO based algorithm.	Babu Kr, Joy Aa, Samuel P. [13]	Vm gets overloaded when too many request are come to the datacente so it need to migrate. (Vm Load Balancing)	Virtual Machine (VM) is overloaded with multiple tasks at that time these tasks are removed and migrated to the under loaded VMs of the same or different datacenter.	Improvement of QOS, Reduce the Makespan and Reduce migration, good performance.	-

Table 5 Techniques of various Compare and Balance Algorithms

Algorithm	Authors	Key objective and type of load balancing	Application Area	Issue	Compare With
Compare and balance algorithm.	Achar R, Thilagam Ps, Soans N, Vikyath Pv, Rao S, Vijeth Am. [1]	Over utilized of server whenever heavy load is there. (Server Load Balancing)	Distributes loads across the servers for allocating right amount of resources dynamically.	Improve performance, Increase the response time,	-
Compare and Balance algorithm.	Zhao Y, Huang W. [3]	Reduce the migration time at the time of overloaded Vm. (VM Load balancing)	Implement a algo with decrease the migration time by storage and fulfils the zero downtime as transforming it as red hat cluster service.	Decrease the Migration time.	-

V. Conclusion

Cloud computing is effectively handle the future computing requirements, it's necessary to optimally handle issues arising during cloud computing environment. Load balancing is important critical issue which affects the utilization of resources and

performance of the system run on cloud. In this paper, different techniques are studied and discussed for load balancing. This surveyed some evolutionary and swarm based optimization techniques with their application and suitability to specific area and environment.

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