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An Enhanced Virtual Machine Load Balancing Algorithm for Cloud Environment

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Abstract---

The cloud computing is a virtual pool of computing resources such as software, platform, infrastructures, applications, storage and information provides to users through internet. The user request for utilize these resources. To handle the request of users and manage the distribution of load is the main challenge in the cloud environment. The load balancing techniques used to balance the load equally to each virtual machine and to enhancing the overall performance of system or performance. Cloud analyst do the simulation on extensive environment with virtualization capability and get the result in graphical view which is easy to understand. We first propose an adaptive strategy for load balancing according to the quality of the solutions found by Genetic. Secondly, the enhanced load balancing strategy is combined with the setting of other parameters like fitness and the selection of the initial resource pool provides the significant impact on the performance of the proposed algorithm. In this paper the new enhanced load balancing algorithm gives the better result than the existing genetic algorithm.

Keywords--- Cloud Computing, Load Balancing, Cloud Analyst, Genetic Algorithm, Enhanced Genetic Algorithm.

I. INTRODUCTION

Cloud Computing has developed as a trend in the field of IT and has become so popular now days such that it can be considered as dream utility computing. It a complete computing as a service rather than computing as a product, which can be delivered to clients over the internet through big data centers in a Cloud Computing environment. In todays the business surroundings competes to finding ways to cut cost and maximize profit. Cloud computing comes up as one of the apparent technology. A new image of computing, cloud computing has appear to change the old ways of computing. This technology allows the information technology world to use computer resource effectively and more efficiently. Cloud computing provide business opportunities to executives who can invest in acquiring servers as well as data storage computers to provide cloud services. The cloud computing is a virtual pool of computing resources such as software, platform, infrastructures, applications, storage and information provides to users through internet. As cloud service usage is increasing rapidly, it becomes difficult to provide quality services in an effective and efficient manner. In this concern Load Balancing is important field for research as revealed by different comparison studies, therefore with better load balancing, performance improves & hence the services. Load balancing dividing the traffic between available servers. Load balancing working with the virtual machines called as nodes. These nodes equally dividing the load come from user request. In load balancing to balance the load equally to each virtual machine and to enhancing the overall performance of system or performance it use different techniques.

The algorithm which is implemented in this paper is helping to improve the utilization of different resources for cloud computing environment. The genetic algorithm is already implemented by using the simulation of cloud analyst. By using this existing genetic algorithm (GA) an optimized or improved genetic algorithm implemented in the simulation of cloud analyst and this enhanced genetic algorithm (EGA) improve the result as existing algorithm. This paper divided into six sections. In section II, we are going to discuss about the existing load balancing genetic algorithm (GA). In section III, Literature review discussed. In section IV, proposed the enhanced genetic algorithm (EGA) for load balancing. In section V, presents the simulation results and analysis with an overview of Cloud analyst simulation. At last section VI conclude this paper.

II. GENETIC ALGORITHM FOR LOAD BALANCING

Genetic algorithm is a unique algorithm for some of the reasons like the optimum solution is built not only by a single entity but various entities, which traverse the length and breadth of the cloud network and then these individually build upon the solution and thus it is used for load balancing. The proposed methodology is to ensure that all the processors in the system or every node in the network does approximately the equal amount of work at any instant of time. And also improves many aspects of the related algorithm which is implemented to realize load balancing in distributed system. Furthermore, the proposed mechanism takes the characteristic of Complex Network into consideration. We first propose an adaptive strategy for load balancing according to the quality of the solutions found by Genetic. Secondly, the strategy is combined with the setting of other parameters like fitness and the selection of the initial resource pool provides the significant impact on the performance of the proposed algorithm. The genetic algorithm described the following steps:

1. **Crossover:** The main aim is to obtain the better quality chosen the two-point crossover which feed the next generation by selecting individuals from the parental generation and interchanging their genes, new individuals are obtained.

2. **Mutation:** After the crossover, each of the individuals of the chromosomes will be mutated. A mutation is a change that occurs swapping. To generate individual some value of gene can swap with another value of gene.
3. **Evaluation:** Evaluation deals with execution time and cost. Evaluation to create single population from combination of evolutionary effects of these species.

III. RELATED WORK

Cloud computing has become the energetic and leading technology. In [1] proposed improved genetic algorithm using new fitness function which objective is to optimize task scheduling. This proposed optimization can be implemented on both ends, one is for task scheduling and another is for resource utilization. Through the simulation solve this problem by using different existing algorithms these algorithms used for overcome the burden which creates on the cloud environment. The algorithm used in this paper is improved which gives better results as comparatively another existing algorithms. In experimental work use limited number of jobs and resources for performance analysis. In [2] working on the concept of load balancing which distribute the workload across the multiple nodes minimizing the interval of a given tasks set. The proposed load balancing algorithm strategy has been simulated using the Cloud Analyst simulator. The Cloud Analyst infrastructure facilitates modeling, GUI based simulation and other experimentation on cloud programmatically. The Future is getting more efficient to do some variations in the crossover and selection strategies in Genetic Algorithm. In [3] presents an algorithm for solving load balancing obstacle among virtual machines through a combination of a genetic algorithm and Gravitational Emulation based hybrid load balancing algorithm. Genetic Algorithm has universal in nature towards the problem area where Gravitational Emulation based hybrid load balancing algorithm searches locally. The combination of both algorithm decrease the make span as well as cut down the number of virtual machines and justified with other existing technique like Genetic algorithm, first come first serve etc. CloudAnalyst used as a simulation tool for the scheduled load balancing method. In [4] proposed load balance aware genetic (LBAG) algorithm for solving the problem of task scheduling with min-min and max-min methods. The load balance aware genetic (LBAG) algorithm results compare with the algorithm of time load balance. This algorithm helps in establish the fitness function with make span and proposed algorithm use population initialization with the method of min-min and max-min. The results show successful performance than existing load balancing algorithms.

IV. PROPOSED ALGORITHM

Step 1: Sort the Population i.e. sorting the population according to length of task.
Step 2: Evaluate each candidate
Repeat Until (termination condition occurs)

i. Select parents
ii. Recombine pairs of parents
iii. Mutate the resulting off springs
iv. Evaluate new candidate
v. Select individuals for next generation

Evaluate fitness of the machines using below formula:

$$\text{fit}_{ij} = \frac{\sum_{i=1}^{n} \text{cloudlet\_length}_{ij}}{\text{Vm}_j\text{\_mips}} \quad (1)$$

where $\text{Vm}_j\text{\_mips}$ is defined by millions of instructions per second for each processor of Vm_j, n is the total no of tasks, fit_{ij} defines the fitness function of population of task for $V\text{m}_j$ or say capacity of $V\text{m}_j$ with i^{th} task, cloudlet_length is defined as the task length that has been submitted to $V\text{m}_j$.
The virtual machine (Vmj) capacity is being calculated using the following parameters

$$\text{Capacity\_Vm}_j = \text{Vm}_j\text{\_cpu} * \text{Vm}_j\text{\_size} + \text{Vm}_j\text{\_bandwidth} \quad (2)$$

where $\text{Vm}_j\text{\_cpu}$ is the number of processors in a virtual machine Vm_j, $\text{Vm}_j\text{\_size}$ is the virtual machine memory size, $\text{Vm}_j\text{\_bandwidth}$ is the network bandwidth ability of Virtual Machine Vm_j.

$$fit2_{ij} = \text{Cloudlet\_length} + \text{Vm}_j\text{\_filesize} / \text{Vm}_j\text{\_size} \quad (3)$$

where Vm_j_filesize is the virtual machine memory size,

$$\text{Mean\_fit} = \text{fit}_{ij} + \text{Capacity\_vm}_j + \text{fit2}_{ij} \quad (4)$$

Select the fittest vm from each patch on the basis of condition i.e. mean fitness value of machine. At each algorithm iteration, the fittest vm will be chosen to assign tasks in Vm_j.
Step 3: Calculate Load Balance Check if the load on selected node less than or greater than threshold then counter balance the load by finding overload and under load nodes.
Step 4: Assign remaining tasks and remaining vms to search randomly and evaluate their fitnesses.
End

V. SIMULATION RESULTS AND ANALYSIS

Cloud analyst: Cloud analyst is the open source simulation. After GridSim, CloudSim provides novel support for modeling and simulation of virtualized Cloud-based data center environments such as interfaces for virtual machines (VMs), memory, storage, and bandwidth and model data centers, service brokers and allocation policies but it became

apparent to have an easy to use tool with a user friendly GUI that lead to Cloud Analyst tool. The use simulation is very easy as compared to working on a real environment of cloud computing. It saves the money or time. Cloud analyst do the simulation on extensive environment with virtualization capability and get the result in graphical view which is easy to understand. Simulation results help us in improvement of quality of service. The technologies used in cloud analyst are java, Java Swing, CloudSim etc. The region (divided into 6 regions), user base (group of users responsible for generate traffic), internet, internet cloudlet (grouping of users request), Data center controller (control data into virtual machines) and VM load balancer (virtual machine assign to each request for processing) are the components of the cloud analyst.

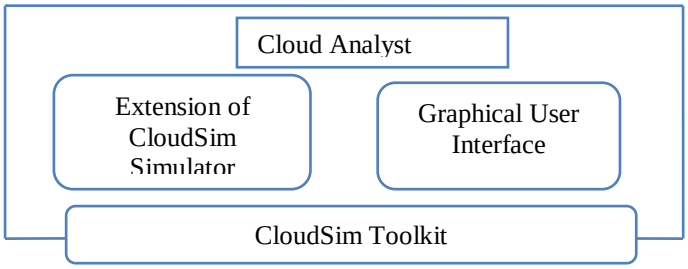

Figure1. Cloud Analyst Architecture

The cloud analyst tool removes all the complexities of programming by making GUI user friendly. It allows the user to do parameter sweep experiments. The cloud analyst allows setting location of users and data centers. Various configuration parameters can be set like no of users, no of request generated per user per hour, no of virtual machines, no of processors, amount of storage, network bandwidth and other necessary parameters. Based on the parameters the tool computes the simulation result and shows them in graphical format. The result includes response time, processing time, cost etc .In this way the cloud provider can find the best way to allocate resources.

Figure 2: Output Screen of Cloud Analyst

Results and Analysis: The simulation and performance analysis has been performed using the cloud analyst toolkit. Following are the statistical metrics derived as the output of the simulation in the cloud analyst version of the simulator:

- Overall response time of the system
- Total Data Center Processing time
- Overall Processing Cost (Sum of Total virtual Machine Cost and Total Data Transfer Cost).

The applied load balancing policy is being executed by using the closest data center broker policy where the userbases chooses the closest data center to be processed. The simulation is being conducted with 6 user base grouping factor and 10 data centers grouping factor. The data center grouping factor must not be greater than the user base grouping factor, so that maximum utilization of resources can be possible for a large number of user bases. Therefore, it must be ensured that user base grouping factor must be greater or equal to the data center grouping factor. For analyzing the consequences and results of the intended technique configuration of various components of cloud analyst tool need to be set.

The position of six user bases has been arranged in the different regions. By considering the Image size, bandwidth of data centers in different regions. The several scenarios in this paper are considered for experimentation and compare the result of existing Genetic Algorithm (GA) and Enhanced Genetic Algorithm (EGA). The new enhanced load balancing algorithm used to calculate the fitness of machines to overcome the drawback of initialization genetic algorithm proved to be better performance and transfer cost. This proposed technique will be adapted in the cloud computing environment for efficient and better scheduling to cloud resources, due to this the user's tasks can be finished in as minimum time as possible.

Table 1. Result Summary of GA and EGA

Algorithms	Scenario,s	Overall Response time -Average (ms)	Data center processing time- Average (ms)	Total Cost
GA	Scenario1: 2 Data Center with 25,25 VM each	157.42	1.12	$6.50
	Scenario2: 3 Data Center with 25, 50,75 VM	111.82	3.79	$16.80
	Scenario3: 5 Data Center with 25, 25, 50, 75, 75 VM	66.73	9.31	$40.15
EGA	Scenario1: 2 Data Center with 25,25 VM each	154.93	1.02	$5.27
	Scenario2: 3 Data Center with 25, 50,75 VM	109.71	3.69	$15.37
	Scenario3: 5 Data Center with 25, 25, 50, 75, 75 VM	57.08	1.49	$12.85

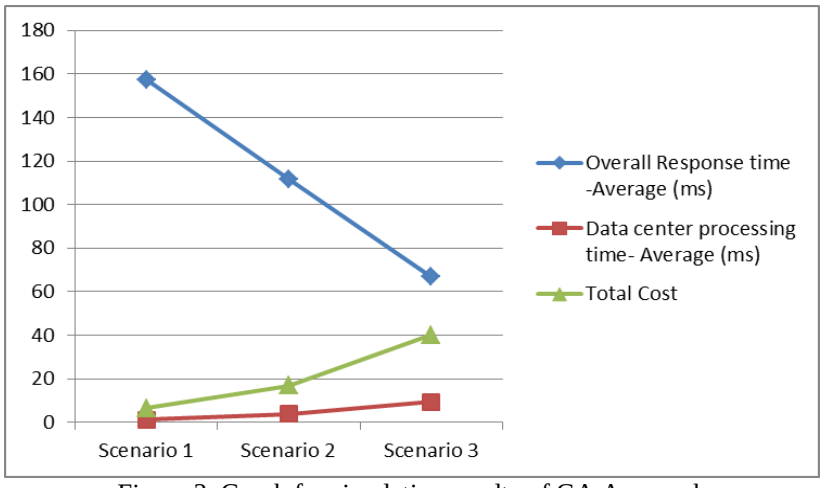

Figure 3. Graph for simulation results of GA Approach

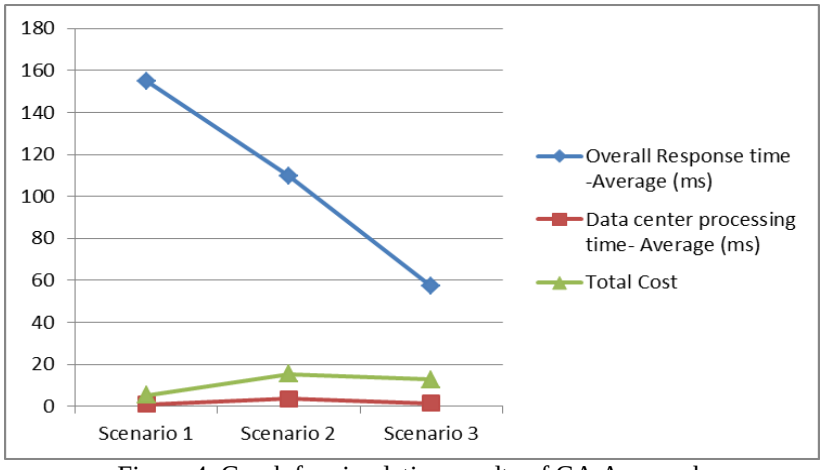

Figure 4. Graph for simulation results of GA Approach

VI. CONCLUSION

This paper is main focusing on genetic based strategy for load balancing in cloud environment. The algorithm which is implemented in this paper is helping to improve the utilization of different resources for cloud computing environment. Analysis of the results, indicates that the enhanced strategy for load balancing not only outperforms a few existing

techniques but also guarantees the QoS requirement of customer. The simple approach of Genetic algorithm has been used however variation of the crossover and selection strategies could be applied as a new enhanced genetic load balancing algorithm. The new enhanced load balancing algorithm used to calculate the fitness of machines to overcome the drawback of initialization genetic algorithm proved to be better performance and transfer cost. This proposed new optimization technique will be able to schedule multiple workloads or jobs on multiple virtual machines in an efficient manner such that the jobs will take the minimum execution time for their completion and load for all the jobs can be balanced. This proposed technique will be adapted in the cloud computing environment for efficient and better scheduling to cloud resources, due to this the user's tasks can be finished in as minimum time as possible.

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