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A Survey on Variants of Genetic Algorithm for Load Balancing in Cloud Computing

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ABSTRACT: Cloud Computing is an emerging area in now days. The User requests on cloud is increasing day by day and for the better performance it should be balanced in such a way that the system performance should not be degraded and works in efficient way. Load Balancing is one of the major Issues in Cloud Computing. Moreover, it is termed as Load Balancing is NP-Complete Problem because as the number of request increases the load balancing will become tougher. Genetic Algorithm is popular to get solutions for NP-Complete Problems. In this paper, the survey has been done to find out the different available Methods with variation in GA parameters and combination of GA with other methods which are used for load balancing in Cloud Computing.

KEYWORDS: Genetic Algorithm, GA, Cloud Computing, Load Balancing.

I. INTRODUCTION

Cloud Computing is emerging field for research and study. It is a pool of multiple configurable computing resources available on demand to user. The field is evolved from past technologies like web services, hardware virtualization, grid and utility computing, system management.
Generally, Cloud provides mainly three types of services which are as follows:

- **SAAS (Software as a Service).**
  The software as a service model consists of premade application that contains an operating system, hardware and networks.

- **PAAS (Platform as a service).**
  In the platform as a service model the customer develops or installs its own software and applications and uses the operating system, hardware and networks.

- **IAAS (Infrastructure as a Service).**
  In infrastructure as a service provides hardware and network only to the customer and it develops its own operating systems, software and applications.
  The cloud computing mainly gets deployed on four deployment servers by which the users can access the services provided by clouds. They are as follows:

  - **Public Cloud**
    It is offered over the internet and free to access to any one those are like social networking sites, emails, and online storage devices.

  - **Private Cloud**
    This kind of clouds is provided by particular organizations and is accesses by authenticated users only.

  - **Community Cloud**
    This kind of service is shared among selected enterprises and is managed by particular owner or cloud service provider.

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- **Hybrid Cloud**
  This is combination of two clouds and combination of different methods of resource pooling.

Moreover, Concepts of virtualization is used in cloud which leads to have a load balancing in the cloud. Virtualization means giving a logical name to physical resources and whenever this name is referred it will point towards corresponding physical resource. Multiple users will access cloud at same time and it is very necessary to serve them all with minimum response time and better service. For this reason load balancing is taken in to effect to balance the request of multiple users on virtual machines evenly. It is said that Load balancing is a NP-Complete Problem method because as the size of the problem increases the size of solution will increase too. That means the more the request comes to cloud it will get tougher to do balancing amongst the Different Virtual Machines.
Genetic Algorithm (GA) is much popular for solving NP-Complete problems. GA is one of technique which belongs to the class of evolutionary algorithms which generates solutions inspired by natural evolution. The Simple GA Concepts are as follows:

- **Population**- it is a set of possible solutions for proposed problem.
- **Chromosome**- the individuals in the population
- **Gene**- a variable in a chromosome

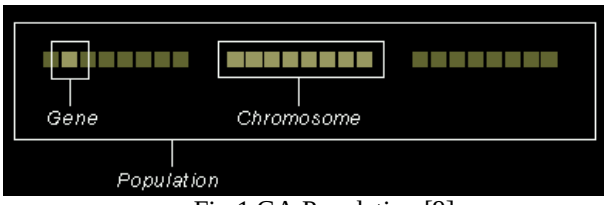

Fig 1 GA Population [9]

- **Fitness Function**- a type of an objective function used to figure out how close the solution is achieving the set aim
- The GA evolves through three operators:-
  - **Selection**- solutions with best fittest are selected
  - **Crossover**- for generation of Child, more than one parent is selected.
  - **Mutation**- altering the gene value in chromosome.

The Next section gives the idea about the different techniques of Genetic Algorithm for Load Balancing in Cloud Computing is been Discussed.

II. RELATED WORK

There are many different techniques given by different author for load balancing in cloud Computing, from which some of them are discussed as below
Kousik Dasgupta, Brototi Mandal, Paramartha Dutta, Jyotsna Kumar Mondal, Santanu Dam [1] has worked with the simple GA concepts. The Eye catching idea of algorithm is introducing the concept of Job Unit Vector (JUV) and Processing Unit Vector (PUV) which was the base for making fitness function. Binary encoding is used by authors for chromosome representation. Single point crossover with 0.5 Mutation rate was the author's algorithm GA parameters. Cloud Analyst is used as a stimulation tool and author has took different results with different number of data centers which was proved as better then Round Robin or Shortest job First methods. Moreover Author has considered same priority for all the requests and concluded that GA provide Good QoS. At initial level the improvement in results is not much satisfactory but after at an average level, the results are good then other algorithms
Tingting Wang, Zhaobin Liu, Yi Chen, Yujie Xu, Xiaoming Dai [2] has provided the idea of using two fitness function such that first fitness function calculates the time performance of VM and Second fitness calculates the intensity of different node's Load using Variance. Numbers are used for chromosome representation which can be called as permutation encoding. A single point crossover and Mutation is performed after selecting two best fitness

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chromosomes. Algorithm end when terminating condition is reached. Authors had compared there proposed method with original GA and shown the results. Also all the requests are of same priority was the consideration done by authors.

Saeed Javanmardi, Mohammed Shojafar, Danilo Amendola, Nicola Cordeschi, Hongu Liu and Ajith Abraham [3] has proposed a method in which they used fuzzy theory with genetic algorithm. The parent chromosomes are selected based on the fuzzy inference system output. Also crossover is performed using fuzzy theory. The requests are having same priority is the consideration done by authors. The paper has no Pseudo Code or any result comparisons with other Available Algorithms, but the conclusion of the authors are there proposed algorithm improves the performance of system in terms of execution time.

Santanu Dam, Gopal Mandal, Kousik Dasgupta and Paramartha Dutta [4] has proposed a method which is a combination of two methods: one is Ga and other is Gravitational Emulation Local Search (GELS). GELS is used for initiating Population for GA. Initial population is generated based on velocity calculation of chromosome done by GELS. Then, the two chromosomes are selected based on Fitness and two point crossover and Mutation is applied. Again velocity is calculated for chromosome and fitness chromosomes are added to new population. Then the algorithm ends. By using Cloud analyst stimulation of the proposed algorithm is carried out and satisfactory results are obtained by authors. No priority is considered for the request by the authors which cannot be the real scenario.

Jinhua GU, Jinhua Hu, Tianhai Zhao, Guofei Sun [5] has given an approach in which Tree Structure are used for chromosome representation. Initialization of population is done by using concept of spanning tree in which the root node is predefined server node, first level is Physical Machines and Second level is Virtual Machines. The algorithm proceeds through selection of fittest chromosome. Crossover operator is applied on selected chromosomes such that the chromosomes selected are having same leaf nodes. Mutation is done by changing leaf nodes of the parent node randomly.

Neha Gupta, Parminder Singh [6] has proposed a method in which the tasks are divided in to sub tasks. The reason behind the division is the parallel execution of jobs on multiple machine. The GA works for distribution of sub tasks to the multiple processors such that execution of one full task will be faster compared to working on one system. Initial population consist of two array consists of VMs and request respectively. Author did not provide any knowledge about use of Crossover. Mutation is applied to fittest chromosome to find the best VM for the job. The stimulation of proposed system is done in Cloud Sim 2.0

Mayur S. Pilavare, Amish Desai [7] has proposed the method in which the VMs are prioritized by using Logarithmic Lease Mean Square Matrix. This Gives priority to the VMs and initial population is made such that VMs having high priority gets the Jobs first. After these steps, GA operators are applied to obtain optimum output. Here there is no priority given to the jobs.

Zhao Li, Dong Yu-min, Huang Chen-Yang [8] has did a study on load balancing using Improved Genetic algorithm. According to author load balance is a constrained of network link bandwidth, link utilization, delays and other factor. It is an NP-complete problem. To obtain it optimal solution is difficult so GA is best option to get the optimal solution as Genetic Algorithm is Intelligent Search heuristic algorithm and popular for solving NP-Complete Problem. In the paper the chromosome representation stated by author is Binary representation. Following the steps, population initialization is being done randomly and GA operators are applied to best fitted chromosome. Roulette Selection and optimal retention has been use for selection of chromosome. Single point crossover with random mutation is taken as GA Operators. Based on this Genetic algorithm author concluded that it is better in meeting the requirements.

Table 1 Brief Overview of GA based method for Cloud Computing

Papers	Chromosome Representation	Initialization of Population	Crossover Method	Mutation Method
A Genetic Algorithm (GA) based Load Balancing Strategy for Cloud Computing	Binary	Randomly	Single Point Crossover	Bit Manipulation
Load Balancing Task Scheduling Based on Genetic	Permutation	Using Greedy Algorithm	Single Point Crossover	Local search mechanism which maintain population

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Algorithm in Cloud Computing				diversity
Hybrid Job Scheduling Algorithm for Cloud Computing	Not Defined	Randomly	Using Fuzzy Theory	Not Defined
Genetic Algorithm and Gravitational Emulation Based Hybrid Load Balancing Strategy in Cloud Computing	Binary	Randomly	Two Point Crossover	Bit Manipulation
A New Resource Scheduling Strategy Based on Genetic Algorithm in Cloud Computing Environment	Tree Structure	Spanning Tree	Hybridization such that chromosome having same leaf node are preferably selected	Changing of Leaf Node based on variation probability
A study of Link Load balancing using Improved Load Balancing	Binary	Randomly	Single Point Crossover	Interchanging of Genes.

On basis of this survey, one common point which some of the papers are having is that there is no priority is given to any of the requests which cannot be the real scenario

III. CONCLUSION

From the above survey work, we can conclude that there are many variants of Genetic algorithm has been made and applied for the load balancing in Cloud. Moreover, there are many algorithms which provide good results but the consideration is no priority of jobs which cannot be real scenario. This can be a research part that how the Genetic Algorithm will work in Real world scenario if priority is given to jobs. Moreover, it will be also a point of interest to know the working of Algorithm with ordered chromosome representation. The other research area is to find out which of the GA parameters will give the best results.

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