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LOAD BALANCING IN CLOUD COMPUTING USING BACTERIAL FORAGING ALGORITHM

Sanyam Gawri[1], Kamaljeet Mangat[2]

[1]Deparment of Computer Science, Punjabi University Regional Centre for Information Technology and Management, Mohali, Punjab, India-160062,

sanyamgawri15@gmail.com,

[2]Deparment of Computer Science, Punjabi University Regional Centre for Information Technology and Management, Mohali, Punjab, India – 160062,

kamalmangat@yahoo.co.in

Abstract

Cloud computing refers to the delivery of computing resources over the Internet. Instead of keeping data on your own hard drive or updating applications for your needs, it can be used as a service over the Internet, at another location, to store your information or use its applications i.e. load is distributed. Doing so may give rise to certain privacy implications. Various load balancing algorithms such as genetic algorithm, ant colony algorithm, particle swarm algorithm and other swarm intelligence algorithms do not give the optimized results(response time) which decreases the performance of the system. To overcome this drawback Bacterial foraging algorithm is used. This paper discusses the characteristics of cloud, load balancing, BFOA i.e. bacterial foraging algorithm which has been used in the proposed work.

Key Words: Load balancing, BFOA, Genetic, Ant Colony, Makespan, EP, ES

INTRODUCTION

Cloud computing is an evolving concept which makes better use of multiple distributed resources that can be allocated to users as per requirements. This helps in cheaper and efficient utilization of available resources and easier handling of larger computational problems. Its advantages include transparency of resources, flexibility, location independence, reliability, affordability, and greater availability of services, etc. To provide these facilities, the tasks need to be scheduled properly on the resources so as to provide maximum performance in minimum time. Without a doubt, the advent of cloud computing in recent years has sparked an interest from different stakeholders also.

There are still many open and interesting issues regarding cloud computing paradigm and standards are still evolving. But, it is a general opinion that security is indeed one of the most important issues. In the recent IDC report over 74% of users think that security is dominant issue for widespread use of cloud computing services. There are a lot of security issues in cloud computing service environments such as virtualization, distributes big data processing, serviceability, traffic-handling, application security, access control, authentication, cryptography and etc

Cloud computing has a number of characteristics that distinguishes it from other computing paradigms. These characteristics can be categorized as essential characteristics and common characteristic. The NIST has identified five essential characteristic fourteen and eight common characteristics of cloud computing. The essential characteristics are:

- **On Demand Self-Service**: allows for provisioning of computing resources automatically as needed.
- **Broad Network Access**: access to cloud resources is over the network using standard mechanisms provided through thin or thick clients in a heterogeneous manner. For example through Smartphone's, mobile phones and laptop computers.
- **Resource Pooling**: the vendors' resources are capable of being pooled to serve multiple clients using a multi-tenant model, with different physical and virtual resources in a dynamic way. The pooling and assigning of resources is done based on the changing needs of clients or consumers. Example of resources include; computation capabilities, storage and memory.
- **Rapid Elasticity**: allows for rapid capability provisioning, for quick scaling out and scaling in of capabilities. The capability available for provisioning to the client seems to be unlimited and that it can be purchased as demanded.
- **Measured Service**: allows monitoring, control and reporting of usage. It also allows for transparent between the provider and the client. In conjunction with the essential characteristics as identified by NIST, there are other cloud computing characteristics. These characteristics are such as: massive scale availability of computing and storage capabilities, homogeneity, use of

Corresponding author: Sanyam Gawri

virtualization technology, resilient computing, and pay-as- you go model.

1. LOAD BALANCING:

Load Balancing is a method to distribute workload across one or more servers, network interfaces, hard drives, or other computing resources. Typical datacenter implementations rely on large, powerful (and expensive) computing hardware and network infrastructure, which are subject to the usual risks associated with any physical device, including hardware failure, power and/or network interruptions, and resource limitations in times of high demand. Load balancing in the cloud differs from classical thinking on load-balancing architecture and implementation by using commodity servers to perform the load balancing. This provides for new opportunities and economies-of-scale, as well as presenting its own unique set of challenges. Load balancing is used to make sure that none of your existing resources are idle while others are being utilized. To balance load distribution, you can migrate the load from the source nodes (which have surplus workload) to the comparatively lightly loaded destination nodes. When you apply load balancing during runtime, it is called dynamic load balancing — this can be realized both in a direct or iterative manner according to the execution node selection:

• In the iterative methods, the final destination node is determined through several iteration steps.

• In the direct methods, the final destination node is selected in one step. A kind of Load Balancing method can be used i.e. the Randomized Hydrodynamic Load Balancing method, a hybrid method that takes advantage of both direct and iterative methods.

Load balancing is the pre requirements for increasing the cloud performance and for completely utilizing the resources. Load balancing is centralized or decentralized. Load Balancing algorithms are used for implementing. Several load balancing algorithm are introduced like round robin algorithm a mining improvement in the performance.

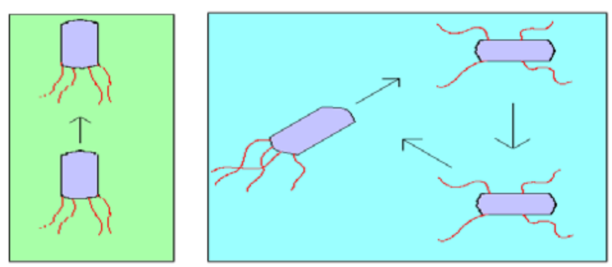
Parameters

- **Computation Time**: It is a total time required for all jobs.
- **Job Execution Time**: Time required by individual job or can be said that execution time per job.
- **Computation Cost**: It is total cost which further depends upon the computation time and effort.
- **Make Span**: It contains Gantt chart which is a type of bar chart which illustrates the project schedule.

2. BACTERIAL FORAGING ALGORITHM:

Bacterial Foraging Optimization Algorithm (BFOA), is new comer to the group of nature-propelled improvement algorithms. For throughout the most recent five decades, algorithms like Genetic Algorithms (GAs), Evolutionary Programming (EP), Evolutionary Strategies (ES), which draw their motivation from advancement and common hereditary qualities, have been commanding the domain of improvement algorithms. As common swarm inspired algorithms like Molecule Swarm Optimization (PSO), Ant Colony Optimization (ACO) have discovered their direction into this area and demonstrated their effectiveness. Following the same technique of a swarm of E.coli microorganisms in multi-optimal function optimization is the key thought of the new calculation. Every bacterium moreover corresponds with others by sending signs. A bacterium takes choices in the wake of considering two past elements. The methodology, in which a bacterium moves by making little steps while looking for supplements, is called chemotaxis and key factor of BFOA is copying chemotactic development of virtual microscopic organisms in the issue inquiry space. Since its initiation, BFOA has drawn the attention of scientists from differing fields of learning particularly because of its organic inspiration and huge structure. Scientists are attempting to hybridize BFOA with distinctive different algorithms so as to investigate its nearby and worldwide properties independently.

Clockwise-rotation Anti-clockwise-rotation



SWIM TUMBLE

Figure 2.1: Swim and tumble of bacteria

During forging of the bacteria, motion is attained to by a situated of tensile flagella. Flagella help an E.coli bacterium to tumble or swim, which are two fundamental operations performed by a bacterium at the time of searching. When they turn the flagella in the clockwise direction; every flagellum pulls on the cell. That outcome in the moving of flagella autonomously lastly the bacterium tumbles with lesser number of tumbling though in a hurtful spot it tumbles much of the time to discover a supplement slope. Moving the flagella in the counterclockwise course helps the bacterium to swim at a quick rate. The microorganisms' experiences chemotaxis, where they like to move towards supplement nutrition and stay away from toxic environment. The microorganisms move for a more extended separation in a neighborly domain. Figure delineates how clockwise and counter clockwise development of a bacterium occur.

When they get nutrition in sufficient, they are expanded long and in temperature they break up from the center to from a definite reproduction of itself. Because of the event of sudden natural changes, the chemotactic advancement may be crushed and a group of microorganisms may move to some other spots or some other may be presented in the swarm of concern. This constitutes the occasion of end dispersal in the genuine bacterial population, where all the microorganisms in an area are killed or a gathering is scattered into another part of nature.

We quickly depict the four prime steps in BFOA.

i. Chemotaxis: This methodology reproduces the development of an E.coli cell through swimming and tumbling through flagella. Naturally an E.coli bacterium can move in two separate ways. It can swim for a time of time in the same bearing or it may tumble, and exchange between these two modes of operation for the whole lifetime.

$$\theta^i(j+1,k,l)=\theta^i(j,k,l)+C^i\,\Delta(i)\Big/\sqrt{\Delta T(i)\Delta(i)} \qquad (1)$$

ii. Swarming: An interesting group behavior has been watched for a few motile types of microbes including E.coli and S. typhimurium, where mind boggling and stable spatio-temporal patterns (swarms) are shaped in semisolid supplement medium. A gathering of E.coli cells organize themselves in a voyaging ring by climbing the supplement slope when put in the middle of a semisolid lattice with a solitary supplement chemo-effecter. The cells when empowered by an abnormal state of succinate discharge an attractant aspertate, which helps them to total into gatherings and consequently move as concentric examples of swarms with high bacterial thickness.

$J_{cc}(\Theta,P(j,k,l))=\sum_{i=1}^{S} Jcc(\Theta,\Theta^i(j,k,l))=\sum_{i=1}^{S}[-d_{attractant}\ \exp(w_{attractant}\ \sum_{m=1}^{p}(\theta_m-\theta_m^i)^2)]$

a. $+\sum_{i=1}^{S}[h_{repellent}\ \exp(-w_{repellent}\ \sum_{m=1}^{p}(\theta_m-\theta_m^i)^2)$

(2)

iii. Reproduction: The slightest solid microorganisms in the end dies while each of the healthier microbes (those yielding lower estimation of the goal capacity) reproduce into two microbes, which are then put in the same area. This keeps the swarm size consistent.

iv. Elimination and Dispersal: Gradual or sudden changes in the neighborhood environment where a bacterium population lives may happen because of different reasons e.g. a critical nearby ascent of temperature may execute a gathering of microscopic organisms that are right now in a region with a high concentration of supplement nutrition Event can happen in such a manner, to the point that all the microorganisms in a district are executed then again a gathering is scattered into another area. To reproduce this wonder in BFOA some microorganisms are exchanged at arbitrary with a little likelihood while the new substitutions are arbitrarily initialized over the search space.

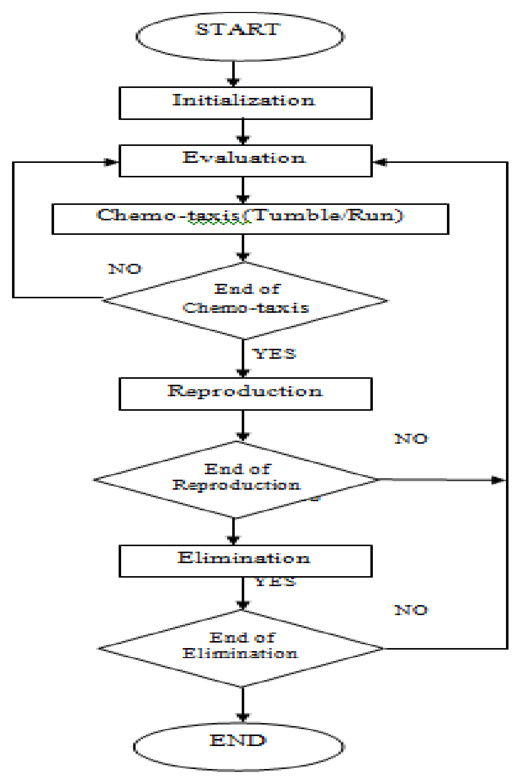


Figure 2.2: Flowchart of BFOA

3. PROBLEM FORMULATION:

Load balancing is main issue in the cloud computing environment, in which various tasks have to be managed. In this technique, various tasks have to be managed on cloud itself so as to handle load on the cloud. These tasks have been divided into number of jobs and assigned to number of processor for the optimization of the tasks. The make span of these tasks have to be created. The make span developed of these tasks have been used for optimization using expert system. Genetic algorithm and ant colony optimization have been used for the purpose of optimization. This does not provide best results, as this optimization approach can further be improved.

4. METHODOLOGY:

In the Proposed work various phases have to be used for the development of the load balancing system in the cloud computing environment. These different phases have to be performed for the completion of proposed work.

- **Phase 1** Develop on cloud computing scenario in which no. of tasks has to be assigned on various processes to handle load on the cloud.
- **Phase 2** Divide tasks into number of jobs and assigned to the different resources for the computation on the basis of priority and dependency checking. Make span is created according to the allocations of tasks.
- **Phase 3** Make span has been developed on the basis of the allocation. This makes pan has to be optimized using bacterial foraging optimization that performs the work on the basis of number of bacteria. These bacteria's has been initialize and the health of these bacteria has been classified on the basis of fitness according to fitness that task is allocate to a processor and execute.

5. RESULTS AND DISCUSSION:

Table 1 and Table 2 represent number of jobs and number of virtual machines corresponding to the system response time in micro second for the genetic algorithm and BFO.

Table 1: System response time for 70 virtual machines and jobs

Number of Jobs	Virtual Machines	System Response Time (micro-sec)	
		GA	BFO
100	70	17.25	14.07
150	70	15.75	13.96
200	70	19.79	17.34
500	70	32.65	29.00

Table 2: System response time for 100 virtual machines and jobs

Number of Jobs	Virtual Machines	System Response Time (micro-sec)	
		GA	BFO
100	100	15.63	13.75
150	100	17.67	15.52
200	100	19.21	16.87
500	100	33.34	29.74

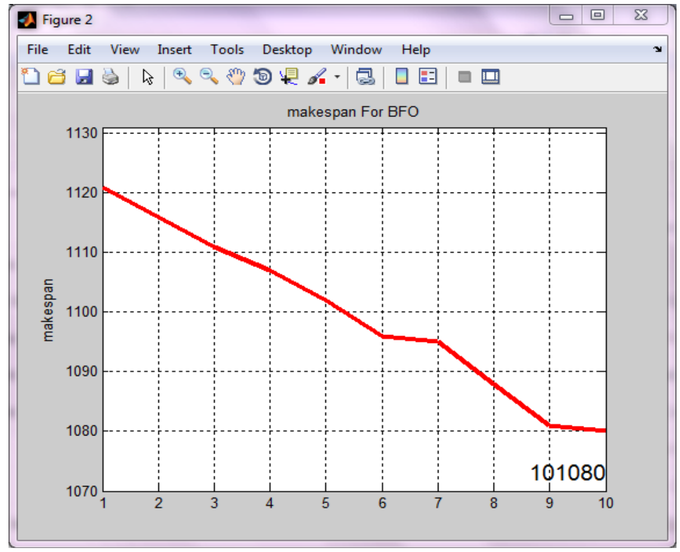


Figure 5.1 Makespan for 100 jobs and 70 virtual machines

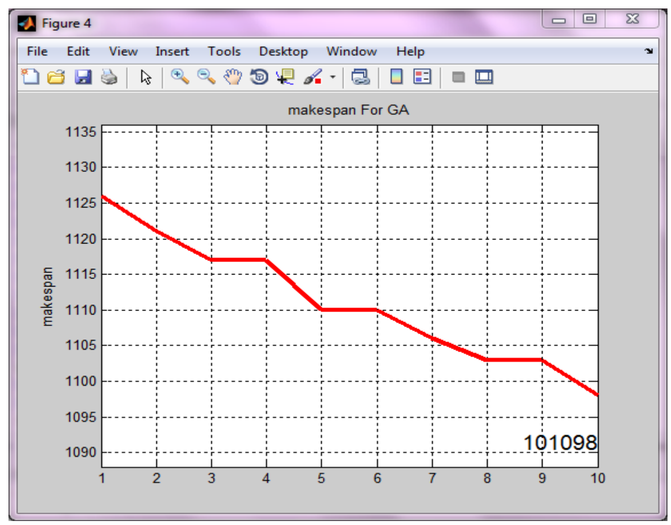


Figure 5.2 Makespan for 100 jobs and 70 virtual machines

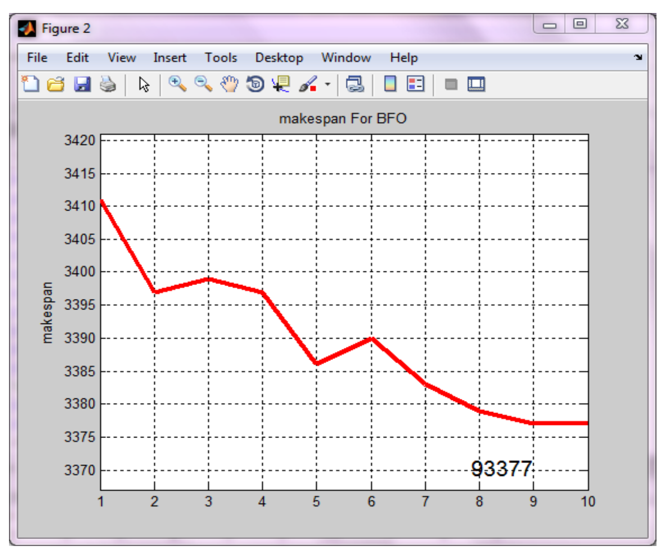


Figure 5.3 Makespan for 200 jobs and 70 virtual machines

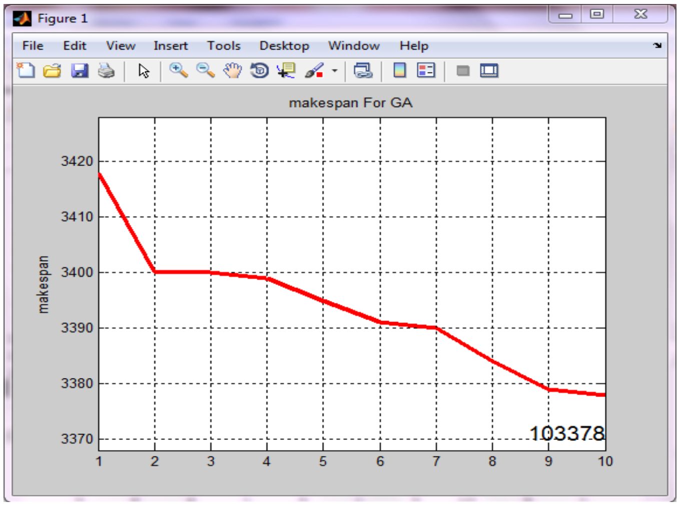


Figure 5.4 Makespan for 500 jobs and 70 virtual machines

On comparing system response time following analysis were made:

The results obtained (response time) from GA embedded BFO are better. This implies, by using BFO algorithm the response time of the system is optimized. Hence enhancing the system's performance.

6. CONCLUSION & FUTURE SCOPE:

Load balancing is main issue in the cloud computing environment, in which various tasks have to be managed. In this technique, various tasks have to be managed on cloud itself so as to handle load on the cloud. The make span developed of these tasks have been used for optimization using expert system. We got various types of parameters such as makespan and response time. On the basis of these parameters we conclude that our system gives us better results.There is still a wide variety of domains in which BFO could be useful for. For instance, it can be useful to study its uses in energy efficiency optimization for buildings and distributed energy generation. Further improvement can also be achieved by combining it with various other swarm intelligence techniques to get more optimized results which can further enhance system's performance.

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