Hybrid Bee Ant Colony Algorithm for Effective Load Balancing And Job Scheduling In Cloud Computing

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Abstract

Cloud Computing is new paradigm in computing that promises a delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices as a utility (like the electricity grid) over a network (typically the Internet). Cloud Computing is a new style of computing on the internet. It has many merits along with some crucial issues that need to be resolved in order to improve reliability of cloud environment. These issues are related with the load balancing, fault tolerance and different security issues in cloud environment. In this paper the main concern is to develop an effective load balancing algorithm that gives satisfactory performance to both, cloud users and providers. This proposed algorithm (hybrid Bee Ant Colony algorithm) is a combination of two dynamic algorithms: Ant Colony Optimization and Bees Life algorithm. Ant Colony algorithm is used in this hybrid Bee Ant Colony algorithm to solve load balancing issues whiles the Bees Life algorithm is used for optimization of job scheduling in cloud environment. The results of the proposed algorithm shows that the hybrid Bee Ant Colony algorithm outperforms the performances of both Ant Colony algorithm and Bees Life algorithm when evaluating the proposed algorithm performances

Keywords — Ant Colony Optimization algorithm, Bees Life algorithm, Scheduling Algorithm, **Performance, cloud computing, load balancing, Waiting time, Response time**

1.0 Introduction

Cloud computing is a general term for anything that involves delivering hosted services over the Internet. Basically, two kinds of cloud are identified in cloud environment. The first type is public cloud. This type service may be sold to anyone on the Internet. Here, Amazon Elastic Compute Cloud (EC2) [1], Google App Engine [2] are large public cloud providers. The second type of the cloud is the private cloud. It is a proprietary network that supplies hosted services to a limited number of clients (end-users). Cloud computing enables users to remotely run services such as Software-as-a-Service (SaaS), Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) [3].

In cloud computing Load balancing is the process of distributing the load among various virtual machines of a cloud computing system to improve both resource utilization and job response time while also avoiding a situation where some of the virtual machines are heavily loaded while other virtual machines are idle or doing very little work. Load balancing ensures that all the virtual machines in the cloud system or every node in the network does approximately equal amount of work at any instant of time. In cloud, there are existing of many dynamic algorithms such as Ant Colony Optimization, Bees Life algorithm, Particle Swarm Optimization and Bee Colony Algorithm. This research paper combines Ant Colony Optimization algorithm and Bees Life algorithm to establish an effective load balancing and efficient scheduling algorithm than can be implemented in cloud environment to ensure that all Virtual Machines are busy in their assigned jobs and none of the Virtual Machines gets Idle.

In view of this the main objective of this research is to develop an effective load balancing and scheduling algorithm by combining Ant Colony Optimization and Bees Life algorithms in order to improve the different performances for both cloud users and providers.

2.0 Related Works

2.1 Job Scheduling in Cloud Environment

Job Scheduling aims at assigning jobs to datacenters in the cloud so that the execution time (makespan) of the overall tasks of jobs is minimized.

Jing Liu et al [3] proposed Multi Objective Genetic Algorithm (MO-GA) for dynamic job scheduling that combines both random and greedy initialization methods. In their research the fitness is calculated by energy consumption and profits of the service providers. Here, the two parameters used to calculate the fitness can be a dependant of the economic situations of user(s) and therefore not much appropriate to be used as a good parameter for the calculation of the fitness.

Another algorithm was introduced in [9] that are based on the reproduction principle of bees which is referred to as marriage in honey bees optimization algorithm. In the marriage in honey bees optimization algorithm it starts with randomly initializing the queen's genotype and then a heuristic is applied to improve the queen's genotype with that therefore preserving the assumption that a queen is usually a good bee. Next, a set of mating–flights is undertaken relatively to the queen's energy and speed. The queen then moves between different states (solutions) in the space and mates with the encountered drones according to probability criterion.

In [8] Tasquia M. et al. proposed modified task scheduling algorithm that combines bees life algorithm and greedy algorithm to obtain job scheduling optimization in cloud environment. With their algorithm the Bee life algorithm was used for the job scheduling and the greedy algorithm was used for randomly selection of a data centre.

2.2 Load Balancing in Cloud Environment

Linan Z. et al. [5] proposed Ant Colony Optimization algorithm to solve travelling sales man problem. Ant colony algorithm chooses the target path through the pheromone strength. This ant colony algorithm achieves QOS requirement and shortest path. Thus ant colony algorithm gives more efficient result for calculating node distribution and load balancing.

Zehua Zhang and Xuejie Zhang [11] described about Load balancing mechanism based on Ant Colony. They described about the function of Load balancing and how to distribute the workload in a cloud and to realize a high ratio of user satisfaction. They described the two

characteristic of Complex Network and these two characteristics are considered for the move of the ants in the work, since the ants move more quickly towards that region where more resources found.

In [7] Marco Dorigo and Luca Maria Gambardella introduced real and artificial ant. An artificial ant colony, that was capable of solving Travelling Salesman Problem. Real ants are capable of finding the shortest path from food source to the nest without using visual cues. Also, they are capable of adapting to changes in the environment, for example finding a new shortest path once the old one is no longer feasible due to a new obstacle.

3.0 **Proposed Algorithm**
- (**Hybrid Bee Ant Colony Algorithm)**

3.1 Conceptualized Framework

The proposed algorithm combines both ant colony optimization algorithm and bee life algorithm to improve the effectiveness of load balancing and cloud scheduling. In this proposed algorithm Ant colony optimization algorithm is used to determine the load balancing problem in cloud and Bees life algorithm is an optimization algorithm used for job scheduling. The bees' life algorithm is used to search the information such as bandwidth and execution time of neighboring, and maintains as a table. If user gives any job as an input to cloud, the BLA first gets the job details and calculates the fitness for each job.

After the calculation of the fitness for each job the Ant Colony Optimization algorithm is therefore used to determine the best path for resource allocation and shares the workload for all the virtual machines.

3.2 Pseudo code for Proposed algorithm.

a. Initialize population (*N* bees).
b. Evaluate fitness of population.
c. ***While*** stopping criteria are not satisfied (Forming new population)
/* **reproduction behavior** */
d. Generate ***N*** broods by **crossover** and mutation
e. Evaluate fitness of broods
f. If the fittest brood is fitter than the queen then replace the queen for the next generation
g. Choose *D* best bees among *D* fittest following broods and drones of current population (Forming next generation
h. drones)
i. Choose *W* best bees among *W* fittest remaining broods and
j. workers of current population (to ensure food foraging)

/* **food foraging behavior** */
k. Search of food source in *W* regions by *W* workers
l. Recruit bees for each region for **neighborhood search**
m. Select the fittest bee from each region.
n. Assign remaining bees to search randomly and evaluate their fitness's.
o. **End While**
p. Initialize parameters and pheromone trails.
q. ***While*** stopping criteria are not satisfied.
Do
Make all Ants Construct their Solutions.
Update pheromone trails
End Do

3.3 Flowchart for proposed algorithm

Figure 1.1 shows the flowchart of the proposed algorithm

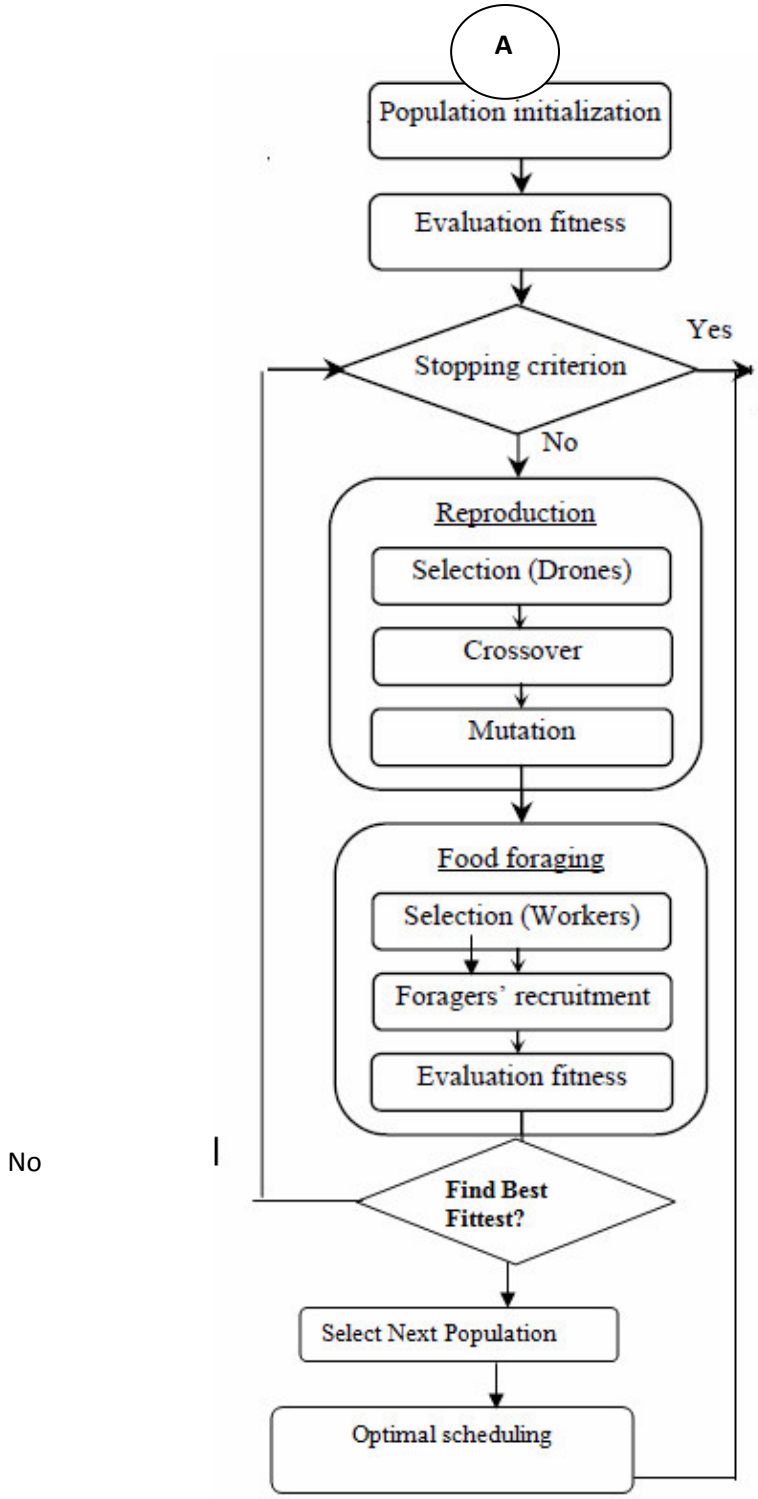

Figure 1.1: Proposed Hybrid algorithm for job optimization.

4.0 Results

For better performance comparison the researcher formulated several test cases for bee's algorithm, ant colony's algorithm and proposed hybrid Ant Bee life algorithm. Table 1-1, Table 1-2 and Table 1-3 give the results of the response time and Data Centre processing time for Ant Colony, Bee Life and the proposed algorithm respectively.

Table 1.1: ***Ant Colony Algorithm Results***

Overall Response Time Summary			
Time	Avg(ms)	Min(ms)	Max(ms)
Overall Response Time	566.02	45.29	22207.9
Data Center Processing Time	207.30	2.36	31698.4

Table 1.2: Bee Life Algorithm Results

Overall Response Time Summary			
Time	Avg(ms)	Min(ms)	Max(ms)
Overall ResponseTime	542.51	40.10	10306.31
Data Center Processing Time	189.02	2.76	16920.16

Table 1.3: Hybrid Ant Bee Algorithm Results (Proposed Algorithm)

Overall Response Time Summary			
Time	Avg(ms)	Min(ms)	Max(ms)
Overall ResponseTime	462.02	26.10	10306.3
Data Center Processing Time	126.18	1.02	30078.2

Comparison of overall response time and Data Centre processing time are shown in Figure 1.2.

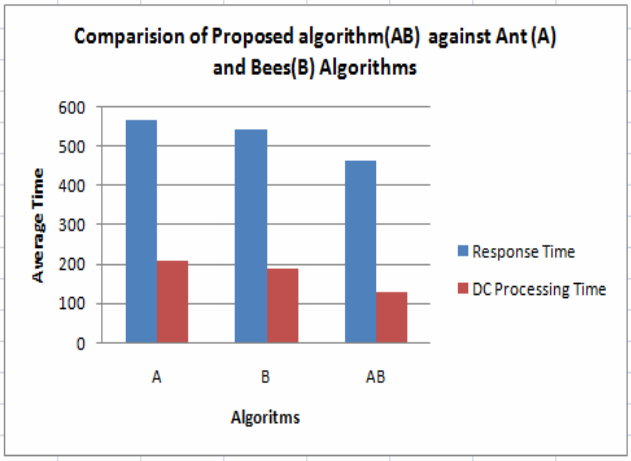

Fig 1-2: Results of Algorithms Compared

5.0 Conclusion.

In this paper, a new algorithm for both job scheduling and load balancing in cloud computing has been proposed. In this algorithm there is emphasis on deposition of pheromone. Here it is observed that when a node with minimum load is attracted by most of the ants gives result to the maximum deposition of pheromone resulted in decrease in waiting time and response time of the data center.

Again, this hybrid algorithm achieves overload avoidance while the number of resources are increased, thus the resources utilization are balanced for systems with multi resource constraints when the proposed algorithm was investigated

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