A Comparative Analysis of Ant Colony Optimization and Efficient Multi Queue Scheduling Algorithms in Cloud Scheduling

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Abstract - *Cloud Scheduling plays a critical role in Cloud Computing as the infrastructure must accommodate different requests from multiple users. Cloud Task Scheduling is an NP-complete problem and can employ different algorithms based on requirements. This paper is a comparative analysis of ACO (Ant Colony Optimization) and EMQS (Effective Multi Queue Scheduling) Algorithms which are both heuristic based job scheduling algorithms in Cloud Scheduling*

Key Words: Cloud Scheduling, ACO, EMQS

1. INTRODUCTION

Task scheduling plays an important role in cloud computing. It is the process of mapping tasks to available resources based the requirements and characteristics of the tasks. The main aim is to maximize resource utilization and minimize waiting time. Scheduling becomes challenging in cases where the cloud provider receives multiple tasks at the same time requesting resources. The task scheduling problem is NP-Complete for which many heuristic based algorithms have been proposed as a solution. The Scheduling can be categorized into three stages which include discovering the resources, selecting the target resource and the final step where the task is mapped to that target resource. This is illustrated in Fig-1.
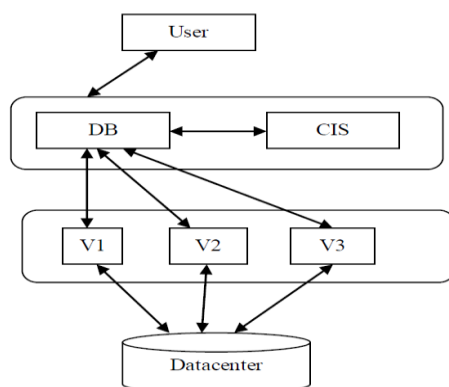
DB: - Datacenter Broker
CIS: - Cloud Information services
V1,V2,V3 are the virtual machines

Fig -1: Scheduling Stages [2]

Different types algorithms can be employed for scheduling based on requirements one of which is heuristic algorithms which solve problems faster and more efficiently than traditional algorithms but compramise on metrices like optimality and accuracy.
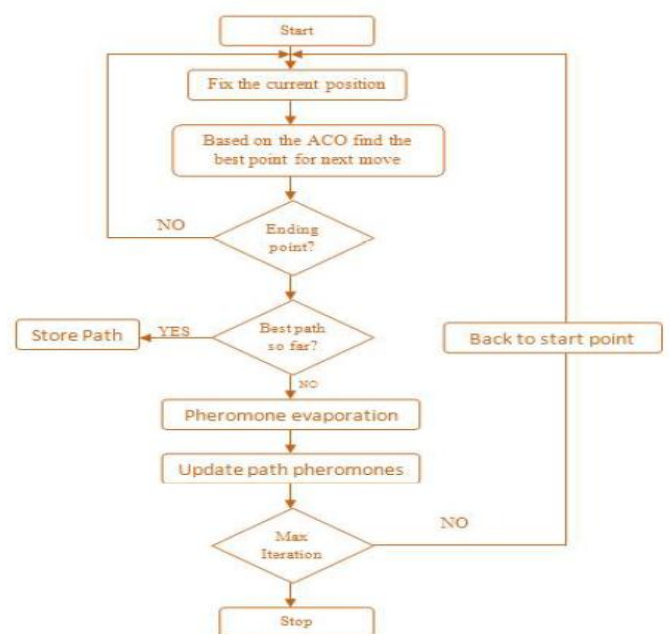
1.1 Ant Colony Optimization (ACO) Scheduling Algorithm

This algorithm is inspired from the behavior of ants when they search for food. During the search for food ants communicate using a chemical substance called pheromones. In the beginning the ants search for food in a random fashion until one of the them succeeds. It leaves a trail of pheromones to guide other ants to the food source, based on the intensity of the pheromone on the different paths the ants determine the shortest path to the destination food source. Be pheromones are constantly being evaporated hence the shortest path to the food source will have higher intensity of the chemical as the rate of the deposition is greater than that of the evaporation. A job can be depicted using an ant in this scenario where each individual result in finally incorporated into the aggregate result. The Computational Flowchart of the algorithm is illustrated below in Figure 2.

Fig -2: Flow Chart of ACO Algorithm [1]

1.2 Efficient Multi Queue Job Scheduling (EMQS)

EQMS is a heuristic algorithm for scheduling which implements the concept of the Multi Queue. The jobs are processed with equal priority and are sorted based on burst time in an ascending order. The Architecture is given below in Figure-3.
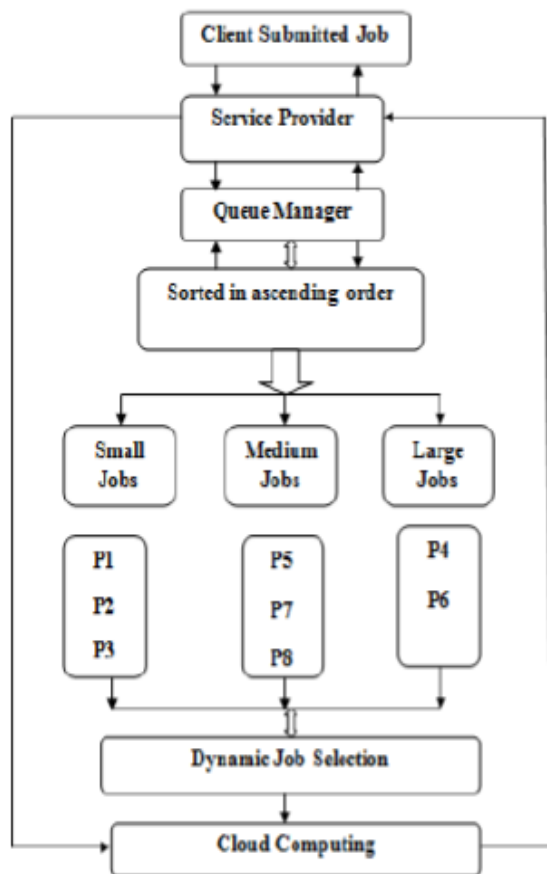

Fig -3: Architecture of EMQS [1]

As illustrated in Figure 3 the jobs are divided and clustered into different queues. There are three queues onto which the jobs are clustered the first 40% of jobs are put into the small queue, the next 40% into the medium queue and the rest into the large queue. The Queue manager is responsible for allocating resources to different clusters and maintaining a record of system which are busy and idle.

2. COMPARISON

Both approaches are Heuristic based but one of the main differences between the two approaches is that EMQS divides the tasks into the respective queues whereas the AOC Scheduling performs a randomized search which will affect the performance capabilities.

2.1 Advantages and Disadvantage of Ant Colony Optimization (ACO) Scheduling Algorithm

The advantages of ACO based task scheduling are:

- **High QOS:** It provides a high quality in the scheduling service.

- **Load Balance**: Provides dynamic and efficient load balancing

One of the main disadvantages of ACO task scheduling is that it performs a randomized search on the tasks for scheduling this will affect both time and energy metrics.

2.2 Advantages of Disadvantage of Efficient MQS Algorithm

The advantages of Efficient MQS are:

- **Starvation:** The dynamic allocation reduces starvation

- Since jobs are clustered into the respective queues and picked at random from each of the queues it helps in the utilization of unused free spaces

One of the disadvantages of EQMS is that it may not always provide a solution with sufficient optimality.

2.3 Performance Comparison

The algorithms were simulated using CloudSim to develop the cloud environment listed in the Table-1

Entity	Parameters	Values
Cloudlet	Number	100-1000
	Length	2000
Host	Number	2
	RAM	2048MB
	Storage	1000000
	Bandwidth	10000
Virtual Machine	Number	15
	Policy	Time Share
	RAM	512MB
	Bandwidth	1000
	OS	Linux
	No of CPU's	2
Data Center	Number	2

Table-1: Cloud Environment Specification

Energy Consumption (in joules) and Time consumption have been used as performance metrics in the analysis. The Table-2 illustrates the performance of the algorithms

No of Jobs	EMQS		ACO	
	Time	Energy in J	Time	Energy in J
5	29	336	74	626
10	59	876	154	2154
15	80	1612	223	4110
20	106	2556	303	7168

Table-2: Performance Result

The Table-2 illustrates the performance of the algorithms with different number of jobs in each of the iterations. The EMQS algorithm consumes lesser energy and time in all the simulation cases.

3. CONCLUSION

After comparing the two algorithms a basic understanding of their working was understood. The performance of the algorithms was compared using time and energy consumption for which Efficient MQs provided better performance in the different test cases. These statistics and analysis can be used to create a better scheduler algorithm which is a hybrid of the best of both algorithms.

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