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AN EXTENSIVE ANALYSIS ON TASK SCHEDULING ALGORITHMS IN CLOUD ENVIRONMENTS

R.Jemina Priyadarsini¹, Dr.L.Arockiam²

¹Research Scholar, ²Associate Professor,

Department of Computer Science, St.Joseph's College,
Trichirapalli-2, Tamil Nadu, INDIA.

Abstract: Task scheduling is one the most essential study in cloud environments . It is the responsibility of cloud scheduler to arrange jobs in such a way to improve the Quality of Service (QoS) offered with respect to Service Level Agreement (SLA). This paper presents a review of research literatures in the field of task to resource scheduling and optimization using metaheuristic and evolutionary approach in cloud. The paper highlights the various existing scheduling algorithms in cloud environments so as provide an extensive knowledge and ways to improve the throughput, makespan, execution cost, computational complexity, etc. The survey of literature also gave a motivation to performing a detailed study on fundamental heuristics and meta-heuristic based task to resource scheduling algorithms and thus leads path to propose a new scheduling algorithm with proposed fitness function.

Keywords: Cloud Computing, Task Scheduling, Optimization, Makespan.

I. Introduction

Cloud computing offers flexible, dynamic, IT infrastructure with guaranteed QoS. It provides increase resource utilization and reduce operation cost with on demand provisioning. Task scheduling is considered as a general assignment problem to find the minimal cost. Some of the most important criteria for efficient task scheduling are task arrival, task waiting time and task processing time in a resource [1]. Some fundamental heuristics methods adopted for the process of scheduling are :

- Minimum Execution Time (MET)
- Minimum Completion Time (MCT)
- Opportunistic Load Balancing (OLB)
- First Fit (FF)
- Round Robin (RR)
- MinMin
- MaxMin

Also some meta heuristics approach has been applied for scheduling [2]. They are:

- Particle Swarm Optimization (PSO)
- Ant Colony Optimization (ACO)
- Cat Swarm Optimization (CSO)
- Bee Colony Optimization (BCO)
- Simulated Annealing (SA)
- Genetic Algorithm (GA)
- Tabu Search

Section 2 briefs the overview on task scheduling, Section 3 gives a clear picture about works related to optimized task scheduling in cloud environments. Section 4 deals with issues and challenges ,Section 5 and 6 concludes with a conclusion and references.

II. Task Scheduling: An Overview

Task scheduling is an important area in cloud computing. It is nothing but a mechanism that maps user task with appropriate resource [3]. Task scheduling is a known NP-hard problem. It is well known that task scheduling is new paradigm and also it is the main goal of cloud computing to achieve with an optimal results. Applications needs scaling, high availability, and fault tolerance to run uninterrupted for long periods of time . Process of task scheduling generally includes:

- Task Submission
- Resource Identification
- Resource Allocation

- Task Waiting Time and
- Task Execution.

Distributing load on the processor and maximizing the utilization with minimization of task execution time (TET) is the major goal of task scheduling [4]. The total time taken for executing all the jobs received per unit time is called the makespan. The three main considerations behind task scheduling are ,makespan, better system throughput and execution cost [5].

Elghoneimy *et al.* identified two scheduling and resource allocation problems in cloud computing. HadoopMapReduce was described and its schedulers and presented recent research efforts in this area, including alternative schedulers and enhancements to existing schedulers. The second scheduling problem is the provisioning of virtual machines to resources in the cloud. A survey of the different approaches was presented to solve this resource allocation problem. Recent research and standards were included for interconnecting clouds and discussed the suitability of running scientific applications in the cloud [6].

Maguluri *et al.* proposed a model which gives the maximum rates at which jobs can be processed in a system. The popularly used Best-Fit scheduling algorithm is not throughput-optimal and presented alternatives which achieved arbitrary fraction of the capacity region of the cloud. The delay performance are studied through simulations [7].

Hu *et al.* studied about the scheduling strategy on load balancing of VM resources based on Genetic Algorithms (GA). This strategy computed the influence it will have on the system after the deployment of the needed VM resources. Also it then chooses the least-affective solution, through which it gets the best load balancing and reduces the dynamic migration. By traditional algorithms and after scheduling the strategy solved the problem of load imbalance and high migration cost. Experimental results proved that the proposed method is capable to realize load balancing and reasonable resource utilization both when system load are stable and variant [8].

Han *et al.* presented a QoS guided task scheduling model, composed of some scheduling strategies and a QoS guided scheduling Sufferage-min heuristic algorithm. Taking into account not only the resource's properties of dynamic and heterogeneous, but also the multi QoS levels of both the resources and tasks, the proposed model try to improve the scheduling efficiency by dividing the tasks and resources into two groups of high QoS level and low QoS level and using different scheduling approach respectively. The experiment showed that the make span value, the key performance was successfully being shortened [9].

Chen *et al.* introduced an improved Load Balanced algorithm on the ground of Min-Min algorithm to reduce the Makespan and increase resource utilization (LBIMM). To observe promised guarantees, user-priority was considered. Finally algorithm was simulated using a Mat lab toolbox. The simulation results show that the improved algorithm achieve over 20% improvement on both user satisfaction and resource utilization ratio [10].

III. Related Works

It is clear that task scheduling is a known np-complete problem and scheduling is a famous combinatorial optimization problem. As we know that cloud computing is a new paradigm and task scheduling is also the main goal of cloud computing, which helps to achieve with an optimal result. Hence more and more applications are migrated onto them. Also applications require to be scalable, highly available, fault tolerant and able to run uninterrupted for long periods of time.

A. Optimization of Scheduling in Cloud Computing

Bilgaiyan *et al.* [11], presented a Cat Swarm Optimization (CSO) - based heuristic scheduling algorithm to schedule the tasks of an application onto available resources. The CSO heuristic algorithm considered both data transmission cost between two dependent resources and execution cost of tasks on different resources. The authors experimented the proposed CSO algorithm using a hypothetical workflow and compared the workflow scheduling results with the existing Particle Swarm Optimization (PSO) algorithm. The experimental results showed that CSO gives an optimal task-to-resource (TOR) and showed an improvement over existing PSO in terms of number of iterations.

Luo *et al.* studied the relationship between infrastructure components and power consumption of the cloud computing environment, and discussed the matching of task types and component power adjustment methods, and then presented a resource scheduling algorithm of Cloud Computing based on energy efficient optimization methods. The experimental results demonstrated that, for jobs that not fully utilized the hardware environment, using the proposed algorithm could significantly reduce energy consumption[12].

Song *et al.* proposed an Ant Colony Optimization based job scheduling algorithm, which integrated specific advantages of Ant Colony Optimization in NP-hard problems. It aimed to minimize job completion time based on pheromone. Experimental results obtained proved that it was a promising Ant Colony Optimization algorithm for job scheduling in a cloud computing environment [13].

Pandey *et al.* presented a particle swarm optimization (PSO) based heuristic algorithm which considers both computation cost and data transmission cost. Comparisons have been done with PSO and existing 'Best Resource Selection' (BRS) algorithm. The results showed that PSO gives 3 times cost savings as compared to BRS, and a good distribution of the workload on task to resources [14].

Arockiam *et al.* investigated the performance of MinMin and MaxMin with the help of CloudSim software. When small tasks outnumber large tasks in a meta-task, max-min algorithm schedules tasks, where system makespan depends on how many small tasks are executed concurrently with large ones. Experiments conducted with sixty tasks assigned to Cloud with 4 resources and the makespan is calculated and found that MaxMin achieves better makespan [15].

Nan *et al.* [16], studied the workload scheduling schemes for multimedia cloud. Specifically, the response time minimization problem and the resource cost minimization problem were examined and solved respectively. Moreover, a greedy algorithm was proposed to efficiently schedule workload for practical multimedia cloud. Simulation results demonstrated that the proposed workload scheduling schemes could optimally balance workload to achieve the minimal response time or the minimal resource cost for multimedia application providers.

Ge and Wei, proposed a new scheduler which made a scheduling decision by evaluating the entire group of tasks in the job queue. A Genetic Algorithm was designed as the optimization method for the new scheduler. The preliminary simulation results showed that the proposed scheduler could get a shorter makespan for jobs than FIFO and delay scheduling policies and achieved a better balanced load across all the nodes in the cloud [17].

Li *et al.* proposed a cloud task scheduling policy based on Load Balancing Ant Colony Optimization (LBACO) algorithm. The main contribution of the work was to balance the entire system load while trying to minimizing the make span of a given tasks set. The new scheduling strategy was simulated using the CloudSim toolkit package. Experiments results showed the proposed LBACO algorithm outperformed FCFS (First Come First Serve) and the basic ACO (Ant Colony Optimization) [18].

Zhu and Liang [19], applied the ant colony optimization (ACO) to the cloud resource scheduling to overcome the defects of the cloud computing data centre in resource management, and ensured that the cloud computing can supply better QoS service according to the actual QoS(Quality of Service) parameters requirement of the environment for the cloud computing. The simulation experiment indicated that the method can solve some problems to a certain extent, such as increased usage of the cloud computing resource and reduced the computing time etc.

Sun *et al.* proposed a Period ACO based scheduling algorithm (PACO) in order to solve the task scheduling problem in cloud computing. PACO used Ant Colony Optimization algorithm in cloud computing, with the first proposed scheduling period strategy and the improvement of pheromone intensity update strategy. The experiments results showed that, PACO has a good performance both in makespan and load balance of the whole cloud cluster [20].

IV. Issues and Challenges Identified

- Users do not have control over their resources because they only rent resources from remote servers for their purpose.
- When the users want to switch to some other service provider for the better usage and storage data migration problem occurs.
- It's also not easy to transfer huge data from one provider to the other.
- Since the working of the cloud mainly depends upon the cloud service provider wide and deeper knowledge is required for allocating and managing resources in cloud.
- Effective resource utilization helps to achieve reliable cloud environment.
- Optimization Techniques like PSO can be used to achieve good resource utilization.
- Existing optimization algorithms can be combined to give a hybrid model with better results.
- New Evolutionary Algorithms to be proposed for resource scheduling.

V. Conclusion

It is well known that scheduling algorithms mainly concentrate on reducing the makespan, failure rate and fault tolerance along with user deadlines, it is better to consider some factor with proposed fitness function to optimize the proposed algorithm. We need to propose a scheduling algorithm that improves the makespan and reliability with respect to availability in cloud computing environment. Thus the paper provides the reader with a general study on existing task scheduling algorithm. As we know that a good scheduling method would enhance the performance of cloud system, it is of much need to propose a better scheduling strategy. Also there is no direct method to find an optimal solution in polynomial time; the scheduling decisions rely on finding the best solution within possibilities. In this paper, the available works in the literature with respect to cloud computing technology, scheduling and optimization of scheduling is reviewed.

VI. References

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