A Review on Task Scheduling Algorithms in Cloud Computing Environment

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----------**ABSTRACT**----------
Cloud computing is a popular computing paradigm that performs processing of huge volume of data using highly available geographically distributed resources. Task scheduling is one of the important step for improve efficiency of all cloud computing services. Task scheduling is used to allocate best suitable resources for the tasks to be executing with the consideration of various factors such as time, cost, reliability, and throughput and so on. In this paper, the author has discussed different algorithms of task scheduling in Cloud Computing. The author mentioned some of their shortcomings for future development.

Keywords- **Algorithms, CloudComputing, Performance, Service, Task Scheduling**

1.Introduction

Cloud computing is made up by adding these terms in the field of technology world. 'Cloud' is first term and 'computing' is second term. Cloud computing is new style of computing which is getting progress constantly and it is model for enabling, convenient, on demand network access to a shared pool of resources that can be rapidly allocated and released with less effort of management or service provider interaction and easier handling of computational problems. Its pros include transparency of resources, mobility, flexibility, reliability, affordability, and greater availability of services, etc.(Rimal,2009).To provide these advantages, the task need to be scheduled properly on the resources so that provide maximum performance in minimum time.

The resource allocation process is executed in the following parts in the first part; the load balancer allocates resources to systems as requested by an application. As well as in second part takes place when coming user requests are assigned to an application in an effort to balance loads within the application as per Quality of Services (QoS) and minimum cost (Patel,2013).To minimize the total time taken, the scheduling principle should aim to reduce the amount of data transfer with minimum cost and ensure balanced distribution of tasks as per processing capability. The total running cost of any task is the total of communication cost and computation cost of that task.

In this paper, presents a study of many algorithms effectively used for task resource scheduling on cloud computing systems. The rest part of the paper organized as follows: Section 2 presents task scheduling description. In Section 3, a survey of algorithms is presented. In Section 4, a tabular format is used to present the summarily. Section 5 concludes the paper and gives a view on some future work.

2.Task Scheduling

In cloud computing scheduling and resource allocation are two major issues. In a cloud environment, traditional scheduling techniques are not able to own properties-dynamical, distributed, and sharable. In cloud computing, a number of jobs may need to be scheduled on various virtual machines for minimize makespan and increase resource utilization. Task scheduling is NP-complete problem, hence finding an exact solution is intractable especially for large task sizes. As the number of user increases, the tasks that needs to be scheduled escalate in proportion that's why there is a need for better metaheurstic algorithm in cloud scheduling, these methods have been applied for solve task assignment problems in these systems. Algorithms required for scheduling are service-oriented and vary in different environments.

2.1 Types of Task Scheduling

2.1.1 Cloud Service Scheduling

Cloud service scheduling is described at two levels user level and system level. At user level scheduling deals with problems raised by services used between providers and customers. The system level scheduling handles resource management within datacenter.

2.1.2 User Level Scheduling

Market-based and auction-based schedulers are useful for regulating the supply and demand of cloud resources. Market based resource allocation is effective in cloud computing environment where resources are virtualized and delivered to user as a service.

2.1.3 Static and Dynamic Scheduling

Static scheduling allows for pre-fetching required data and pipelining different stages of task

execution. By using Static scheduling less runtime overhead. In case of dynamic scheduling information of the job components/task is not known beforehand. Thus total processing time of the job may not be known and the allocation of tasks is done on fly as the application executes.

2.1.4 Heuristic Scheduling

Optimization problems are in Class NP-hard. These problems can be solvable by these methods enumeration method, heuristic or approximation method. In enumeration method, an optimal solution can be selected if all the possible solutions are enumerated and compared one by one. When number of instances is large, exhaustive enumeration is not feasible for scheduling problems. In that case heuristic is a suboptimal algorithm to find reasonably good solutions reasonably fast. Approximation algorithms are used to find approximate solutions to optimized solution . These algorithms are used for problems when exact polynomial time algorithms are known.

2.1.5 Real Time Scheduling

The primary goal of real time scheduling is to increase throughput and minimize average response time instead of meeting deadlines. The real-time tasks are scheduled non-preemptively with the objective to maximize the total utility in two different time utility functions (TUFs)-a profit TUF and a penalty TUF- are associated with each task at the same time. This approach not only rewards the early completions but also penalizes the abortions or deadline misses of real-time tasks.

2.1.6 Workflow Scheduling

A workflow enables the structuring of applications in a directed acyclic graph form,where every node represents the constituent task and edges represent inter task dependencies of the applications.A single workflow generally consists of a set of jobs each of which may interact with another job in the workflow.

3. Literature Survey

Saurabh Bilgaiyan et al (Bilgaiyan, 2014)analyzed various evolutionary and swarm based task scheduling algorithm that help to manage escalating costs of data intensive applications. The benefits using these methods include searching of large and complex problem spaces and atlast get an optimal solution in less time. Multiple objectives could be simultaneously optimized and alternative solutions can be explored.Dr.Amit Agarwal and Saloni Jain (Agarwal, 2014) presented Generalized Priority algorithm for efficient execution of task and comparison with FCFS and Round Robin scheduling. Algorithm tested in CloudSim toolkit and consequence shows that it gives better performance compared to other traditional scheduling algorithms. Varying number of virtual machines used for experiment and workload traces. Savitha.P and J Geetha Reddy (Savitha.P, 2013) focused on different types of workflow scheduling algorithms. The main focus is to study various problems, issues and type of scheduling based on the Genetic algorithm for cloud workflows. In this paper, various existing workflows scheduling based on Genetic algorithms are surveyed in cloud computing and tabulated their various parameters along with tools. Lizheng Guo and Azade Khalili et al (Guo, 2012) (Khalili , 2015) presented the task scheduling optimizing method in cloud computing to minimize the cost and makespan of the problem and solved it by PSO algorithm. Liyun Zuo et al (Zuo, 2015)described an improved ant colony optimization algorithm is used to solve the optimization problem of cost and performance. By comparing PBACO with ACO, Min-Min and FCFS, PBACO method was better than other methods.In this paper, Tripti Mandal and Sriyankar Acharyya (Mandal, 2015)worked on three meta-heuristic techniques such as Simulated Annealing, Firefly Algorithm and Cuckoo Search Algorithm have been implemented to find an optimal solution.The main goal of these algorithms is to minimize the overall processing time of the VM's which execute a set of tasks. The experimental result shown that Firefly algorithm (FFA) performed better than other two algorithms.In this paper, Jing Xue et al (Xue, 2014)used the Differential Evolution (DE) algorithm for minimizing completion time, maximum load balancing degree and the minimum energy consumption. The experimental result shown that DE algorithm can efficient to optimize cloud computing task scheduling problems in load balancing, energy and time.Er. Shimpy, Mr. Jagandeep Sidhu (Shimpy,2014) studied different scheduling algorithms in different environments with their respective parameters for reducing the complexity of task scheduling problem increases with the size of the task. In this paper, some heuristic techniques also provide an optimal or near optimal solution for tasks i.e., large in size. Mohammed Alhanjouri and Dian Palupi Rin et.al (Alhanjouri) (Palupi,2011) used two algorithms (Ant Colony Optimization and Genetic Algorithm) for solved the traveling salesman problem (TSP) and other oversaturated conditions. The result shown both algorithms reduce makespan. Wu Mingxin (Mingxin,2015)described a dual fitness genetic algorithm (DFGA), it got shorter total task scheduling completion time and better results and the results of the scheduling task average completion time is also shorter. Through the simulation experiment of this algorithm, compared with other algorithms, the experimental results shown that, this algorithm is better than adaptive genetic algorithm. Sapna Katiyar (Katiyar, 2010) presented PSO and GA evolutionary heuristic algorithms and by implemented statistical analysis and formal hypothesis testing compared the effectiveness and efficiency of the GA and PSO.The result showed PSO is more computationally efficient (uses less number of function evaluations) than the GA. V.Selvi and Dr. R. Umarani (Selvi,2010) focused on the comparative analysis of most successful methods of optimization techniques inspired by Swarm Intelligence (SI) ,Ant Colony

Optimization (ACO) and Particle Swarm Optimization (PSO). In this paper, analysis is carried out to endow these algorithms with fitness sharing and to investigate whether PSO improves performance which can be implemented in the evolution*-ary algorithms.

R.K. Jena (Jena,2015) focused on task scheduling using a multi-objective nested Particle Swarm Optimization (TSPSO) to optimize energy and processing time. The experimental results illustrated that the proposed method multi objective particle swarm optimization (MOPSO) outperformed the BRS and RSA.

4. Comparative Evaluation of Algorithms

Author	Objective	Algorithm	Environment/Tool	Advantage	Further Studies
Dr.Amit Agarwal and Saloni Jain	Efficient execution of task	Generalized priority algorithm performs better than FCFS and Round Robin.	CloudSim	Less Execution time	Take more task and try to reduce the execution time.
Lizheng Guo et al	Reduce the cost of processing.	PSO performs better than PSO embedded crossover and mutation.	Cloud Environment	Minimize the cost of the processing.	Optimization will be of energy and service level agreement.
Liyun Zuo et al	Achieve Multi-Objective optimization of both performance and cost.	An improved Ant Colony Optimization algorithm is used to solve the problem.	Simulation Experiment	Optimization of both performance and cost.	Similar methods regarding other metrics, such as cost, the violation rate of deadline and resource utilization.
Tripti Mandal and Sriyankar Acharyya	Minimize total processing time of Virtual Machines.	Firefly Algorithm (FFA) performs better than Simulated Annealing and Cuckoo Search Algorithm.	Cloud Environment	Minimize the total processing time of Virtual Machines (VMs).	Hybrid version of Firefly Algorithm is used to solve problems.
Jing Xue et al	Minimum completion time, maximum load balancing degree, and the minimum energy consumption.	The improved differential evolution algorithm is efficient optimize cloud computing task scheduling problems in load balancing, energy and time.	CloudSim	Minimum completion time, maximum load balancing degree, and the minimum energy consumption.	Task scheduling problems in load balancing, energy and time.
Er. Shimpy, Mr. Jagandeep Sidhu	Solve the complexness when size of the task increase.	Optimize task scheduling used the different algorithms to solve this problem.	CloudSim	Proper utilization of resources.	Disk space management is vital issue in virtual atmosphere.
Azade Khalili, Seyed Morteza Babamir	Minimize makespan using five different interia weights strategy.	PSO used with LDIW strategy used and improved makespan with an average 22.7% compared to FCFS mode.	Experiment	Select the best value for chromosome population, crossover, and mutation probabilities.	Improve makespan by another algorithm.
Mohammed Alhanjouri and Belal Alfarra	Solve TSP by using the same dataset.	GA is better than ACO for TSP.	CloudSim	Minimize makespan	Use another method for compare with GA.
Wu Mingxin	Shorter the total task scheduling completion time.	The experimental results show that, dual fitness genetic algorithm	Simulation Experiment	Programming environment to achieve the task scheduling.	To facilitate real-time management of traffic networks

		(DFGA) is better than adaptive genetic algorithm.			in oversaturated conditions.
Sapna Katiyar	Compare the computational effectiveness and efficiency.	By compared the computational effectiveness and efficiency of the GA and PSO using a formal hypothesis testing approach. The result is PSO is better than GA.	Cloud Environment	Better computational efficiency.	The average completion time as a direct reference to Volume.
V.Selvi and Dr. R. Umarani	Investigate fitness sharing, improve performance.	An elaborate comparative analysis is carried out to endow these algorithms PSO is better than GA.	Experiment	Better solution by improving the effectiveness.	PSO can be applied to multi-objective problems, in which the fitness comparison takes pareto dominance.
Rahul Putha et al	Solve oversaturated conditions	Two scenarios are considered and results are rigorously compared with solutions obtained using the genetic algorithm (GA), ACO. ACO is better than GA.	Experiment	Reduce the overall execution time	Controlling the velocity and the stable convergence.
R K Jena	Optimize energy and processing time.	The experimental results illustrated that the proposed methods (MOPSO) out-performed the BRS and RSA.	CloudSim	Reduce energy and makespan	Optimization model should add more objectives (bandwidth, load balancing, cost etc) and should focus more robust algorithm.

4.1 Comparison Evaluation

In the above shown Table various algorithms have been discussed such as PSO (Particle Swarm Optimization), DE (Differential Evaluation), FCFS (First Come First Serve), and GA (Genetic Algorithm) etc. The comparative result shown of traditional algorithms in Fig: 1 that is GP (Generalized Priority Algorithm) is performs better than FCFS (First Come First Serve) and RR (Round Robin) (Agarwal,2014). In Fig: 2 results of optimization algorithms are shown that is PSO is better than GA, and DE is better than PSO and GA (Chandrasekar,2012). As studied of different algorithms in the paper that result concluded is that the mostly optimization algorithms work on single objective. The further study can be proceeding on multiobjective task scheduling problems.

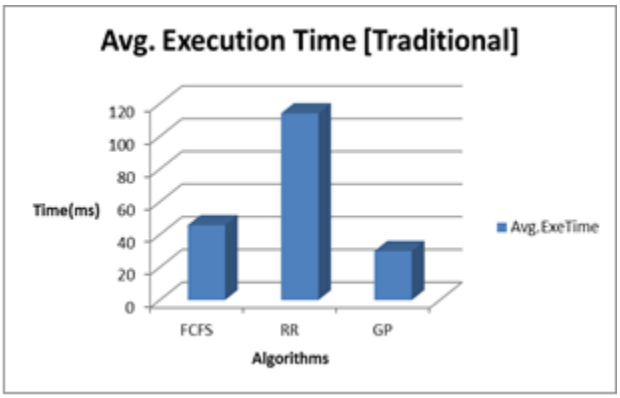

Figure 1: Performance analysis of FCFS (First Come First Serve),RR (Round Robin) and GP (Generalized Priority)

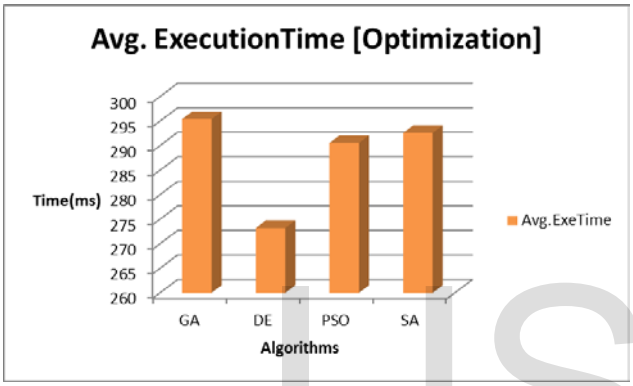

Figure 2: Performance analysis of Genetic Algorithm,Differential Evolution,Particle Swarm Optimization,Simulated Annealing

5. Conclusion and Future Work

Scheduling of task in cloud environment is very challenging issue in cloud computing. In today's time to meet thousands of user requests while making best possible use of available resources as well as fulfill the both user and service provider request, it is challenge for task scheduler. This paper give a review on many task scheduling algorithms used for solving the problems while scheduling of tasks is done. In future, the further work will be proceed by using new algorithm for solving the task scheduling problems in multiobjective such as minimizing time, energy, cost and load balancing and so on.

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