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Review

A Comparative Study Of Various Task Scheduling Algorithms In Cloud Environment

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Abstract

Task scheduling approach is a strategy through which tasks are coordinated, or assigned to datacenter resources. Due to conflicting scheduling, it is difficult to offer an absolutely perfect scheduling algorithm. In cloud computing, data stored in distant cloud data centers to reduce the memory constraints, and the main focus of scheduling is to reduce the memory constraints and the computation time and cost. The data sent from the cloud center is needed to be scheduled on the appropriate virtual machine for maintaining the performance of the server. In this paper, various task scheduling algorithms in cloud environment are presented. This study concludes that most of the existing scheduling algorithms mainly focus on minimizing and reducing the cost, CPU utilization, completion time, reducing service response time and maximizing throughput.

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1. Introduction

A Cloud is a type of parallel and distributed system consisting of a collection of interconnected and virtualized computers, that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements that are established through negotiation between the service provider and consumers[1]. Cloud computing is considered as a benefit for the small businesses since it enables them to have admittance to innovations that weren't available before, as far as cash spending; and these is considered leverage for them since they can begin contending with other independent ventures or even with huge ones[2].

The cloud has three different deployment models. Each model has its own benefits and trade-offs. Private cloud: This cloud is setup specifically for an organization that has its own data center. The organizations manage all the cloud resources owned by them. The private cloud offers more security as compared to the other two models; the resources are shared internally. Public cloud: This cloud is available to all the external users through the internet who can register with cloud and can use the cloud resources on a pay-per-use model. This cloud is not secure like the private cloud because it is accessible to the internet users. Hybrid cloud: This is a type of private cloud, which uses the resources of one or more public clouds. It is a mix of both, private cloud and public cloud. Hybrid cloud thus aggregates the properties of every personal and public cloud like measurability, flexibility and security. Community Cloud: Community Cloud permits sharing its resources among the users of multiple organizations who have the same desires and objectives. As cloud computing services have grown in popularity, the amount of data and tasks to be dealt with have also sharply increased, requiring a lot of system resources and sometimes resulting in severe resource waste [3]. The cost suggested for somebody to come and settle/introduce an application will be chopped down and the organization will spare cash; it is less expensive to utilize applications that are on cloud than to purchase different ones. There is the likelihood to utilize one multi-application cloud benefit for every one of the necessities of the organization. The applications that exist on the cloud will incorporate consummately inside the organization in light of the API; that is finding the application that is good with the organizations objectives. Since cloud computing is overhauled consistently, the organization does not have to burn through cash for this. Cloud computing is a route for organizations to cut the costs of the organization [4].

2. Related Work

A cloud scheduler is a cloud-enable distributed resource manager. It manages virtual machines on clouds to create an environment for job execution. The first-in-first-out (FIFO) scheduler in Hadoop MapReduce, fair scheduler on Facebook, and capacity scheduler in Yahoo are typical examples that serve the cloud systems with efficient and equitable resource management, but none of these schedulers satisfies QoS (quality of service) constraints. Therefore, they are not applicable to soft real-time needed applications and services that are becoming more and more important and necessary in the hybrid cloud environment [5]. Task scheduling can approximately be categorized into two groups, dynamic scheduling and static scheduling. In the dynamic category, the execution, communication costs, and the relationship of the tasks are unknown. Decisions are made at runtime. While in the static category, such information is known ahead of time. Dynamic scheduling is runtime scheduling, whereas static scheduling is compile-time scheduling [6]. In cloud computing, the tasks are performed in the physical machine (PMs) or the VMs as per the task requirements. The data required for the execution of the tasks and services are stored at multiple distant storage locations called as the data centers which are also used with specific costs [7].

An evolutionary multi-objective optimization (EMO) algorithm [8] proposed to reduce the workflow scheduling problem such as cost and makespan. Due to the specific properties of the workflow scheduling problem, the existing genetic operations, such as binary encoding, real-valued encoding, and the corresponding variation operators are based on them in the EMO. The problem is that the approach does not consider

monetary costs and time overheads of both communication and storage. Zhang et al.
[9] proposed a fine-grained scheduling approach called phase and resource information-aware scheduler for MapReduce (PRISM) for scheduling in the MapReduce model. MapReduce has been utilized for its efficiency in reducing the running time of the data-intensive jobs but most of the MapReduce schedulers are designed on the basis of task-level solutions that provide suboptimal job performances. Moreover, the task-level schedulers face difficulties in reducing the job execution time. Hence, the PRISM was developed, which divides tasks into phases. Each phase with a constant resource usage profile performs scheduling at the phase level. Thus, the overall job execution time can be reduced significantly, but the problem of meeting job deadlines in the phase level scheduling is a serious concern that requires specified attention.

In [10] a cost-effective deadline constraint dynamic scheduling algorithm proposed for the scientific workflows. The workflow scheduling algorithms in the grid and clusters are efficient but could not be utilized effectively in the cloud environment because of the on demand resource provisioning and pay-as-you-go pricing model. Hence, scheduling using a dynamic cost-effective deadline-constrained heuristic algorithm has been utilized to exploit the features of cloud by considering the virtual machine performance variability and instance acquisition delay to determine the time scheduling. The problem with the approach is that VM failures may adversely affect the overall workflow execution time. Mohammed et al.
[5] presented adaptive cost-based task scheduling (ACTS) considering the data access completion time and the cost of data access to improve the scheduling performance, and fetching the data from the data centers effectively. The approach focuses on providing data access for executing each task with maintained costs, and provides better performance in terms of execution time, computation cost, communication cost, and bandwidth as well as CPU utilization. The task scheduling is performed for the already determined task demands, and it is quite challenging to schedule tasks with undetermined demands. An agent-based dynamic scheduling algorithm named ANGEL [11] proposed for effective scheduling of tasks in the virtualized clouds. In this approach, a bidirectional announcement-bidding mechanism and the collaborative process are performed to improve the scheduling performance. To further improve the scheduling, elasticity is considered to dynamically add VMs. The calculation rules are generated to improve the bidding process that in turn reduces the delay. The problem with this approach is that it reduces the performance as it does not consider the communication and dispatching times. Zhu et al. [12] presented real-time task oriented energy aware (EA) scheduling called EARH for the virtualized clouds. The proposed approach is based on rolling-horizon (RH) optimization and the procedures are developed for creation, migration, and cancellation of VMs to dynamically adjust the scale of cloud to achieve real time deadlines and reduce energy. The EARH approach has the drawback of the number of cycles assigned to the VMs that cannot be updated dynamically. Hyper-heuristic scheduling algorithm (HHSA) [13] provided effective cloud scheduling solutions. The diversity detection and improvement detection operators are utilized in this approach to dynamically determine the better low-level heuristic for the effective scheduling. HHSA can reduce the make span of task scheduling in addition to the overall scheduling performance. The drawback is that the approach has a high overhead of connection which reduces the importance of scheduling and thus reduces the overall performance. Zuo et al.
[14] presented self-adaptive learning particle swarm optimization- (SLPSO-) based scheduling approach for deadline constraint task scheduling in hybrid IaaS clouds. The approach solves the problem of meeting the peak demand for preserving the quality-of-service constraints by using the PSO optimization technique. The approach provides better scheduling of the tasks with maximizing the profit of IaaS provider while guaranteeing QoS. The problem with this approach is the lack of priority determination, which results in failure of deadline tasks. From the literature, it is found that the major issues in the above described methods have high cost consumption, especially for communication and computation

of data from cloud data centers. The inability to meet up the deadlines, due to the inappropriate data path allocation while task scheduling, is another area of concern. The analysis of various scheduling schemes is listed as below.

Analysis of Task Scheduling Schemes

Scheduling of the task is a major activity performed in all the computing environments. The main reason is that in cloud computing the resource provision is on-demand and the resources are provided on the basis of pay-per-use. Hence, the scheduling approach has to make use of the features of the cloud in order to efficiently schedule the tasks without time delay. While processing a task in a VM, the data are needed to be obtained from the distant data centers located at multiple locations. As the tasks are deadline constrained, the data are needed to be obtained within the particular time using effective scheduling approaches. However, the solution for scheduling deadline constraint tasks in the cloud leads to a new problem in the form of cost. The computation and the storage resources are the basic resources in the cloud environment that form the cost models. Table 1 shows the various scheduling schemes described in the literature and their advantages, drawbacks and simulations used.

Scheduling Scheme	Advantages	Drawbacks	Simulations
Phase and Resource Information-aware Scheduler for MapReduce (PRISM)	Reduced the overall job execution time	Deadlines are not specified	Hadoop 0.20.2.
Throughput-optimal Scheduling & Load-Balancing Algorithm	An exact MaxWeight schedule is chosen automatically at refresh times	Utilizing queue lengths in weights is based on assumption	Unknown
Hyper-heuristic Scheduling Algorithm	Reduce the make span of task scheduling and improves the scheduling performance	High overhead of connection	Hadoop
Adaptive Cost-Based Task Scheduling (ACTS)	-Provided data access for executing each task with maintained costs. -Fetched the data from the data centers effectively	-Improved the scheduling performance Doesn't schedule tasks with undetermined demands	CloudSim
Self-Adaptive Learning Particle Swarm Optimization (SLPSO)-based scheduling	Provided better scheduling of the tasks with maximizing the profit of IaaS provider while guaranteeing QoS	Lack of priority to deadline constraint tasks results in task failures	Matlab 7.0
Energy Aware Rolling-Horizon (EARH) Optimization Based Scheduling	Achieved real time deadlines and reduce the energy.	Lack of updating in number of VM cycles	CloudSim toolkit
Agent-Based Scheduling Algorithm In Virtualized Clouds (ANGEL)	Improved the bidding process that in turn reduces the delay	Non-consideration of communication and dispatching time reducing performance	CloudSim toolkit
Evolutionary Multi Objective(EMO) workflow scheduling	Reduced the workflow scheduling	Non-consideration of monetary costs and time overhead does not improve performance	Unknown

3. Conclusion

Scheduling is one of the most important issues in the management of applications in a cloud computing environment. Scheduling tasks in cloud computing with minimum delay and effective cost management is a challenging task. Hence, in this paper, we have analyzed various task scheduling algorithms in cloud environment. This study concludes that most of the existing scheduling algorithms mainly focus on minimizing the completion time, reducing the cost, reducing service response time and maximizing throughput. The ACTS algorithm is the most efficient because it avoids the most drawbacks on the various scheduling algorithms that are described in the literature.

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