Survey on Various Scheduling Algorithms in Cloud Computing

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ABSTRACT
Cloud computing consist of cost effective, scalable, and flexible IT operations. As it works on pay-as-you go model, user's request must be fulfilled as fast as possible. Resources should be managed and scheduled in a way that gives fast response in economical way. In this paper various scheduling algorithms have been discussed with respect to their various constraints such as time, cost, energy, SLA and so on.

Keywords: cloud computing, scheduling algorithm, scheduling parameters, scheduling process.

1. Introduction

A cloud is a dynamic provisioned collection of interconnected and virtualized, parallel and distributed systems that are one or more unified computing resources based on service level agreement that is established via communication between the consumer and service provider [1]. One of the major aspect of cloud computing is to focus on maximizing the shared resources. Cloud resources are usually not only shared by multiple users but are also dynamically reallocated per demand. This can work for allocating resources to users. Cloud computing relies on sharing of resources with minimum cost. In this computing large group of servers are networked to provide services. It not only looks after for sharing of resources but also dynamically reallocate them as per user's request. Cloud computing services are not bounded by geographical location. User can access cloud services anywhere. Service providers provide their services based either on metered system means pay-as-use or based on SLA. SLA is "Service Level Agreement" which is an agreement between user and service provider providing terms and condition while using services. A simple example of Cloud Computing is use of electricity in houses or in organizations. Payment is made upon metered system. Another is Yahoo email, Gmail, or Hotmail etc. All you need is just an internet connection and you can start sending emails.

2. Problem Formulation

Cloud computing promises the easier access to remote computational resources that are located limited [1]. Data centers are important aspect in cloud computing that should be managed and scheduled in efficient manner.Through scheduling algorithms we can minimize total execution time by spreading load on processors [2]. A scheduling algorithm may be traditional or new one that is discovered by adding some constraints in conventional one [3]. Traditional algorithms are static but discovered algorithms are dynamic by nature.
Scheduling algorithms must follow a process of scheduling. Steps [4] of scheduling are:

1. **Resource discovering and filtering:** Datacenter Broker discovers the resources

present in the network system and collects status information related to them.

2. **Resource selection:** Target resource is selected based on certain parameters of task and resource. This is deciding stage.
3. **Task submission:** Task is submitted to resource selected.

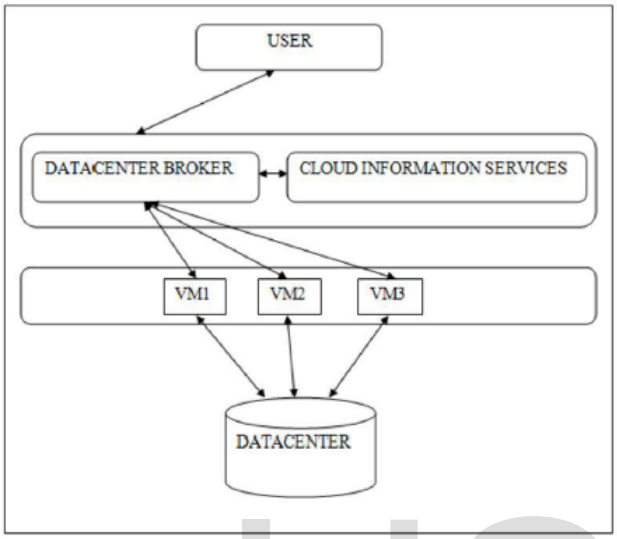

Fig. 1 Scheduling process.

Scheduling is classified into two main classes:
Batch mode heuristic scheduling: First of all, all requested jobs are collected in system then scheduling algorithm starts its process. E.g.RR scheduling algorithm.

Online-mode heuristic scheduling: All requests are scheduled as they entered in the system. That's why it is a fast approach of scheduling. Eg.FCFSscheduling algorithm.

3. Related Work

In this section, various scheduling algorithms are discussed taking various parameters- time, cost, SLA, QoS, and energy into consideration.
The basic purpose of resource management is to maximize the utilization of resources to gain maximum profit. QI CAO et. al. (2009) [5] proposed ABC (Activity Based Cost) method. In this algorithm, under-cost of large jobs and over-cost of smaller jobsare taken into consideration. Individual cost of resources is calculated with respect to time, memory, CPU, I/O etc. HIGH, MID, LOW queues are set based on their priorities. But performance of resources was not taken in account. Mrs.S.Selvaraniet. al. (2010) [6] proposed cost effective algorithm that considered resource performance and performance cost, measured by calculating individual task costs. QoS and SLA still were missing in this algorithm. Zhi Yang et. al. (2011)[7] calculates cost w.r.t supplier's demand in sorted order then resource cost was calculated considering QoS (Quality-of-Service) and SLA (Service-Level-Agreement). But this algorithm was evaluated on private cloud only. Bo Yang el. al. (2011) [9] proposed RL (Reinforcement Learning) for saving cost based on Markov Decision Process (MDP), a decision making process. It is a utility based computing framework; which reduces the cost by finding the system state in advance specially in overloading condition. It also maximized resource utility by hardware fault tolerance and recovery method. YogitaChawlaet. al. (2013) [8] proposed algorithm for both user and service provider. Cost of each task is calculated and task with highest profit is assigned to minimum execution task cost resource.

Apart from saving cost energy ulitization should be minimized at provider's side. Xuan Li et. al. (2011) [10] consider cost with energy using Pricing and Peak aware scheduling algorithm for scheduling the task. In their proposed algorithm price is combined with energy. Dynamic cost is considered with energy consumption. Main objective of this algorithm is to aware the user to save the electricity. If a user's request is consuming less electricity then price rate will be less but as he start consuming high energy then price will automatically increase. R.G. Babukarthiket. al. (2012) [11] proposed hybrid algorithm for saving energy based on voltage scaling algorithm. This algorithm is based on computing infrastructure. The use of energy can be decreased by decreasing computing infrastructure. This is a hybrid algorithm, uses ACO (Ant Colony Optimization) algorithm and Cuckoo search algorithm for saving energy and cost.Jing SiYuan (2013) [12] saves energy by VM (Virtual Machine) migration and turning off servers when not in use. Network flow theory based algorithm forecast workload of resources and turns on servers to increase capacity and

turns off servers to save electricity. Time constraint in VM migration was proposed by AbdulrahmanAlahmadiet. al. (2014) [13] in EFFD (Enhanced-First-Fit-Decreasing) algorithm. In their proposed algorithm a bag of clouds task is migrated within time constrains. It works in two cases. In first case for migration, VM is chosen that is not so much busy. In second case, a VM with light load is selected and migrated to another VM to save energy.Abbas Horriet. al. (2014) [14] consider SLA and QoS while save energy. In their proposed algorithm detect overloaded servers then select some VM and migrate them to the under loaded servers. Another algorithm TESA (Three Threshold Energy Saving Algorithm) by Zhouet. al. (2015) [15] was proposed to save energy. TESA divides data centers into four classes: host with light load, proper load, middle load, and heavy load. Light loaded host is migrated with proper load.

Everyone wants fast execution of their tasks to save time. Zhongyuan Leeet. al.(2011) [16] schedules the task based on dynamic priority. In DPSA (Dynamic priority based scheduling algorithm), 3-tier architecture considering service provider, resource provider and customers, was used in cloud structure. Number of priority queues is based on task unit.Priorities of low tasks were increased by a time interval $A_k$so that all the task get resource. LI Kun-lunet. al. (2014) [17] minimize execution time by improved GEP algorithm with double fitness functions (DF-GEP). Considering running task time and cost ETCC (Expected Time to Compute Cost) was constructed. It reduces execution time and operational cost. Dinesh Komarasamyet. al. (2014) [18] reduced execution time using Minimum Variation First algorithm (MVF). In their proposed algorithm, tasks execution time and deadline constraints are considered while allocation the resources. Deadline based tasks were scheduled using MVF algorithm while other tasks were scheduled using iMVF (Improved minimum Variation First) algorithm.

GAN Guo-ninget. al. (2010) [19] proposed "Genetic Simulated Annealing Algorithm" considering QOS (quality of service) and SLA. It deals with different types of tasks' dimension or characteristics (cost, execution time, bandwidth, reliability) using genetic simulation annealing method. In this tasks are divided according to their parameters.
Hu Songet. al. (2012) [20] proposed algorithm based on Torque management system. It is Eucalyptus cloud platform depended. Torque management system was used for dynamic task/job scheduling. With this algorithm QOS and cost are considered according to the SLA. It minimizes the number of running virtual machines to save energy and idle resources are also fully utilized using this algorithm.

4. Comparison Table of scheduling algorithms:

Algorithm	Finding	Scheduling Method	Tool	Nature
Activity Based Costing Scheduling Algorithm	• Over-cost and under cost • Calculate cost based on type of activity.	Batch mode	Simgrid	Dynamic
Improved Cost-Based Algorithm For Task Scheduling	• Calculate individual task cost	Batch Mode	Cloudsim	Static

A Cost-Based Resource Scheduling Paradigm	• Based on market trends.	Batch Mode	Java Cloudware	Dynamic
Utility based Reinforcement learning algorithm	• Maximize resource utility • Tolerate Hardware failure	Online mode	Matlab	Dynamic
Dynamically optimized cost based task Scheduling	• Maximize profit for user and service provider.	Batch mode	CloudSim	Dynamic
Pricing and Peak aware scheduling algorithm	Dynamic price rate algorithm associated with energy consumption.	Online mode	GridSim	Dynamic
Hybrid algorithm based on voltage scaling method	• ACO and Cuckoo search to reduce cost • Save energy	Online mode	Matlab	Dynamic
Network flow theory based approximation algorithm	Minimize resource requirement with VM replacement.	Online mode	Matlab	Dynamic
Enhanced-First-Fit-Decreasing Algorithm	VM migration using FFD algorithm.	Batch Mode	Cloudreport	Dynamic
Novel resource allocation algorithm	QoS aware Vms Consolidation approach	Batch mode	CloudSim	Dynamic
Three Threshold Energy Saving Algorithm	For VM migration server is divided into four classes.	Batch Mode	CloudSim	Dynamic
Dynamic priority based scheduling algorithm.	Set dynamic priority on 3-tier architecture	Batch mode	Matlab	Dynamic
Improved GEP algorithm	ETCC matrix for tasks time and cost.	Batch Mode	Matlab	Dynamic
Minimum Variation First Algorithm	• Use MVF for deadline constraint based tasks. • Use iMVF algorithm for normal tasks	Batch mode	CloudSim	Dynamic

Genetic Simulated Annealing Algorithm	Task annealing method based on QoS.	Batch mode	Matlab	Dynamic
Torque Cloud management system based IdleCached scheduling algorithm	Utilize idle resources considering QoS and SLA and also save energy.	Online mode	Eucalyptus	Dynamic

5. Conclusion

Scheduling of resource is necessary and important task in cloud computing. In this paper, a study of various scheduling algorithms with respect to their execution time, cost, speed, SLA, QoS, Networkwas conducted. It was identified that the issues of reliability and availability was not given due weightage. These are very important aspect of scheduling. In future, the researcher will try to concentrate on these aspects.

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