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A STUDY ON DIFFERENT SCHEDULING ALGORITHMS IN CLOUD ENVIRONMENT

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Abstract

Cloud computing is an advanced concept of delivering internet services from a pool of internet resources. The resources can be shared very efficiently using cloud environment. The resources in cloud are scattered and it is essential for an efficient scheduling algorithm to access these resources. Different task scheduling algorithms are used to schedule the task effectively. The main goal of these task scheduling algorithms is to reduce the turnaround time and should be cost effective. Many parameters should be taken into account while selecting a scheduling algorithm like throughput, latency, bandwidth, computational time, physical distance. The scheduling algorithms posses many problems regarding the availability and reliability of the resources. This paper deals with the study of various scheduling algorithms used in cloud environment. A comparative study of various scheduling algorithms is also provided.

Key words: Cloud computing, scheduling algorithms

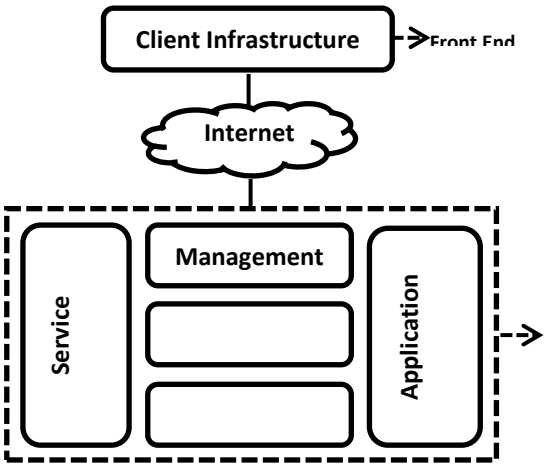
Introduction

Cloud computing refers to the sharing of pool of resources and infrastructures virtually over the internet on a pay per time basis. The customer need not have the infrastructure of their own. They only need to pay for exactly what they use. The traditional computing techniques like parallel computing, grid computing were extended using the cloud infrastructure. The word cloud comes from the fact that the user need not be in the specific place to access the data that is stored in cloud. This feature helps the customers or employees to work on remote computers. An important characteristic feature of cloud computing is its scalable infrastructure. The main goal of cloud is to provide an easy way to use the technologies without having a profound knowledge on these technologies. The users can overcome many IT obstacles and can concentrate on the business. Cloud computing uses the technology of virtualization in which the entire network is separated into one or more virtual devices.

There are three models of cloud and they are software as a service (SaaS), platform as a service (PaaS) and infrastructure as a service (IaaS).The different types of deployments of cloud are-public cloud which is owned and created by a third party service provider and is accessible to the public-private cloud is owned by a single organisation and is accessible to the employees of that organisation-hybrid cloud is a combination of public and private cloud

Cloud Architecture

Cloud Architecture includes various components. These components are loosely coupled. There are two parts in cloud architecture. The Front end is the client part and it includes interfaces and applications which are needed to access the cloud computing platform. The Back end includes the resources like huge data storage, virtual machines etc. the cloud architecture is illustrated with the help of a figure.



Cloud Architecture [1]

What is Scheduling

Scheduling is the process of allocating resources to specific task at a particular time. The allocation should be done in such a way that the waiting time should be minimum and the resources should be used effectively. The main goal of scheduling is maximum throughput, minimum latency and maximum fairness.

Scheduling Process[2]

Scheduling process in cloud is categorized into three stages namely:

- Resource discovering and filtering: Data center Broker discovers the resources present in the network system and collects status information related to them.
- Resource selection: Target resource is selected based on certain parameters of task and resource. This is deciding stage.
- Task submission: Task is submitted to resource selected.

Types of scheduling

There are different types of scheduling like:

1. Static scheduling v/s Dynamic scheduling:[3] In static scheduling algorithm information about the status of the task and resources is known in advance and then schedule the task to the resource .In dynamic scheduling algorithm the task is allocated to runtime.
2. Online v/s Batch mode scheduling: In online scheduling algorithm the job is executed as soon as it arrives. In batch mode scheduling the task is executed in the specific time interval.
3. Preemptive v/s Non-preemptive scheduling: In preemptive scheduling algorithm job can be interrupted to the current execution and job can be migrated to another resource. In non preemptive scheduling, algorithm job is executed on the resources until the job cannot be finished.
4. System level v/s User level scheduling: [4]system-level scheduling handles the resource management issues within the data centers and user-level scheduling deals with problems between cloud providers and customers. Moreover, user-level scheduling consider the economic concerns such as cost minimization.
5. Independent v/s Dependent scheduling:[5] Scheduling independent tasks is called task scheduling, and scheduling dependent tasks is called workflow scheduling.

Types of scheduling Algorithms

There are different types of scheduling algorithms in cloud environment[6]. They are

1. First Come First Serve (FCFS): In this scheduling algorithm the resources are allocated to the task in the order in which they arrive. The next task will be executed as soon as the first task is complete. It is also called FIFO (First In First Out) and FCFC (First Come First Choice).It is the basic scheduling algorithm. But it is slower than other algorithms.
2. Round Robin (RR): This algorithm uses the same principle as FCFS. In this scheduling algorithm each task is scheduled to a fixed time interval. When a task is not executed during this time slot, the task has to wait until it gets next chance. The performance rate of this algorithm is comparatively good and the complexity is very less. This algorithm needs pre-emption and the waiting time is high for large tasks.
3. Min-Min method: In this algorithm the smallest task is taken first and it is allocated to the machine with minimum completion time for a task. The makespan and the overall throughput of the system is increased. The bigger tasks need to wait until the smaller ones are completed.
4. Max-Min method: In this algorithm the completion time of each task is calculated. The task with maximum completion time is allocated first to a machine with minimum execution time. It increases the makespan and the overall throughput of the system. The load balancing is not considered much in this algorithm.
5. Priority based job scheduling: Each task is assigned a priority and the tasks allocated tot the machines according to this priority. The completion time is better and the performance is improved.
6. Improved cost based algorithm: This algorithm works based on the cost of the resources needed. The task is allocated in such way to reduce the cost. As the complexity of the task increases the cost also increases.
7. Genetic Algorithm: This algorithm uses the hereditary qualities for problem solving. Here a population is generated based on a biological concept. It is based on the Darwin's theory of evolution. Here we use the operators such as mutation, crossover and selection
8. Earliest Feasible deadline first algorithm (EDF): This algorithm is based on the deadline of each task. The task with shortest deadline is scheduled first. Whenever a scheduling event occurs (end of a task, the release of the new task.) then the queue will be searched for the process that is closest to its deadline, the found process will be the next that is going to be scheduled for execution.
9. Particle Swarm Optimization Scheduling Algorithm (PSO) : This algorithm was developed by Dr.Eberhart and Dr.Kennedy in 1995. It is similar to genetic algorithm. It is initialised with a population set and searches for an optimum solution. It is very easy to implement.
10. Hybrid Cuckoo Algorithm [8]: This algorithm focuses on optimization of task scheduling. The Hybrid Cuckoo algorithm is a combination of Genetic Algorithm and Cuckoo search algorithm. This algorithm increases resource utilization and reduces energy consumption. The result of the Hybrid Cuckoo algorithm is compared with FIFO, Genetic Algorithm and Cuckoo algorithms.

Table 1 : COMPARISON OF DIFFERENT SCHEDULING ALGORITHMS

Algorithm	Parameter	Objectives	Advantages	Disadvantages
FCFS	Simplest scheduling algorithm	Resources are allocated to the task in the order they arrive	Complexity is less	Slower
RR Algorithm	The overall performance depends on the size of time slots	Preemption is done when the given time slot is over	Better performance and less complexity	Slower
Min-Min Max-Min	Makespan	To provide the resources efficiently	Better makespan and less waiting time	Not suitable for load balancing
Priority Based Job Scheduling Algorithm	Priority is assigned to each task	The task with highest priority is executed first	Better performance rate	The consistency and complexity rate should be improved
Improved Cost Based Algorithm	Completion time and cost of each task	To reduce makespan and cost	Lesser waiting time and cost	Not suitable for dynamic environment
Genetic Algorithm	The task to be scheduled decides the complexity	The best job is selected using a greedy algorithm	Better performance rate less waiting time	Complexity is high
Earliest Feasible Deadline First Algorithm	Based on deadline of the task	Time complexity should be reduced	The total completion time is less	Not suitable in real time systems
PSO Algorithm	Makespan and execution cost	To reduce makespan and improve memory utilization	Simple and less computational cost	Solving problems on scattering and optimisation is difficult
Hybrid Cuckoo Algorithm	Priority and capacity of machines	To increase the resource utilisation	Energy consumption is less	Complexity is high and difficult to implement

Conclusion

Cloud computing is an emerging paradigm now a days. Different scheduling algorithms are being used to allocate the resources to the task efficiently and to balance the load in different virtual machines. So it is necessary to know more about the scheduling algorithms used in cloud environment. Some of the important scheduling algorithms are explained with their advantages and disadvantages. An algorithm should be selected in such a way that it should be cost effective and which provide the user with better makespan and increased throughput.

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