A Review and Analysis of Task Scheduling Algorithms in Different Cloud Computing Environments

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Abstract— Task scheduling plays a key role in cloud computing systems. Scheduling in cloud is responsible for selection of best suitable resources for task execution, by taking some static and dynamic parameters and restrictions of tasks' into consideration. The users' perspective of efficient scheduling may be based on parameters like task completion time or task execution cost etc. In this paper we are performing comparative study of the different algorithms for their suitability, feasibility, adaptability in the context of cloud scenario, parameters, description, advantages etc.
*Keywords— Cloud Computing, Cloud Architecture, Task Scheduling, Optimal Scheduling, Dynamic task execution*

I.   INTRODUCTION:

Cloud Computing is an essential ingredient of advanced computing systems. Computing concepts, technology and architectures have developed and consolidated in the last decades. Many aspects are subject to technological evolution and revolution. Cloud Computing is a computing technology that is rapidly consolidating itself as the next step in the development and deployment of increasing the number of distributed application. To gain the maximum benefit from cloud computing, developers must design mechanisms that optimize the use of architectural and deployment paradigms. The role of Virtual Machine's (VMs) has emerged as an important issue because, through virtualization technology, it makes cloud computing infrastructures to be scalable. Therefore developing on optimal scheduling of virtual machines is an important issue. The cloud computing architecture has three layers, for the software which require on demand services over Internet.
Figure 1 shows cloud architecture.
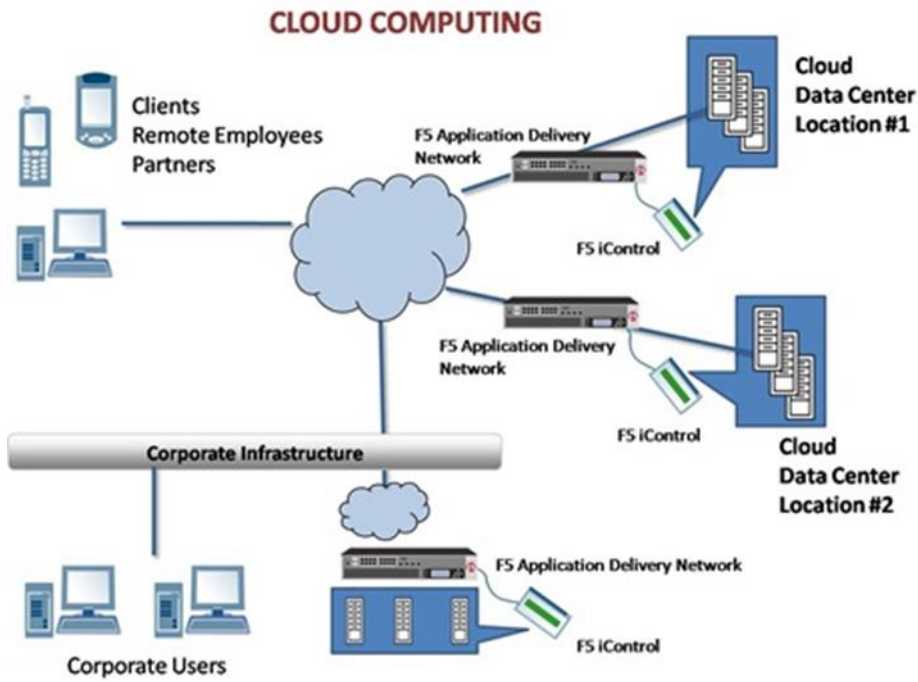
1. Infrastructure as a Service (IaaS): This layer delivers hardware components (like server and storage) and software as services.

2. Platform as a Service (PaaS): Cloud application developers are the users of this layer. Automatic scaling, load balancing and integration with other services (e.g. email services) are the major benefits to cloud application developer.

3. Software as a Service (SaaS): This layer hosts the software and provide to the customer through Internet. It reduces the purchase and maintenance cost of the customer. The main Purpose is to schedule tasks to the Virtual Machines (VMs) in accordance with adaptable time, which involves finding out a proper sequence in which tasks can be executed under transaction logic constraints. The job scheduling of cloud computing is a challenge. To take up this challenge we review the number of efficiently job scheduling algorithms. It aims at an optimal job scheduling by assigning end user task. The rest of the paper is organized as follows. In next section Literature Survey about different scheduling algorithms of Virtual machine in cloud are discussed.
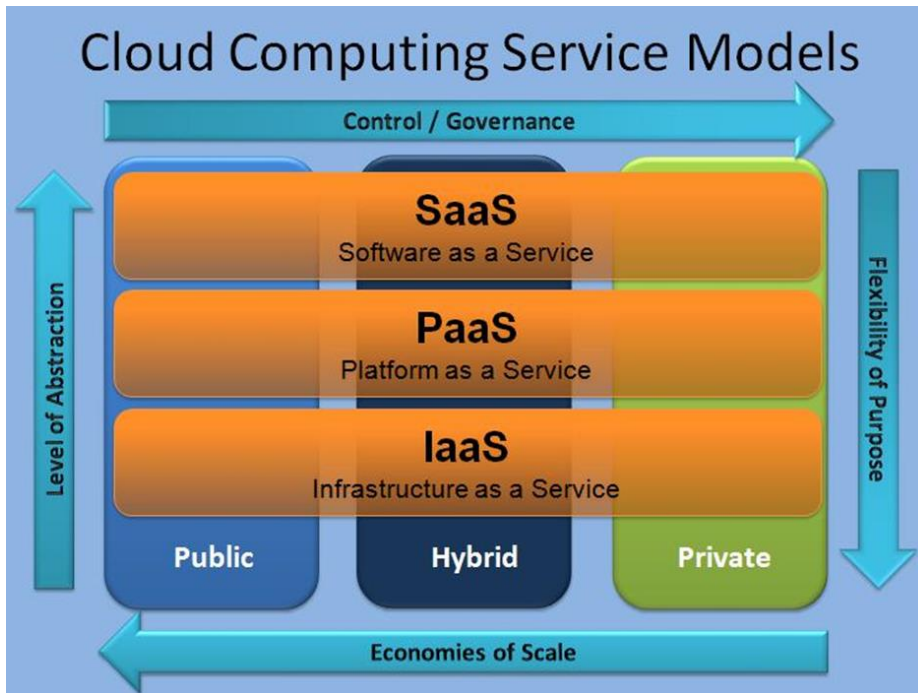

Figure: Cloud computing service models

II.   SCHEDULING:

There has been various types of scheduling algorithm exist in distributed computing system. Most of them can be applied in the cloud environment with suitable verifications. The main advantage of job scheduling algorithm is to achieve a high performance computing and the best system throughput. Traditional job scheduling algorithms are not able to provide scheduling in the cloud environments. According to a simple classification, job scheduling algorithms in cloud computing can be categorized into two main groups; Batch mode heuristic scheduling algorithms (BMHA) and online mode heuristic algorithms. In BMHA, Jobs are queued and collected into a set when they arrive in the system. The scheduling algorithm will start after a fixed period of time. The main examples of BMHA based algorithms are; First Come First Served scheduling algorithm (FCFS), Round Robin scheduling algorithm (RR), Min–Min algorithm and Max–Min algorithm. By On-line mode heuristic scheduling algorithm, Jobs are scheduled when they arrive in the system. Since the cloud environment is a heterogeneous system and the speed of each processor varies quickly, the on-line mode heuristic scheduling algorithms are more appropriate for a cloud environment. Most fit task scheduling algorithm (MFTF) is suitable example of On-line mode heuristic scheduling algorithm.

a. First Come First Serve Algorithm:

Job in the queue which come first is served. This algorithm is simple and fast.

b. Round Robin algorithm:

In the round robin scheduling, processes are dispatched in a FIFO manner but are given a limited amount of CPU time called a time-slice or a quantum. If a process does not complete before its CPU-time expires, the CPU is pre-empted and given to the next process waiting in a queue. The preempted process is then placed at the back of the ready list

c. Min–Min algorithm:

This algorithm chooses small tasks to be executed firstly, which in turn large task delays for long time.

d. Max – Min algorithm:

This algorithm chooses large tasks to be executed firstly, which in turn small task delays for long time.

e. Most fit task scheduling algorithm:

In this algorithm task which fit best in queue are executed first. This algorithm has high failure ratio.

f. Priority scheduling algorithm:

The basic idea is straightforward: each process is assigned a priority, and priority is allowed to run. Equal-Priority processes are scheduled in FCFS order. The shortest-Job-First (SJF) algorithm is a special case of general priority scheduling algorithm. An SJF algorithm is simply a priority algorithm where the priority is the inverse of the (predicted) next CPU burst. That is, the longer the CPU burst, the lower the priority and vice versa. Priority can be defined either internally or externally. Internally defined priorities use some measurable quantities or qualities to compute priority of a process.

2.1 Scheduling Process

Scheduling process in cloud can be generalized into three stages namely–
Resource discovering and filtering – Datacenter 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.
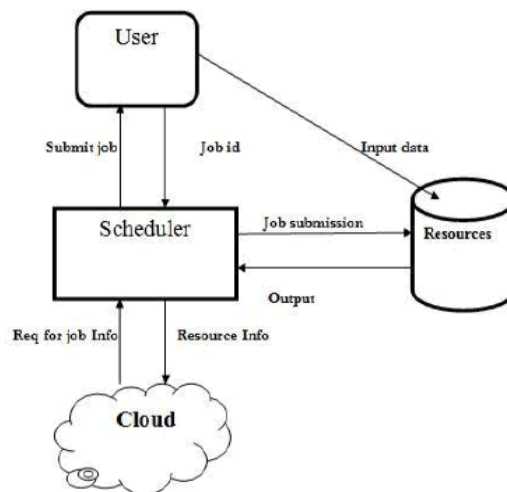Task submission -Task is submitted to resource selected.

Figure 1 Scheduling in Cloud

III.   EXISTING SCHEDULING ALGORITHM:

I.   Kousik Dasgupta, Brototi Mandal, Paramartha Dutta, Jyotsna Kumar Mondal, Santanu Dam proposed new A Genetic Algorithm (GA) based Load Balancing Strategy for Cloud Computing [2], Load balancing which one of the main challenges in Cloud is computing, distributes the dynamic workload across multiple nodes to ensure that no single resource is either overwhelmed or underutilized. This can be considered as an optimization problem and a good load balancer should adapt its strategy to the changing environment and the types of tasks. This paper proposes a novel load balancing strategy using Genetic Algorithm (GA). The algorithm thrives to balance the load of the cloud infrastructure while trying minimizing the make span of a given tasks set. The proposed load balancing strategy has been simulated using the Cloud Analyst simulator. Simulation results for a typical sample application shows that the proposed algorithm outperformed the existing approaches like First Come First Serve (FCFS), Round Robing (RR) and a local search algorithm Stochastic Hill Climbing (SHC).

II.   Monika Choudhary, Sateesh Kumar Peddoju proposed A Dynamic Optimization Algorithm for Task Scheduling in Cloud Environment [3], Cloud computing is a style of computing where massively scalable resources are delivered as a service to external customers using Internet technologies. This paper proposes a scheduling algorithm which addresses these major challenges of task scheduling in cloud. The incoming tasks are grouped on the basis of task requirement like minimum execution time or minimum cost and prioritized. Resource selection is done on the basis of task constraints using a greedy approach. The proposed model is implemented and tested on simulation toolkit. Results validate the correctness of the framework and show a significant improvement over sequential scheduling.

III.   Ji Lia;b, Longhua Fenga;b, Shenglong Fan are proposed An Greedy-Based Job Scheduling Algorithm in Cloud Computing[4], In this paper we have proposed Greedy-Based Algorithm in cloud computing. In order to prove our opinions we will process this artical as the following steps. First of all, we will classify tasks based on QoS. Then, according to the tasks categories,we will select the appropriate branch of the function and compute the justice evaluation. This will also reflects the greedy algorithm to select local optimum. Compare to other methods, it can decrease the completion time of submitted jobs and increases the user satisfaction.

IV.   Stuti Dav Prashant Maheta proposed this algorithem Utilizing Round Robin Concept for Load Balancing Algorithm at Virtual Machine Level in Cloud Environment Day by Day increasing traffic on internet introduces the requirement of load balancing concept to get the most utilization of the resources available on Cloud. There are so many complex calculations and concepts implemented to achieve better and better resource utilization and performance. Out of all this complexity the Rounrobin algorithm provide the simplest solution for load balancing in cloud environment. So we are going to use roun robin as a base algorithm and propose an improved version of load balancing algorithm in the paper.

V.   Lizheng Guo Shuguang Zhao, Shigen Shen, Changyuan Jiang, proposed this Task Scheduling Optimization in Cloud Computing Based on Heuristic AlgorithmIn this paper in order to minimize the cost of the processing we formulate a model for task scheduling and propose a particle swarm optimization (PSO) algorithm which is based on small position value rule. By virtue of comparing PSO algorithm with the PSO algorithm embedded in crossover and mutation and in the local research, the experiment results show the PSO algorithm not only converges faster but also runs faster than the other two algorithms in a large scale. The experiment results prove that the PSO algorithm is more suitable to cloud computing.

VI.   Jia Yu, Rajkumar Buyya & Chen Khong Tham In this paper, "a cost-based workflow scheduling algorithm" is proposed [7] that minimizes execution cost while meeting the deadline for delivering results.

The related work done in task scheduling in cloud compuing is shown below in tabular form

s.no.	Algorithms	Complexity	Description	Parameter	Environment
1	An Optimal Model for Priority based Service Scheduling Policy for Cloud Computing Environment	Simplest Scheduling Algorithm	An array of workflow **instances** High QoS High throughput Batch Mode	Quality of Service, Service request time	Cloud environment
2	A Priority based Job Scheduling Algorithm in Cloud Computing	Difficult to understand and code	Grouped Task Batch Mode It is used for efficient load balancing. Petrin net is used to remove limitation of maxmin algorithm.	Priority to each queue	Cloud environment
3	An Optimistic Differentiated Job Scheduling System for Cloud Computing	Difficult to understand	Dependency mode Quality of service, Maximum profit Single Job with multiple user The Qos requirements of the cloud computing user and the maximum profits of the cloud computing service provider are achieved.	Quality of service, Maximum profit	Cloud environment
4	Improved Cost-Based Algorithm for Task Scheduling	Performance Heavily depends upon the size of time quantum	Batch mode Unscheduled task group .Measures both resource cost and computation performance Improves the computation /communication ratio	Cost, Performance	Cloud environment
5	An Optimistic Differentiated Job Scheduling System for Cloud Computing	Complexity depends on the task to scheduled	Dependency mode Single Job with multiple user The Qos requirements of the cloud computing user and the maximum profits of the cloud computing service provider are achieved.	Quality of service, Maximum profit	Cloud environment
6	Resource-Aware-Scheduling algorithm (RASA**)**	Simplest Scheduling Algorithm	Batch Mode Grouped task It is used to reduce make span	Make Span	Grid environment

IV.   CONCLUSION:

Task scheduling is one of the most famous problems in cloud computing so; there is always a chance of modification of previously completed work in this particular field. In this paper various scheduling algorithms new namely A Genetic Algorithm (GA) based Load Balancing Strategy for Cloud Computing, A Dynamic Optimization Algorithm for Task Scheduling in Cloud Environment, An Greedy-Based Job Scheduling Algorithm in Cloud Computing etc.. have been studied and analysed.

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