

## TASK SCHEDULING ALGORITHMS IN CLOUD COMPUTING: A REVIEW

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**Abstract** - Cloud computing is a rising technology in distributed computing which facilitate pay per model as per user command and requirement. Cloud consists of a set of virtual machine which includes both computational and storage facility. Now a days, cloud computing technology is used all over. Cloud provides many facilities due to its vast area such that sharing of resources for different purposes. The primary aim of cloud computing is to give most suitable access to remote scattered resources. Cloud is developing day by day and faces many challenges, one of them is scheduling. In this context, Scheduling becomes a necessary factor to discuss. Scheduling points to a set of rules to control the order of work to be fulfilled by a system. A good scheduler fit its scheduling policy according to the varying situation and the type of task. To efficiently increase the working of cloud computing environments, task scheduling is one the main Task performed in order to get highest profit. This paper gives a comprehensive survey on such problems and provide a detailed analysis of some best scheduling techniques from the domain of soft computing with their performance in cloud computing.

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**Keywords** - Cloud computing, Task Scheduling Algorithms, Heuristic Techniques.

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### I. INTRODUCTION

Cloud computing is an emerging field of computing where a set of resources (i.e. hardware and software resources) are accessible as a service to the user but not as a product. The best part about this computing paradigm is, user need not to be worried about the physical resource locations and number of available instances of any resources. Cloud computing is a large-scale distributed computing model, which depends on the economic size of the operator of cloud that is abstract, virtualized and dynamic. The main objective of the cloud computing is to manage computing power, storage, various type of platforms and services which assigned to the external users by the demand through the internet. Cloud computing is a rapidly emerging computation model with a goal of freeing up users of cloud from the management of hardware, software, networks and data resources and assigning these works to cloud service providers[1]. Cloud provides the different type of methods for managing the resources such that users of cloud can access them without facing any kind of performance related problems. Cloud Computing Services are divided into three classes, basing on the abstraction level and the service model of providers as **XAAS** where **X** is Infrastructure, Platform and software. It can be **Software as a Service (SAAS)** model that offers software on a single platform. SAAS provides the user to run the applications which can be accessed through standard interfaces like web browsers and

email clients on cloud infrastructure. It can be **Platform as a Service (PAAS)** model which offers a platform from where the software and data can be accessed by the user. PaaS provides customers with the capability to deploy and develop the applications based on tools and programming languages supported by the providers. It can be **Infrastructure as a Service (IAAS)** model which provides the safety and backup services. In IAAS the provider provides the virtual interface where the computing resources like processing units and storage unit etc., are provided to setup the deployment environment for their software system [2]. One of the main feature of cloud is Virtualization. In the virtualization technology complexity of underlying hardware or software are hidden.

### II. OVERVIEW OF TASK SCHEDULING

The most important activity that performed within the cloud computing environment is Task Scheduling. Scheduling is one of the methods that is performed to improve the efficiency of the task load of cloud computing. The main purpose of the scheduling algorithms in cloud environment is to utilize the resources properly [1].

#### 2.1 Scheduling Types

In general, there are two types of task scheduling. They are Static Scheduling and Dynamic Scheduling  
**Static scheduling:** In static scheduling, tasks arrives simultaneously at the processor. The tasks are

submitted to the available resources. Scheduling decisions are taken before tasks are submitted i.e., the information of the complete structure of tasks and mapping of resources before execution is already known, estimates of task execution/running time.

**Dynamic scheduling:** In dynamic scheduling, the resource allocation is not fixed, moreover the arrival time of the tasks is also not known. It depends on both the submitted tasks to cloud environment and the current states of system, computer machines to make scheduling decision. It is further divided into two types: batch mode and online mode. In batch mode, the tasks are queued into a set and scheduled to the resources after fixed period of time whereas in online mode the tasks are scheduled when they arrive in the system [3].

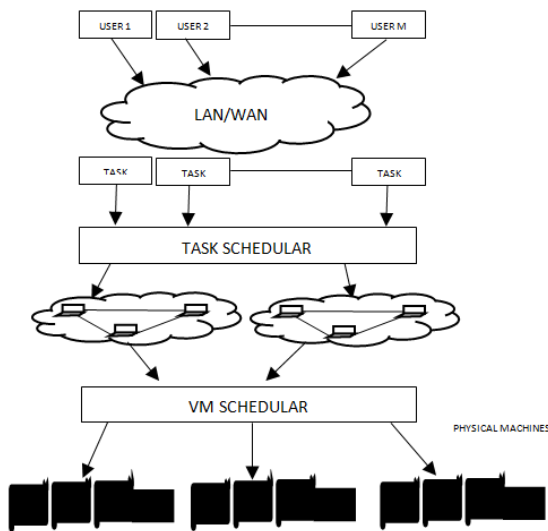


FIG-1: GENERAL VIEW OF TASK SCHEDULING

### III. STUDY OF BASIC SCHEDULING ALGORITHM

Some of the Task Scheduling Algorithms are given below

- **First Come First Serve Scheduling Algorithm (FCFS)** [4]- Also known as First in First out. It is one of the simplest and best Scheduling algorithms. We have to allocate the Central Processing Unit (CPU) in the order in which the process arrive. It is assumed that the ready queue is managed as first in first out process which implies that the first task is going to be processed first with no other preferences. Thus, the “FCFS” presents a weakness on tasks and resources allocation scheduling, because if a task with more processing time takes on the lead of the queue list, then all the other tasks with even less processing time will have to wait till the execution of the task with more processing time is done.
- **Shortest Job First Scheduling Algorithm (SJF)**[5]- It is a scheduling technique that selects

the task with the smallest execution time first. The tasks are queued with the smallest execution time placed first, given the high priority and the task with the longest execution time placed last and given the least priority. This Scheduling algorithm is deal with different approach in this algorithm. CPU is allocated to the process with least burst time first.

- **Round - Robin Scheduling Algorithm (RR)** [6] - It is one amongst the simplest and broadly used scheduling algorithms. A new perception of scheduling, the concurrent execution of tasks that did not exist for the “FCFS” algorithm is introduced [4]. A small unit of time, called time slice is defined here. All runnable processes are reserved in a circular queue. The processor scheduler goes around this queue, allocating the CPU to each process for a time interval of one quantum. New processes are added at the end of the queue. The processor scheduler picks the first process from the queue, sets a timer to interrupt after one quantum, and dispatches the process. If the process is still running at the end of the quantum, the CPU is preempted and the process is added at the end of the queue. If the process finishes before the end of the quantum, the process itself releases the CPU.
- **Priority Scheduling Algorithm** [7] - This algorithm is preemptive in which all things are based on the priority. Each process in the system is based on the priority whereas highest priority Task can run first whereas lower priority Task can be made to wait. The biggest problem of this algorithm is starvation of a process.
- **Genetic Algorithm (GA)**[8] - Genetic algorithm is a problem solving method that uses genetics as its model of problem solving. It is a search system to find optimized solution. Each solution is represented through a chromosome. Genetic algorithm is a method of scheduling in which the tasks are assigned resources according to individual solutions, which tells about which resource is to be assigned to which task. In Genetic Algorithm the initial population is generated randomly. Genetic algorithm is a random searching method.

#### Basic Steps in Genetic Algorithm

1. A population with randomly generated individuals (chromosome) is taken.
2. The fitness function for each and every individual is calculated.
3. Two chromosomes selected, as parents which has best fitness value.
4. Crossover between the parents is applied with probability and crossover rate.
5. Mutation is applied with probability and mutation rate.

6. Repeat Step 3- Step 6, until enough members are generated.

Step 3 is repeated, till stopping criteria is met.

- **Ant Colony Optimization**[9] -Ants basically are simple being, they jointly forms an ant colony which perform important tasks including shortest path traversal to find food source and information sharing with other ants by generating pheromone. In the field of ant colony optimization, models of collective intelligence of ants are transformed into useful optimization techniques that finding uses in computer networking. The problem-solving hypothesis of Ant colony optimization is compared to traditional routing algorithms along with the issues of routing information, routing overhead and adaptively.

#### Basic Steps in Ant Colony Optimization

1. First Pheromone Initialization.
2. Location of the ant is initialized as an entry state.
3. Next state will be selected.
4. Check if the next state is final state or not if it not then repeat from state 3, if yes the do state 5.
5. Pheromone updating step (deposit, daemon and evaporate of pheromone).
6. If stopping criteria is satisfied than stop the execution, else repeat from step 2

- **Cost-Based Algorithm** [10] – The cost of each task differs contingent upon user task schedule. Scheduling of user tasks in the cloud environment is not the same as in the traditional scheduling methods. This algorithm measures both “computation performance for scheduling, and improves the computation/communication ratio by grouping the user tasks according to a particular cloud resources processing capability and sends the grouped tasks to the resource” and “resource cost”. This scheduling strategy focuses on grouping independent tasks with small processing requirements, into suitable tasks with larger processing requirements and schedules them in accordance with in-deterministic network conditions. For the more number of simple tasks this increases the cost and the cost is decreased if we have less number of complex tasks. Tasks are sorted according to their priority i.e., three levels of priority namely high priority, medium priority and low priority. For the computation of tasks, the system can select the tasks from the high priority list first, then medium priority and then low priority. In this paper, the suggested algorithm is applied to group the above lists in order to allocate the task-groups to different available resources. The Improved Activity Based Costing method selects a set of resources to be used for computing. It groups the tasks based on the processing capabilities of the available resources. The gritty tasks are processed in the selected resources, so

that the Computation- Communication ratio is reduced.

#### IV. VARIOUS IMPROVED TASK SCHEDULING ALGORITHMS

Following are the scheduling algorithms that are presently used in cloud. The objective of these scheduling algorithms are proper use of resources.

- **Multi Level Feedback Queue (MLFQ)** [11] - This scheduling method use M/M/C queues for grid computing. The design of MLFQ is divided into multiple prioritized queues. This approach provides resources to gridlets that starve within the lower priority queue for long time to get resources. As a result, the response time of the starved gridlets decreases and overall turnaround time of the scheduling process decreases. Comparison of FCFS and machines used via MLFQ are more than FCFS.
- **Preemptable Shortest Job First Scheduling Algorithm** [12] - This algorithm was projected in a private cloud. It is the combination of Round-Robin algorithm with Shortest Process Next (PSN). This algorithm improve the response time and execution time. This algorithm also produce cost benefits.
- **Shortest Task Scheduling Algorithm** [13] - This algorithm was proposed in a public cloud environment. In this algorithm the allocation of resources on dissimilar clouds under overload conditions. This algorithm also includes the allocation of resources on dissimilar clouds under underload conditions as well.
- **Optimized Activity based Costing Algorithm** [14] - Activity-based costing is a method for measuring both the cost of the items and the exhibitions of exercises and it can gauge the cost more precise than traditional ones in cloud computing. The main goal of this optimized algorithm is to have more profit as compare to the traditional methods.
- **Min-Min scheduling Algorithm** [15] - This algorithm was done on the basis of Min-Min algorithm. Min-Min algorithm starts with a set of all unmapped tasks. The machine that has the minimum completion time for all jobs were selected. Then the jobs with the overall minimum completion time were selected and mapped to that resource. An improved load balanced algorithm was introduced. Min-Min algorithm considers all which are not assigned tasks in each task mapping, Min-min algorithm will execute until the whole tasks set is empty. Min-min will

execute short tasks in parallel and the long tasks will follow the short tasks. Min-min can cause both the whole batch tasks executed time get longer and unbalanced load. Even long tasks cannot be executed. The main goal of this algorithm is to maximize the use of resource and minimize the makespan.

- **Ant colony Optimization (ACO) based modified pheromone rule algorithm** [16] – Properties of Ant Colony System have been utilized to conquer the issues looked by conventional ACO algorithm. There are three primary modifications in this algorithm. Firstly, pseudorandom proportional rule is used to select the next node an ant should travel which is used in Ant Colony System.
- Second, in order to expel the stagnation conduct of the algorithm and to expand its investigation for the arcs that have not been visited yet, a local pheromone update is done. Third, the best visit found from the beginning of the execution of algorithm is provided with extra pheromone deposition in order to expand its convergence speed. But this algorithm was found to be working in the grid environment.
- **Improved Cost Based Algorithm**[17] - This algorithm improves the traditional cost-based scheduling algorithm for making appropriate mapping of tasks to resources. This algorithm groups the tasks according to the processing capabilities of available resources.
- **Workflow Scheduling Algorithms in Cloud Computing** [18] - Gives a review of different types of workflow scheduling algorithm in cloud computing and compares different types of workflow scheduling algorithms. There working with respect to the resource sharing. Workflow is defined as the automation of a business process, in whole or in part, during which documents, information or tasks are passed from one participant to another for action, according to a

set of procedural rules. When talk about cloud, the major advantage of cloud is its application scalability or elasticity. This elastic nature of cloud facilitates changes of resource and characteristics at run time. They methodize the scheduling problem in cloud computing and present a cloud scheduling hierarchy, mainly rendering into user-level and system-level.

## V. COMPARISON OF ALGORITHMS

The number of the scheduling algorithms and comparison between them on the basis of allocation, waiting time [17]and advantages. Resource Allocation defines how the tasks are assigned to the resources. Waiting Time defines how much time the processor need to be in waiting state for processing a task. Advantages defines the advantage of the algorithm in the cloud computing environment. The First Come First Serve algorithm is a simplest algorithm for scheduling but waiting time to process the tasks is much more in this. Whereas the waiting time in Shortest Job First algorithm less than FCFS. Priority algorithm is difficult to understand because how priority can be assigned to the task is difficult. Here waiting time is less because task with higher priority processed first. In Round-Robin algorithm waiting time is more than all because after a fixed time interval the next task will execute. So problem faced when one task is very heavy and other one is with very simple and small calculations. Genetic algorithm is a bio inspired artificial intelligent scheme and its complexity depends on the task. The best selected task executes first so waiting time is less here. In Ant Colony Optimization Algorithm, the more time it takes for an ant to travel down the path and back again, the more time the pheromones have to evaporate. The shortest path is selected which, gets marched over more frequently, and thus the pheromone density becomes higher on shorter paths than longer ones [9].

### 5.1TABLE OF COMPARISON

Algorithm Name	Parameters Considered	Resource Allocation	Waiting time	Advantages
First Come First Serve(FCFS) [4]	Arrival time	CPU is allocated in the order in which the process arrive	More	Simple in implementation
Shortest Job First(SJF) [5]	CPU Burst time	CPU is allocated to the process with least CPU burst time	Less than FCFS	More tasks can be executed in less amount of time
RR algorithm [6]	Size of time quantum	The preemption take place after a fixed interval of time	More than all	Less complexity and load is balanced more fairly

Priority algorithm [7]	Priority order of the tasks	Based on priority, the higher priority task can run first	Less	Priority is considered for Scheduling. Designed based on multiple criteria Decision making model.
Genetic algorithm[8]	Chromosome	There is a greedy algorithm and pick the best task to allocate the CPU	Less	Better performance and efficiency in terms of Makespan
Ant Colony Optimization [9]	Time and cost	Improve the efficiency and reliability in all conditions	More	Fault tolerance and load balancing
Cost based algorithm[10]	Task grouping and cost	Minimizing the cost and completion time	Less	Resource cost and computation performance is considered before scheduling
Optimized algorithm	Priority, Cost and profit	Measure the cost and performance more accurately	More	Better resource utilization
Preemptable Shortest Job Next (PSJN)	Time and cost	Effective and Fast execution	Less	Execution is fast and cost optimized
Min-Min Algorithm[19]	Makespan	Promised the guarantee regarded the provided resource	Less	Better Makespan compared to other algorithm

## CONCLUSION

In this paper, we discuss the different types of scheduling algorithms and also compared with each other. Scheduling is one of the foremost vital tasks in cloud computing atmosphere. This paper we have analyzed varieties of programming algorithmic rules and tabulated varied parameter. Most Suitable technique for scheduling is the heuristic techniques like ANT Colony Optimization, Genetic Algorithm. FCFS algorithm has some disadvantages like processing time of each task must be known in advance and it is suitable only for batch process. The key drawback of this scheme is that the average time is often quite more. In SJF long tasks may wait longer because it has to wait not only for tasks that are in the system at the time of its arrival, but also for all short tasks that are in the system at the time of its arrival. In Priority Algorithm only higher priority tasks get chance to execute. In Round-Robin scheduling, like other first - come, first - served methods, and doesn't give special priority to more important tasks. This

shows that heuristic techniques are most suitable for task scheduling in cloud environment and also there is a need to propose a new scheme which achieves all the objectives and as well as provide better performance. So, our future work will use cloud computing algorithm based on queuing model to reduce the time of routing end users request and decrease the waiting time.

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