A Survey On Various Types Of Task Scheduling Algorithm In Cloud Computing Environment

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Abstract: Now a days, Cloud computing has become an significant and most popular computing model that usually supports on demand services. Cloud Computing provides its services on pay-as-you-go basis .By using cloud computing resources expeditiously and by reducing in managing time and cost and increasing the outcome of the project is the main idea of cloud service provider. Therefore, using effective cloud scheduling algorithms is still main concern in cloud computing. Task scheduling is a pivotal part in the field of the cloud environment. In task scheduling user requests for certain task, then tasks are scheduled to certain resources at a specific exemplification of time. Basically task scheduling mainly focuses to diminish the make span and lengthen the resource utilization. Task scheduling is an Non Polynomial-Complete problem. There are lots of subsisting trail-and-error techniques for task scheduling till now but more amelioration and rectification is needed for better execution and to increase the efficiency of task scheduling till now, there is no combined study of task scheduling mechanism in cloud computing which describes its parameter, pros, cons, algorithm. This paper mainly emphasis on explaining Comparison on different Task scheduling algorithm in cloud computing adaptive

1. INTRODUCTION

In the simplest term, Cloud computing means to storing and accessing data and programs over the Internet instead of your computer's hard drive. It is just an image for the Internet. The term network or Internet are also refers a cloud. In other words, we can say Cloud is something, which is present at remote location. Cloud can provide services over various types of network, i.e., on public networks or on private networks, i.e., Wide Area Network , Local Area Network or Virtual Private Network. There are various types of Applications run in cloud and they are-

- e-mail
- web conferencing
- customer relationship management (CRM)
- Online File storage
- Photo editing software
- Digital video software
- Twitter-related applications
- Creating image-album
- Web application for antivirus
- Word processing application
- Spreadsheets
- Presentation software
- Finding a way on the map
- E-commerce software.
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The term Cloud Computing refers to manipulating, configuring, and accessing the applications online. The location of physical resources and devices being accessed are typically not known to the end user.

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Cloud also provides facilities for users to develop, deploy and manage their applications 'on the cloud', which give rise to virtualization of resources that maintains and manages itself. In general, there are three cloud computing characteristics that are common among all cloud-computing venders:

1. The back end of the application (especially hardware) is completely managed by a cloud vendor.
2. A user only pays for services they used i.e. (.memory, processing time and bandwidth, etc).
3. Services are scalable

2. CLOUD MODELS

In cloud models there are certain kinds of services and models which is functioning behind the scene making the cloud computing feasible and accessible to end users. There are two types of the working models for cloud computing:

- Deployment Model
- Service Models

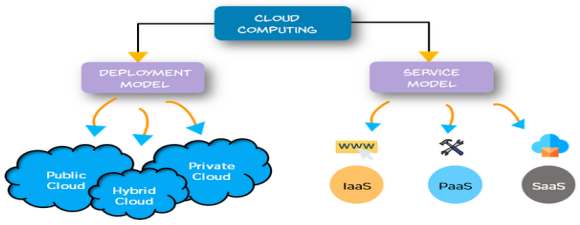

Figure.1 *Cloud Models*

DEPLOYMENT MODELS

A cloud deployment model is a "configuration" of certain cloud environment parameter such as storage size, accessibility and proprietorship. Cloud deployment model can have four types of access i.e : Public, Private, Hybrid and Community.

- **PUBLIC CLOUD –**The name speaks for itself , as the public clouds are available to the general public data are creatsed and stored on third-party servers. In other words, Public Cloud allows systems and services to be easily accessible to the general public. Examples of Public cloud deployment models are-Amazon Elastic

Compute, Google AppEngine, IBM's Blue etc.

- **PRIVATE CLOUD –**There is very less difference between public and private cloud from the technical point of view, as there designs are very similar. The Private Cloud allows systems and services to be accessible within an organization. Due to this kind of private nature it offers more security than public cloud. Examples are-Amazon, IBM, Dell, Cisco and Red Hat.

- **COMMUNITY CLOUD** -A Community Cloud deployment model feature a private one to a large extent. In other words it allows systems and services to be accessible by group of organizations.

- **HYBRID CLOUD –** The Hybrid Cloud envelop the best feature of the above mentioned cloud computing deployment model. The Hybrid Cloud is mixture of public and private cloud. However, The critical activities are performed using private cloud while the non-critical activities are performed using public cloud.

SERVICE MODELS

Service Models are the reference models on which the Cloud Computing is based. The service model can be categorized into three basic service models listed below-

1. Infrastructure as a Service (IaaS)
2. Platform as a Service (PaaS)
3. Software as a Service (SaaS)

There are many other service models all of which can take the form like XaaS, i.e.

- Anything as a Service. This can be
  - Network as a Service
  - Business as a Service
  - Identity as a Service
  - Database as a Service
  - Strategy as a Service.

INFRASTRUCTURE AS A SERVICE (IaaS) - Infrastructure as a Service provides access to fundamental resources such as physical machines, virtual machines, virtual storage, etc.

PLATFORM AS A SERVICE (PaaS) – PaaS provides the runtime environment for the user the capability to develop and deploy application in the cloud using the development tools, application programming interfaces (API), software libraries and services provided by the cloud service provider.

SOFTWARE AS A SERVICE (SAAS)- SaaS provide the user a complete software applications or user interface to the application itself as a service to end user.

3. SCHEDULING IN CLOUD

Scheduling is the one of the most prominent activities that executes in the cloud computing environment. To gain more positive result in the work load of cloud computing, scheduling is one of the major component to get maximum profit. The main objective of the scheduling algorithms in cloud computing environment is to utilize the resources properly while managing the load between the resources so that to get the minimum execution time

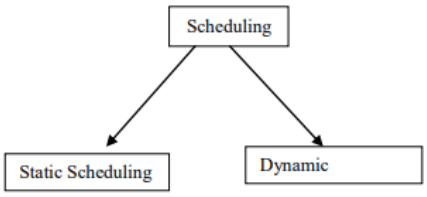

***Figure. 2** Types of Scheduling*

Following are some reasons to use scheduling in cloud computing:

- Fair resource allocation
- Quality of Services (QoS)
- Maximize resource utilization
- Reduce energy Consumption

- **Fair resource allocation-** Fairness is an important aspect in resource sharing. The resource sharing can be possible among different users only when fairness allows them to do so. One of the most popular fair allocation policy is (weighted) max-min fairness, which maximizes the minimum resource allocation obtained by a user in a shared computing system.
- **Quality of Services (QoS)-** One of the major challenges set infront of user by cloud applications is Quality-of-Service (QoS) management, which is the process of allocating resources to the application to insure a service level along dimensions such as performance, availability and reliability.
- **Maximize resource utilization-** Resources lies at the heart of cloud computing. Resource utilization (pooling) is an important topic in the field of computer science, still its an area of hot research . The resource utilization will always be in demand because resources are limited compared to the increasing demand on computers and computing. Resources are meant to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.
- **Reduce energy Consumption-** Energy consumption is not compulsive to hardware efficiency, but it is also dependent on the resource management system deployed on the infrastructure and the efficiency of applications running in the system. Energy efficiency affect customer in terms of resource usage costs, which is specifically determined by the total cost of ownership (TCO) incurred by a resource provider.

The cloud computing is a the riving region and it has been developing as a business reality in term of data innovation area.. There are still various regions that should have been centered around nd they are

- Resource Management- Resource management is a major concern at various computing areas. In cloud computing various cloud consumers demands variety of services as per their dynamically changing needs. So it is the job of cloud computing to avail all the demanded services to the cloud consumers. But due to the availability of finite resource It is very difficult for cloud providers to provide all the demanded services From the cloud providers perspective cloud resources must be

allocated in a fair manner. So, it is a vital issue to meet cloud consumers to provide Quality of Service requirements and satisfaction. Traditional resource management techniques are not adequate for cloud computing as they are based on virtualization technology with distributed nature. Cloud computing introduce new challenges for resource management due to heterogeneity in hardware capabilities, on-demand service model, pay per use model and guarantee to meet Quality of Service.

4 CLASSIFICATION OF SCHEDULING ALGORITHM

The cloud scheduling algorithms [1] are classified into groups as follows:

• Batch Mode Heuristics Algorithm (BMHA)
• On-line Mode Heuristics Algorithm (OMHA)
•Dependency Mode Heuristics Algorithm (DMHA)

In a Batch Mode Heuristic Algorithm when the jobs are arriving in the system, they form a queue and collected into a set. Also, after a particular amount of time the scheduling starts. Example-

- First-Come-First-Serve
- Round Robin
- Shortest Job First scheduling
- Minimum-Minimum
- Maximum-Minimum.
- In an On-line Mode Heuristic Algorithm the jobs are

promptly scheduled when they arrive at the system Example-

- Most-Fit Task Scheduling Algorithm.
- Depending on the previous one, the jobs or

resources are processed in Depending Mode Heuristic Algorithm. Example-

- Genetic Algorithm
- Multi-Objective Genetic Algorithm.

5. TASK SCHEDULING

In cloud computing world, task scheduling is very important topic. It is used to schedule tasks for better utilization of resources by allocating certain tasks to particular resources in particular time. The main focus of task scheduling algorithm is to better the performance, quality of service and also maintaining the productivity among the tasks and reduce the cost. In task scheduling available virtual resources are optimally used. By efficient resource scheduling high achievement of cloud computing. Various parameters that are considered in scheduling algorithms are completion time, task completion cost.

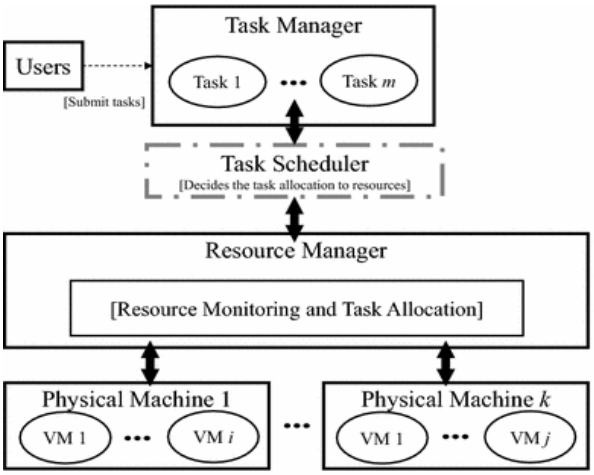

***Figure 3**-Task Scheduler*

6. TYPES OF TASK SCHEDULING

➢ **Cloud Service Scheduling:**

The term Cloud Service scheduling is usually placed on user and system level [2]. The service provision is done at user level scheduling and obstacles are raised between the providers and customers. The managing of resources with data center involves the system level scheduling. Several physical machines stay connected are said to be data center. The user sends millions of tasks and the tasks are appoint to the physical machines in the data center.

➢ **User-Level Scheduling:**

the market based and action based schedulers are useful for regulating the supply and demand of cloud resources. Market based schedulers is a scheduler where the resources are virtualized and delivered to the user as a service. Service Level Agreement (SLA) includes service provisioning in the cloud, where the SLA indicates the contract to be signed among the providers and customers stating the agreement, including counterproductive requirements specified by Quality-of-service (QoS), obligation and in penalties [3]. The SLA is used by novel cloud scheduling [4] having trust monitor to provide the scheduling faster with immune processing because of over flooding user demand. This innovative approach is considered by two variants of heuristics [5] and they are stimulated Annealing and GI-FIFO scheduling.

➢ **Static and Dynamic Scheduling:**

In static scheduling the required input are perfected and the task execution at various stages are pipelined. And in dynamic scheduling where the task or job components are not known beforehand and whereas the task execution time may not be known. The scheduling strategies in three tier cloud structure based on service request are

• Resource Providers
• Service Providers
• Consumers

A tremendous amount of energy is wasted by the large number of cloud computing servers and it emits a carbon dioxide, therefore the green task scheduling [6] [7] is

needed to lower the power usage and to reduce the pollution.

➢ **Heuristic Scheduling:**

The Non Polynomial hard problems are solved by enumeration, analytical and approximation approach. If all possible solutions are calculated and correlated in succession, then the optimal solution is selected in an enumeration method. In case of large instances, where an enumeration is not feasible the heuristic handles the instances of finding the best solutions and reasonably fast. To optimize the solution, the approximate solutions are found in case of approximation algorithms. The makespan of the given task is minimized while balancing the entire system load according to the load balancing task schedule [8]. The definite execution time of a large number of tasks is known by the batch-heuristics. Also the heuristics MaxMin [9], Min-Min [10] are used by the batch mode scheduling.

➢ **Real Time Scheduling:**

The real time scheduling involves some objectives and they are used to increase the throughput instead of meeting deadlines, also the average response time will be minimized. The real time tasks should be scheduled non-presumptively to maximize the total utility [11]. There are two different utility functions associated at the same time for every task-

- Profit Time Utility Function
- Penalty Time Utility Function

➢ **Workflow Scheduling:**

In a Workflow scheduling where the applications are structured in the form of Directed Acyclic Graphs (DAG) [12]. Here the edges denote the task dependencies [13] and the nodes represent the constituent task. A single workflow has some set of task where each task is communicating with another task in the workflow manner. Workflow scheduling is one of the major issues in workflow execution management.

7 LATEST TASK SCHEDULING TECHNIQUES IN CLOUD ENVIRONMENT

➢ **Genetic-Based Task scheduling Algorithm**

Genetic Algorithm (GA) is based on the biological concept of generating the population. GA is reputed as a rapidly growing area of Artificial Intelligence [14] [15]. By Darwin's theory of evolution inspired the Genetic Algorithms (GAs). According to Darwin's theory, term “Survival of the fittest” is used as the method of scheduling in which the tasks are assigned to resources according to the value of fitness function for each parameter of the task scheduling process [16]. The main principles of the GA are described as follows [14] [15]:

➢ **Initial Population**

The initial population is the set of all individuals that are used in the GA to find out the optimal solution. Every solution in the population is called as an individual. Every individual is represented as a chromosome for making it suitable for the genetic operations. From the initial population, the individuals are selected, and some operations are applied on them to form the next generation. The mating chromosomes are selected based on some specific criteria.

➢ **Fitness Function**

The productivity of any individual depends on the fitness value. It is the measure of the superiority of an individual in the population. The fitness value shows the performance of an individual in the population. Therefore, the individuals survive or die out according to the fitness or function value. Hence, the fitness function is the motivating factor in the GA.

➢ **Selection**

The selection mechanism is used to select an intermediate solution for the upcoming generation to come based on the Darwin's law of survival. This operation act as a directional source for the GA based on the performance. There are so many strategies to select the best chromosomes such as roulette wheel, Boltzmann strategy, tournament selection, and selection based on rank.

➢ **Crossover**

Crossover operation can be accomplished by selecting two parent individuals and then creating a new individual tree by alternating and reforming the parts of those parents. Hybridization operation is a guiding process in the GA and it boosts the searching mechanism

5) Mutation

After crossover, mutation takes place. It is the operator that introduces genetic diversity in the population. This process takes place when the population tends to become homogeneous due to repetitions use of reproduction and crossover operators. It takes places during evolution. According to a user-defined mutation probability, usually set to reasonably low. Mutation modifies one or more gene values in the chromosome from its original state. This can produce the entirely new gene values which can be added to the gene pool. With this new gene values, the genetic algorithm may be able to produce a better solution than the previous one (see Fig. 4) [14].

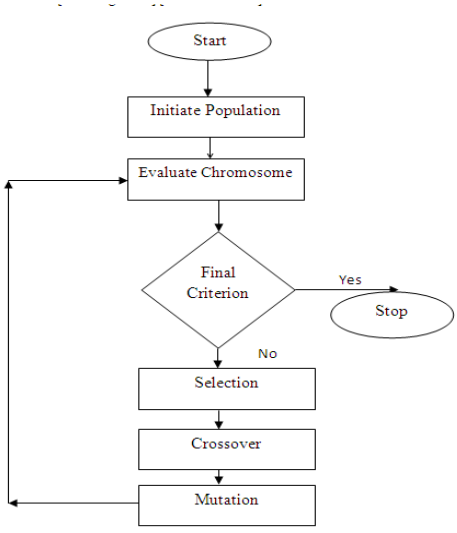

***Figure 4**-Genetic Algorithm*

A. Multi-Objective Task Scheduling Algorithm

Yongkui Liu et al. (2017) presented a model based on multi-task scheduling that integrates workload modeling of the task with several service-related quality. A model is created first and then the examination of different work-load effects according to task scheduling procedures such as random scheduling and work-based scheduling is done. Results show that scheduling higher priority workload is preferable for obtaining an efficient performance of the system like minimum make span and high service rate.

B. Various types of Multi-objective Task Scheduling Algorithm-

- A.I .Awad et.al[17] –This survey paper describe the efficient allotment of jobs to available virtual machine for users based on different parameters such as reliability, time, cost and load balancing of virtual machine. Agent used to create dynamic system. The proposed mathematical model multi-objective Load Balancing Mutation particle swarm optimization (MLBMPSO) is used to schedule and allocate tasks to resource.
- VG.Ravindhren.et.al [18]- This survey paper describe that allotment of Resource allocation among multiple clients has to be ensured as per SLAs. In order to accomplish the goals and achieve high performance, it is important to design and develop a Responsive multi-objective load balance Transformation using PSO An Efficient Approach for task Scheduling Based on Multi-Objective Genetic Algorithm in cloud Computing Environment.
- Sourabh Budhiraja et.al [19]- State that the scheduling of the cloud services the consumers by service providers influences the cost benefit of this computing paradigm. In such a scenario, tasks should be scheduled efficiently such that the execution cost and time can be reduced.
- Atul Vikas Lakra et.al [20]- This survey paper describe that the problem is to hold the various tasks together which was received by the broker to the received list of VMs, so that execution time of workload is reduced to minimal optimized time. This kind of problem is also seen with Single objective scheduling algorithms .
- Shubhashree S. R et.al [21]- This survey paper describe the multi-task scheduling algorithm that enhances the data center exeution without creating any damage to SLA.
- Majid Habibi.et.al [22]- This survey paper describe that Since, the tasks scheduling in the cloud computing environment and distributed systems is an Non P-hard problem, in most cases to optimize the scheduling issues, the meta-heuristic methods inspired by nature is used rather than traditional or greedy methods. One of the most powerful meta-heuristic methods of optimization in the complex problems is an Imperialist Competitive Algorithm (ICA).
- Vanita Dandhwani.et.al [23]-This survey paper describe that K-mean clustering algorithm is used to create the clusters for tasks.
- R K Jena.et.al [24]-This survey paper describe the task scheduling using a multi-objective nested Particle Swarm Optimization (TSPSO) to optimize energy and processing time.

C. A Hybrid Particle Swarm Optimization and Hill Climbing algorithm for Task Scheduling-

This algorithm is working in two stages
First, the application and system models are described.
Then, the phases of hybrid PSO-hill climbing are illustrate.

D. Application and system models

In this phase application is fragmented into subtask as shown by G = (V, E).Where V indicates subtasks and E indicates dependencies among the subtasks [21].The relations between the tasks on the directed acyclic graph (DAG) are labeled with communication costs which is shown in Fig 5. Each task must be executed on one resource, and all tasks must be executed.

- . **Hybrid PSO-hill climbing algorithm**

This algorithm start by initializing the population randomly using Particle Swarm Optimization. Then, each particle is calculated and then ranked with makespan by the Heterogeneous Earliest Finish Time (HEFT) processor mapping method [25] using Algorithm 2.After that the hill climbing algorithm is then applied to some selected particles. The proposed algorithm is rerun until the stopping condition is satisfied.

E. Task Scheduling algorithm Based on Ant Colony Optimization

The basic idea of ACO is to simulate the foraging behavior of ant colonies. When an ants group tries to search for the food, they use a special kind of chemical to communicate with each other. That chemical is referred to as pheromone. Initially, ants start search their foods randomly. Once the ants find a path to food source, they leave pheromone on the path. An ant can follow the trails of the other ants to the food source by sensing pheromone on the ground. As this process continues, most of the ants attract to choose the shortest path as there have been a huge amount of pheromones accumulated on this path [26]. The advantages of the algorithm are the use of the positive feedback mechanism, inner parallelism and extensible. The disadvantages are overhead and the stagnation phenomenon, or searching for to a certain extent, all individuals found the same solution exactly, can't further search for the solution space, [26]. Ant Colony Optimization algorithm can only be applied to any combinative problem if certain rules are defined-

1. The problem depiction which allows ants to incrementally build/ adapt solutions.
2. The heuristic significance η of edges.
3. A coercion contentment method which forces the construction of feasible solutions.
4. A pheromone updating rule which specifies how to modify pheromone trail τ on the edges of the graph.
5. A probabilistic transition rule of the heuristic valuation and of pheromone trail [27].

F. Symbiotic Organism Search Optimization Based Task Scheduling

Symbiotic Organism Search (SOS) algorithm is a novel population based meta examining algorithm .It was presented info for solving scientific optimization problem on

a steady real space, Symbiotic Organism Search mime the symbiotic association (mutualism, commensalism, parasitism) among distant species in an environs. Mutualism simply means the relationships between different species where both individuals benefits from the association. Colonialism is the federation between two distant species profit and the other one is not injured. Each n every member with in ecosystem is illustrated by a vector in plane solution.
This algorithm frequently uses a population of the feasible solutions to coverage to an best position where the global ideal solution lies.

TABLE 1 . *COMAPARTIVE ANALYSIS*

Author Name	*Parameter*	*Algorithm Used*	*Result*
Safwat A. Hamad [14]	▪ *Cost* ▪ *reliability* ▪ *Size*	*Task Scheduling-Genetic*	▪ *Less time for completion, cost reduction* ▪ *maximize throughput*
A.I.Awad, N.A.El-Hefnawy and H.M.Abdel_kader [17].	▪ *time,* ▪ *cost* ▪ *reliability* ▪ *load balancing of virtual machine(VM).*	*multi-objective Load Balancing Mutation particle swarm optimization (MLBMPSO)*	▪ *minimization of makespan* ▪ *Improved Execution time*
VG.Ravindhren and Dr. S. Ravimaran [18].	▪ *job size*	*Particle Swarm Optimization*	▪ *Increase the throughput.* ▪ *reducuction in waiting time.* ▪ *minimization in missed process* ▪ *balancing of load among the physical machines in a Data centre.*
Sourabh Budhiraja, Dr. Dheerendra Singh [19].	▪ *Cost* ▪ *and size*	*Multi- Objective Genetic Algorithm (MOGA).*	*Algorithm (MOGA) diminish execution cost and execution time.*
Atul Vikas Lakraa, Dharmendra Kumar Yadav [20].	▪ *Size* ▪ *Cost*	*Multi-objective task scheduling algo.*	▪ *Improved performance* ▪ *Maximize throughput* ▪ *Reduction in cost*
Shubhashree S. R [21].	▪ *Job size*	*Non-Dominated Sorting*	▪ *Enhancement in data-center efficiency* ▪ *Reduction in the execution time*
Majid Habibi, Nima Jafari Navimipour [22].	▪ *Size of task*	*Imperialist Competitive*	▪ *Improve Execution time*
R K Jena [23].	▪ *Size of task*	*multi-objective nested Particle Swarm Optimization(TSPSO) and processing time.*	▪ *Optimize energy efficiently* ▪ *processing time.*
Vanita Dandhwani, Dr.Vipul Vekariya [24]	▪ *Deadline* ▪ *And Task length*	*multi-objective task scheduling algorithm using k mean clustering .*	▪ *Minimize the execution time* ▪ *Makespan*

Negar Dordaie [25].	▪ *Makespane*	*Hybrid PSO-Hill climbing*	▪ *Minimize makespane* ▪ *cost* ▪ *efficient energy consumption than meta objective heuristic algorithm.*
Ashraf A-sisi Medhat Tafeek [26]	▪ *Pheromone Updating rule*	*Ant Colony Optimization algorithm*	▪ *Enhance the performance* ▪ *reduce makespane cost*
Mohammed Abdullahi [27]	▪ *Makespane,* ▪ *Response time* ▪ *Degree of imbalance among VM*	*Symbiotic Organism Search algorithm*	▪ *It has less parameter and easy to execute* ▪ *minimize makespane*

8. CONCLUSION

Scheduling mechanism is an important issue in case of cloud computing. Scheduling mechanism is very much necessary to improve the server and resource utilization also to increases the performance of the computer. Scheduling in cloud environment is a critical task because of distributed environment. Various scheduling algorithms have been proposed by different authors. Each scheduling algorithm has certain pros and cons and also the existing algorithms don't ensure reliability and availability. New algorithms need to be proposed and developed that can provide better efficiency and performance. In this various terminologies and concepts were thoroughly looked and thus explained. This work will give way to more future findings regarding the scheduling techniques in a cloud environment. More efficient and faster ways to schedule jobs and increase CPU throughput needs to be discovered. Also, this will fuel the greater knowledge and popularity of cloud environment among the peoples.

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