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Survey of Different Task Scheduling Algorithms in Cloud Environment

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Abstract- Cloud-Computing is a dynamical as well as an ascendible model of distributed computing which gives effective accessibility to distant resources. Cloud-Computing is made up of Cloud and Computing. Cloud is a big network of huge structure which consists of applications, hardware, and system software deliverable to the end users with minimum maintenance, high accessibility and at lessened cost. Computing is done when cloud resources are pooled by enormous number of clients and those clients allot their jobs or tasks to the cloud. Task Scheduling is the process to schedule those tasks in the cloud. The aim of task scheduling associated with distributed systems, is to allot the tasks among processors, increasing resource utilization and decreasing the overall task execution time as well. In this paper we described the comparative analysis of various task scheduling algorithms and find their limitations regarding cloud environment. We highlighted and evaluate the recent research trends in this area.
Keywords – Cloud-Computing, task scheduling, Virtual Machine (VM), static scheduling, dynamic scheduling, preemptive, non-preemptive scheduling.

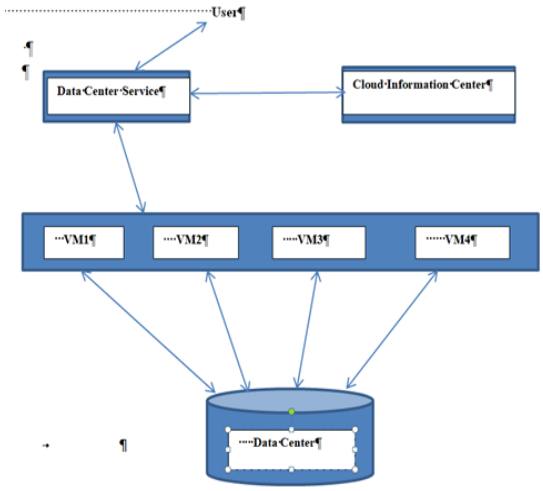
I. INTRODUCTION

The U.S. NIST(National Institute of Standards and technology)describes Cloud-Computing as-"Cloud computing is a system that allows on-demand and extremely dynamic resources that can be conveniently provisioned network access to shared pool of configurable computing and released involving least management effort or service provider interaction"[15].Cloud-Computing is divided into three classes: Software as a service (SaaS): SaaS provides the license to an application to customers on pay per use basis or at no charge. Platform as a Service(PaaS): PaaS gives permission to use virtual servers as well as particular cloud environment to give users platform to develop their own applications. Infrastructure as a Service (IaaS): IaaS provides license to use different resources (storage, hardware, servers and networking components) to customers [16].Cloud is accessible to the consumers through four deployment models:(a) Public cloud- it is accessible to overall public.(b) Private Cloud- it is accessible to a particular organization.(c) Hybrid Cloud- it is an arrangement consist of more than one cloud like Public, Private or Community cloud. d) Community Cloud- this type of cloud environment is accessible to only a specific group or community of cloud users[15].This paper is divided four sections. Section-I is introduction part which gives the overview of cloud computing. Section-II discusses about the scheduling of tasks and gives brief information about the research done in this area. Section-III focuses on the comparative analysis of scheduling algorithms. Section-IV gives brief idea of recent research done in this area.

II. RELATED WORK AND TASK SCHEDULING IN CLOUD COMPUTING

In the area of task scheduling large amount of work has been proposed. A heuristic algorithm based on dynamic workflows was presented, which was constrained to network cost and deadline [2]. A methodology for scheduling tasks for workloads in presence and absence of network budget constraints through remotely allocated data centers was also presented which worked under network cost and network bandwidth as scheduling parameters [1]. A deadline aware scheduling scheme (DASS) based on user request was proposed which worked under QOS performance metrics and data center response time as scheduling measures for experiments [5]. A task allocation method with modified cost efficient Genetic algorithm was proposed [10].A unique resource scheduling hyper heuristic based improved bacteria foraging algorithm was also proposed, for effective scheduling of tasks on an available physical machine in a cloud environment [7].

Cloud resources are shared among a large number of consumers and consumers sent their jobs or tasks to the cloud. Therefore in the cloud environment it is a challenge to execute tasks scheduling mechanism. In task scheduling user sent their tasks to cloud and those tasks are allotted to different virtual machines giving the illusion of a single entity as depicted in Fig-1. Data center service deals with the communication between virtual machines and the user. It also manages two way transmissions with cloud information center. Data center is a group of servers used for storing data remotely, distribution of data and for processing large amount of data.



2.1 Task Scheduling in Cloud Environment

The aim of task scheduling algorithms is to allocate the tasks among processors, increasing their resource utilization and decreasing the overall task execution time as well. Scheduling algorithms are classified into static scheduling and dynamic scheduling. Static scheduling takes less execution time because collection of required data and pipelining of the tasks to be processed are done before runtime. But in the dynamic scheduling there is no prior knowledge about tasks and allocation of task is done at the time of execution of the application only. Scheduling can also be classified as centralized and decentralized scheduling. In centralized scheduling, centralized schedulers do the job of taking global decisions. Decentralized scheduling is managed by local schedulers and it is more realistic for the real world. One more classification of scheduling is in the form of pre-emptive and non-preemptive scheduling. In pre-emptive type resources can be reallocated to other jobs or tasks without completing the ongoing task, whereas in non-preemptive scheduling resources cannot be reallocated to other jobs or tasks until the completion of the ongoing task.

III. COMPARATIVE ANALYSIS OF VARIOUS EXISTING TASK SCHEDULING ALGORITHMS

In this section we analyze various scheduling algorithms based on certain parameters, which is shown in Table-1.1. We study their limitations with respect to scheduling parameters and analyzed them under some constraints.

Table1.1: Comparative analysis of Scheduling Algorithms

Algorithms	Scheduling Measures	Allocation Order	Conclusion
First Come First Serve(FCFS)	Order based on arrival.	In the order in which process arrives.	Waiting time is more.
Shortest Job First (SJF)	Order of arrival and execution time.	Order with the least execution time.	Waiting time is lesser than FCFS.
Round Robin	Time quantum has to be selected.	Time quantum is assigned to each resource. Pre-emption is there.	More waiting time than all.
Min-Min Scheduling	Execution time	Task with min. execution time is assigned to resource.	Overall resource utilization is higher.
Max-min	Completion time	Max execution time task assigned to resource.	Small delays for long tasks.
RASA(Resource Aware Scheduling)	Completion time has to be	Depends on the number of	Reduced completion time.

	reduced.	resources.	
Priority based scheduling	Priority is assigned to each task.	Task with the highest priority.	Lesser completion time
PSO based (Particle Swarm optimization based heuristic scheduling	Resource utilization time	Random initialization	Improved distribution of tasks on the resources.
Ant colony optimization(ACO)	Pheromone updating rule(known path to the most efficient solution)	Each VM is loaded and calculate load balance factor.	Reduced time, local search improved the results.
Genetic Algorithm	Make-span, efficiency, performance, optimization	A set of task schedules and population are created using the scheduling function. A fitness function is used to evaluate the population.	Complexity and longtime consumption

IV. NEW RESEARCHES IN VARIOUS TASK SCHEDULING PROCEDURES IN CLOUD ENVIRONMENT

In this section we described the recent research trends in the task scheduling algorithms in the cloud computing environment which is shown in Table1.2. We discussed about different researches done in the field of task scheduling in the cloud and the methodology used which were undergone in the corresponding research work. We also focused on the research gaps in each discussed work.

Table1.2: Recent Research Developments in Scheduling Algorithms in Cloud Computing Environment

References	Paper Title	Algorithm or Methodology used	Outline	Scheduling Parameters	Research Gap
[1]	"Time and Cost Efficient Task Scheduling across GEO-Distributed Data Centers".	A new approach for scheduling tasks for workloads in presence and absence of network budget constraints through remotely allocated data centers.	The source problem is first expressed as a lexicographical linear programming problem and then uses a convex objective function to transform it into nonlinear problem. Then this transformed problem is solved through standard problem solver based on linear programming.	network cost, network bandwidth	Task scheduling, data replication and data placement can collectively optimize for wide area of processing under big data. Directed Acyclic Graph scheduling techniques can be used to directly optimize the jobs.
[2]	"A cost effective deadline constraint dynamic scheduling algorithm for	A heuristic algorithm based on dynamic workflows. It is constrained to network	The proposed methodology uses the performance variations of virtual machine and instance acquirement time to find accurate schedule of scientific	Performance variability of Virtual Machine and instance	The robustness can also be taken into account in contrast to the tasks and the Virtual Machine failure. We can also analyze the change

	scientific workflows in a cloud environment" .	cost and to deadline	workflow constrained under sharp deadline on reduced cost.	acquisition delay.	in the cost while changing the deadline and reviewing it.
[3]	"Simulated Annealing multi-population genetic algorithm (SAMPGA) task scheduling algorithm in cloud computing"	This algorithm is the combination of simulated annealing algorithm and multi population genetic algorithm.	SAMPGA adopt max-min algorithm to enhance the search efficiency. SA incorporated into SAMPGA to avoid local optimum and improve the performance of global optimum and improve convergence speed.	Execution time, execution cost, load imbalance factor and convergenc e speed.	The proposed algorithm can be improved by reducing completion time.
[4]	"Map -reduce scheduling for deadline constrained jobs in heterogeneou s clouds computing systems".	A new map-reduce scheduler called BGRMS is proposed using bipartite graph modeling.	Here the objective is to find prime solution of the scheduling problem constrained under deadline by converting the problem into minimum weighted bipartite matching.	Various nodes performanc e and dynamic task execution time	In future better output can be produced and network bandwidth and cost can also be considered.
[5]	"Modeling and analysis of a novel deadline aware scheduling scheme for cloud computing data center".	A new deadline aware scheduling scheme(DASS) based on user request is proposed.	This methodology is built to capture the system dynamics and to evaluate system performance functioning under DASS.	QOS performanc e metrics and data center response time.	The proposed methodology can be deployed in real cloud computing environment and various performance factors like scalability, availability, parallelism etc. can be evaluated.
[6]	"Scalability aware scheduling optimization algorithm for multi objective cloud task scheduling problem".	A modified and improved Cat Swarm Optimization algorithm is proposed which is based on Simulated Annealing approach. It is scalable as well as multi-objective.	This approach is given to improve local search process of the existing algorithm. This approach is aimed to adapt the runtime changes in the status of resources and tasks and at the same time meeting the QOS constraints of the consumers.	No preemption , task independen ce, no transmissio n cost and also assuming that datacenters belongs to the same service provider.	In future, more proficient results can be produced by using different optimizing techniques in the cloud computing environment.
[7]	"Bacteria foraging based task	For cloud resource scheduling, an	A unique resource scheduling hyper heuristic based	No. of Hosts , No. of	We can plan to apply more parameters for

	scheduling algorithm in cloud environment. ”	optimization technique for bacterial foraging is proposed.	improved bacteria foraging algorithm has been proposed for effective scheduling the tasks on an available physical machine in a cloud environment.	cloudlets, bandwidth, number of VMs per machine	evaluation. We can apply the dynamic distribution of VMs to execute tasks to improve a quality of service of the cloud center.
[8]	“Dynamic cloud task scheduling based on a two stage strategy”.	Using Bayes’ classifier principle of design the given tasks are matched with the existing VMs dynamically.	In this research VMs are recognized in specific number based on their resource attributes before execution. So that the failure rate could be reduced and the time needed to create VMs at runtime could also be saved.	Task parameters(Task type, task requirements, task deadline, task count),VM parameters(VM type, VM count, VM attributes)	The proposed method can be deployed to the actual cloud computing environment to test the system performance, to reduce energy consumption and guaranteeing the service quality as well.
[9]	“A new flower pollination based task scheduling algorithm (TSFPA) in cloud environment” .	A new task scheduling approach has been presented to efficiently allocating resources to the tasks.	This task scheduling approach is proposed in order to map tasks and resources in best optimized way, thus minimizing make-span as a consequence.	Set of tasks of different completion times and set of resources of different processing powers.	Comparative analysis of the proposed approach with different heuristic algorithms could be done. The analysis of the effect of precedency of the tasks and impact of load variation, on the result could also be done.
[10]	“Monkey search algorithm for task scheduling in cloud IaaS”.	Atask allocation method with cost efficient Genetic algorithm is proposed.	To minimize the overall completion time and to improve resource utilization, a dynamic learning inspired task allocation algorithm has been proposed.	Minimized cost, network cost, execution time, network delay.	In future better output can be produced and network bandwidth can also be considered.

[11]	"Optimization of Resource and Task scheduling in cloud using random forest".	Resource provisioning based resource allocation method using new approach Random Forest for optimization is proposed.	A resource and task allocation strategy with new approach Random Forest for optimization is proposed for scheduling the tasks, instantiated by cost proficient service provisioning for customers.	Minimum cost and execution time.	For future work, more accurate and proficient results can be produced by using different optimizing techniques in the cloud.
[12]	"Task scheduling algorithm in cloud computing environment and on cloud pricing model".	Each VM is allotted a fraction of total requested power based on its power factor.	The requested tasks are allotted to the available VMs by taking into account the processing power of VMs and tasks.	Cost of processing of tasks among different VMs, power requirement of VMs and tasks.	Future work can consider the dependent tasks in the enhancement task scheduling algorithm and dynamic workflow scheduling can also be considered.
[13]	"A hybrid Bio-inspired algorithm for scheduling and resource management in cloud environment".	A new hybrid approach incorporating two existing approaches- a)Modified Particle Swarm Optimization (MPSO) b)Modified Cat Swarm Optimization (MCSO)[13].	This approach focuses on two goals a) to provide efficient load balancing in task scheduling by building enhanced PSO algorithm b) to provide dynamic resource allocation and resource management by building hybrid approach using MPSO and MCSO algorithms.	VM type, No. of resources demanded by task, entering time of the task while using VM.	A more proficient dynamic approach can be proposed in which tasks can enter the cloud environment or approaching the VMs at different time interims.
[14]	"An optimized task scheduling algorithm in cloud computing".	An intelligent, optimized algorithm, which is based on existing optimization techniques, has been proposed.	The proposed approach is based on intelligent processing technique which enables the system to adapt the most suitable scheduling algorithm from existing algorithms depending on the scenario.	Load balancing factor.	The proposed approach can be implemented in actual cloud computing environment and can study the various practical evaluation factors like scalability, robustness and availability.

V. CONCLUSION

In this paper we did the comparative analysis of different task scheduling algorithms on parameters: order of allocation of tasks and scheduling criteria. The FCFS has high waiting time therefore high turnaround time too, while SJF has low waiting time and low turnaround time. We compared these two algorithms and found that SJF has high throughput whereas FCFS has low throughput. Round Robin algorithm has the highest waiting time when we compared it with other algorithms. Finally we concluded that the SJF has the highest throughput and lowest turnaround time when compared it with priority based scheduling and other algorithms discussed earlier in cloud environment. We studied the recent research trends in the existing task scheduling algorithms and convoluted up with research gaps, on which further study can be originated.

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