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Study and Comparison of VM Scheduling Algorithm in Cloud Computing Using CloudSim Simulator

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Abstract: ***Scheduling in cloud computing is a technique which is used to improve the overall execution time of the job. A good scheduling algorithm can help in load balancing as well. Scheduling in cloud can be done in three areas i.e. Scheduling Cloudlets (where Cloudlet is small scale data center that is located at the edge of Internet) within the virtual machine, Scheduling Virtual Machine on the host, and scheduling cloudlets to the Virtual Machine. There are used CloudSim Simulator which is control environment in which programmer can run application instead of practically running it. This paper presents Different VM Scheduling algorithm using CloudSim and trying to find out best algorithm.***
Keywords: Cloud computing, CloudSim, Scheduling Algorithm, First Come First Serve, Round robin, Shortest Job First.

I. INTRODUCTION

Cloud is a set of hardware, network, storage , services and interfaces that enable the delivery of computing service..Cloud computing is a complete new technology. It is the development of parallel computing, distributed computing grid computing, and is the combination and evolution of Virtualization, Utility computing, Software-as-a-Service (SaaS), Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS)[2].Cloud computing is a pay per use model for providing convenient and on demand network access to sharable and configurable computing resources like networks, servers and applications that can be easily managed with minimal effort or service provider interaction[1].

Cloud computing environment requires a suitable algorithm for executing the various jobs provided to the system in a cost effective manner based on certain constraints. This task is performed by a VM scheduler using a suitable scheduling algorithm.

In Space-shared scheduling policy it schedule one task on virtual machine at a given instance of a time and after its completion it schedule another task on virtual machine [3]. This same policy is used to schedule the virtual machines on the host. This policy behave same as the first come first serve algorithm (FCFS).In Time-shared scheduling policy it schedule all tasks on virtual machine at the same time. It shared the time among all tasks and schedule simultaneously on the virtual machine. This policy is also used to schedule the virtual machine on the host. The concept of round-robin (RR) scheduling algorithm is used in this policy.

II. CLOUD COMPUTING SIMULATION

Cloud Computing is faced many problem by many Industries which are directly or indirectly related to the Information Technology. This field is growing very fastly as many of the big players in the Information Technology field like Microsoft, Google, Amazon, SAP are investing a lot of money to get improved results[1]. They feel that it is the future of technology.

There are variety of simulator tools for modelling and simulation of large-scale Cloud computing environments [4] (figure 1). Generally, we can designate between two types of simulators: graphical user interface (GUI) simulators or programming language based simulators (like Java for example).

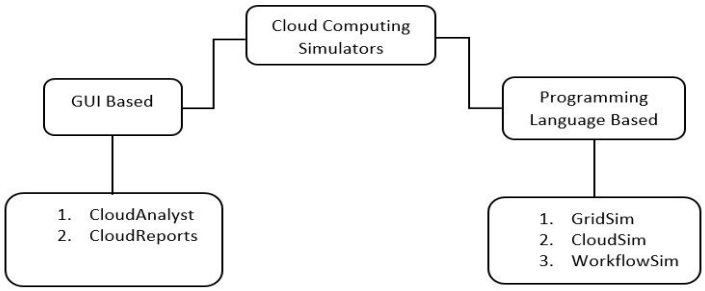


Fig. 1 Cloud Computing Simulation frameworks [11]

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III. CLOUD COMPUTING SIMULATORS EVALUATION

As described on the previous section, there are a diversity of Cloud Computing simulators, each with specific characteristics and oriented for a specific objective. Choosing the finest Cloud Computing simulator is a challenging mission. To the best of our knowledge, it was not very difficult to spot CloudSim as the core platform for the most used [5] Cloud simulators up to this moment. CloudSim was established as an extension of the GridSim simulator in order to introduce the Cloud Computing virtualization layer that was not present on the original simulator [9]. CloudSim is a programming language based simulator and even though it does not support a graphical user interface for simulation [2]. CloudSim presents itself to the cloud-computing researchers as a Java based framework that supports the main characteristics of Cloud Computing (IaaS) with virtualization support and task scheduling (PaaS and SaaS). CloudSim is a library for the simulation of cloud scenarios [1]. CloudSim support for modeling and simulation of large scale Cloud computing environments, including data centers, on a single physical computing node [5].

IV. VIRTUAL MACHINE SCHEDULING ALGORITHMS

VM Scheduling determines how many processing cores of a host are allocated to virtual machines and how many processing cores will be delegated to each VM. It also determine how much of the processing core's capacity will effectively be attributed for a given VM. There are different VM scheduling policies are like First-Come First-Serve (FCFS), Shortest Job First, Round Robin Scheduling, Priority Scheduling, Min-Min Scheduling, Max-Min Scheduling, which are evaluated in this project [7].

A. First Come First Served (FCFS) Scheduling :

The simplest [4], algorithm for resources scheduling is the "FCFS" algorithm (It is also called FIFO=First In First Out). This algorithm is based on the arrival time of the resource request [11]. To clarify the performance of the "FCFS" algorithm, let take the following Example:

TABLE 1. First Example Tasks list

Task Order	Task Name	Burst Time
1	Task-1	10
2	Task-2	4
3	Task-3	5
4	Task-4	20

TABLE 2. First Example Gantt chart

Task-1	Task-2	Task-3	Task-4
0	10	14	19	39

B. Shortest Job First Scheduling

Another Algorithm is Shortest Job First algorithm (SJF). In SJF, Process from the ready queue that has shortest finish time will execute first. If two process are having same burst time and arrival time, then FCFS procedure is used to break the tie [8]. To clarify the performance of the "SJF" algorithm, let take the following Example:

TABLE 3. Second Example Process list

Process	Burst Time
P1	6
P2	8
P3	7
P4	3

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TABLE 4. Second Example Gantt chart

P4	P1	P3	P2
0	3	9	16	24

C. Round Robin Scheduling

The "Round Robin" algorithm [10], was designed based on the distribution of the CPU time among the scheduled tasks. On the same context, all the tasks get on a queue list whereas each task get a small unit of CPU time (Quantum, usually 10-100 milliseconds), let take the following Example:

TABLE 5. Third Example Tasks list

Task Order	Task Name	Burst Time
1	Task-1	10
2	Task-2	4
3	Task-3	5
4	Task-4	20

TABLE 6. Third Example Gantt chart

Task-1	Task-2	Task-3	Task-4	Task-1	Task-3	Task-4	Task-1	Task-4	Task-4	Task-4
0	4	8	12	16	20	21	25	27	31	35

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Static time Quantum which is calculated based on the number of instructions the processor can execute per second:

$$TQ = (NP * MIPS) / 1000$$

Whereas:

TQ = Time Quantum
NP = Number of Processors
MIPS = Million Instruction per Second

D. Priority Scheduling Algorithm :

The Priority based Algorithm generally is based on a new concept "priority". In this generally a job which needs high space shared is given high priority, because they used high computational power [15]. A job, which exhibits low parallelism and needs low computational power and it is given a low priority [10], let take the following Example:

TABLE 7. Forth Example Process list

Process	Arrival Time	Burst Time	Priority
P1	0	11	2
P2	5	28	0
P3	12	2	3
P4	2	10	1
P5	9	16	4

TABLE 8. Fourth Example Gantt chart

P2	P4	P1	P3	P5
0	28	38	49	51	67

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E. Min-Min Scheduling :

Min-Min Scheduling Algorithm is the most simple and well known algorithm for efficient job scheduling .The algorithm first calculates the expected execution time of tasks, and then scheduling the task with the minimum execution time to the corresponding VMs [11]. In other words Min-Min scheduling algorithm work on determining the minimum completion time for each task [6]. Advantage of Min-Min Scheduling Algorithm is Applicable in small scale distributed systems. And Disadvantage of Min-Min Scheduling Algorithm is Number of the small tasks is more than the number of the large tasks in a then Min-Min algorithm cannot schedule tasks [12].

F. Max-Min Scheduling

Max-Min algorithm is similar to the Min-Min algorithm. It calculates the expected execution time of each task, and then scheduling the task with the maximum execution time to the corresponding VMs.The Max-Min scheduling is a selective algorithm that functions exactly as for the Min-Min scheduling algorithm. But this time the algorithm chooses the task with the higher completion time and continues the work on a descending order [12].Advantage of Max-Min Scheduling Algorithm is Allocates larger task to the resource where large tasks have highest priority rather than smaller tasks[11].

G. Improve Shortest Job First Scheduling:

Another Algorithm is Improve Shortest Job First algorithm. Proposed algorithm gives better result in comparison to the Shortest Job First Scheduling algorithm [15].

V. SIMULATION ENVIRONMENT AND RESULT COMPARISON

A. Simulation Environment

To analyse and compare all algorithm the researcher used CloudSim tool for the simulations. The cloud environment set up generated was having the following configurations.

TABLE 9: Cloud Environment Setup Specifications

Parameters	Capacity
Virtual Machine- Number of VM	50
Cloudlet(Workload)- Number of Cloudlet	100
VM memory	512
Data center – Architecture	X86
Data center – OS	Linux
Data center –No. of Machines	5
Data center – Processor speed	100MIPS
Data center – Number of processors per machine	5
Data center – Available BW per Machine	10,000

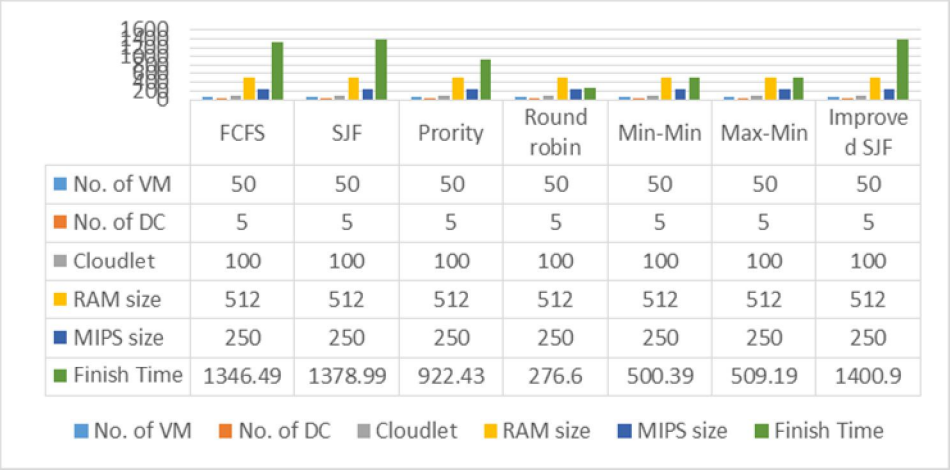
B. Comparison of Results

The performances of First-Come First-Serve (FCFS), Shortest Job First, Round Robin Scheduling, Priority Scheduling, Min-Min Scheduling, Max-Min Scheduling, and Improve Shortest Job First Scheduling were compared and Fig. 2 shows the performances of the all seven algorithms [13].There are different Scenario which are discuss below:

1) Scenario – 1

I have compared our all seven algorithm using CloudSim Simulator and the Output shown in Figure 2. The experiment are done on 50 Virtual Machine, 100 Cloudlet, 5 Datacenter, X86 Data center Architecture, 512 MB RAM size, 250 mips size,1000 Bandwidth size, Windows java environment [13].

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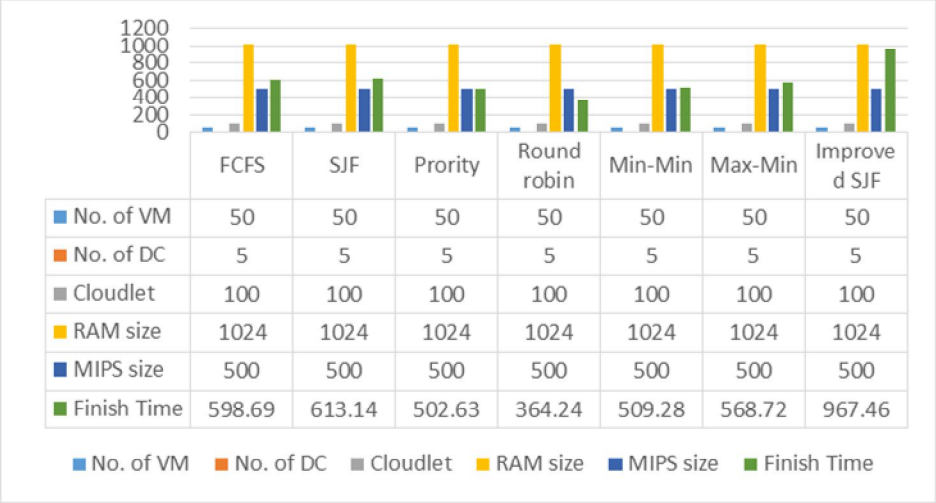


	FCFS	SJF	Prority	Round robin	Min-Min	Max-Min	Improved SJF
No. of VM	50	50	50	50	50	50	50
No. of DC	5	5	5	5	5	5	5
Cloudlet	100	100	100	100	100	100	100
RAM size	512	512	512	512	512	512	512
MIPS size	250	250	250	250	250	250	250
Finish Time	1346.49	1378.99	922.43	276.6	500.39	509.19	1400.9

Fig. 2 Result of Scenario-1[13]

2) Scenario – 2

I have compared our all seven algorithm using CloudSim Simulator and the Output shown in Figure 3. The experiment are done on 50 Virtual Machine, 100 Cloudlet, 5 Datacenter, X86 Data center Architecture, 1024 MB RAM size, 500 mips size,10000 Bandwidth size, Windows java environment [13].



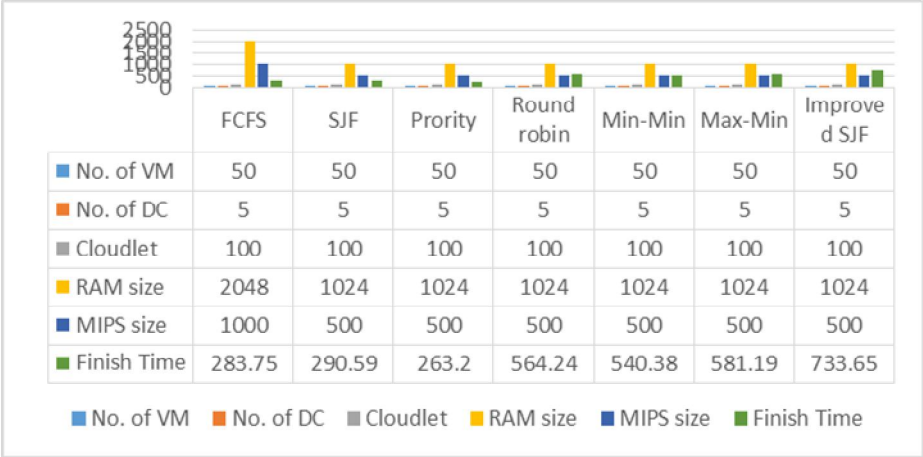
	FCFS	SJF	Prority	Round robin	Min-Min	Max-Min	Improved SJF
No. of VM	50	50	50	50	50	50	50
No. of DC	5	5	5	5	5	5	5
Cloudlet	100	100	100	100	100	100	100
RAM size	1024	1024	1024	1024	1024	1024	1024
MIPS size	500	500	500	500	500	500	500
Finish Time	598.69	613.14	502.63	364.24	509.28	568.72	967.46

Fig. 3 Result of Scenario-2[13]

3) Scenario – 3

I have compared our all seven algorithm using CloudSim Simulator and the Output shown in Figure 4. The experiment are done on 50 Virtual Machine, 100 Cloudlet, 5 Datacenter, X86 Data center Architecture, 2048 MB RAM size, 1000 mips size,10000 Bandwidth size, Windows java environment [13].

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	FCFS	SJF	Prority	Round robin	Min-Min	Max-Min	Improved SJF
No. of VM	50	50	50	50	50	50	50
No. of DC	5	5	5	5	5	5	5
Cloudlet	100	100	100	100	100	100	100
RAM size	2048	1024	1024	1024	1024	1024	1024
MIPS size	1000	500	500	500	500	500	500
Finish Time	283.75	290.59	263.2	564.24	540.38	581.19	733.65

Fig. 4 Result of Scenario-3[13]

Comparison of Result of all scheduling algorithm: Below table shows, Comparison of Result of all scheduling algorithm with Different No. of Virtual Machine, No. of Cloudlet, RAM, MIPS and Bandwidth [13].

Scenario	Virtual Machine	Cloudlet	RAM	MIPS	Bandwidth	FCFS	SJF	Priority	RR	Min Min	Max Min	Improve SJF
1	50	100	512	250	1000	1346.99	1378.99	922.43	276.60	500.39	509.19	1400.9
2	50	100	1024	500	10000	598.69	613.14	502.63	364.24	509.28	568.72	967.46
3	50	100	2048	1000	10000	283.75	290.59	263.20	564.24	240.38	581.19	733.65

Table 9. Comparison of Result of all scheduling algorithm [13]

VI. CONCLUSION

From the Table-9 , I can see that execution time is reduced drastically about half time by increasing the RAM, MIPS and Bandwidth with more scheduling algorithm i.e. Improve Shortest Job First scheduling algorithm. Overall performance in this algorithm can be seen very much better compared to other routine algorithm.

Hence, I can conclude that by scheduling algorithm i can reduce execution time, So that we can attract more and more customers.

VII. FUTURE WORK

Other factor should be taken into consideration such as bandwidth and cpu utilization. This concept can be extended for handling fault tolerance.

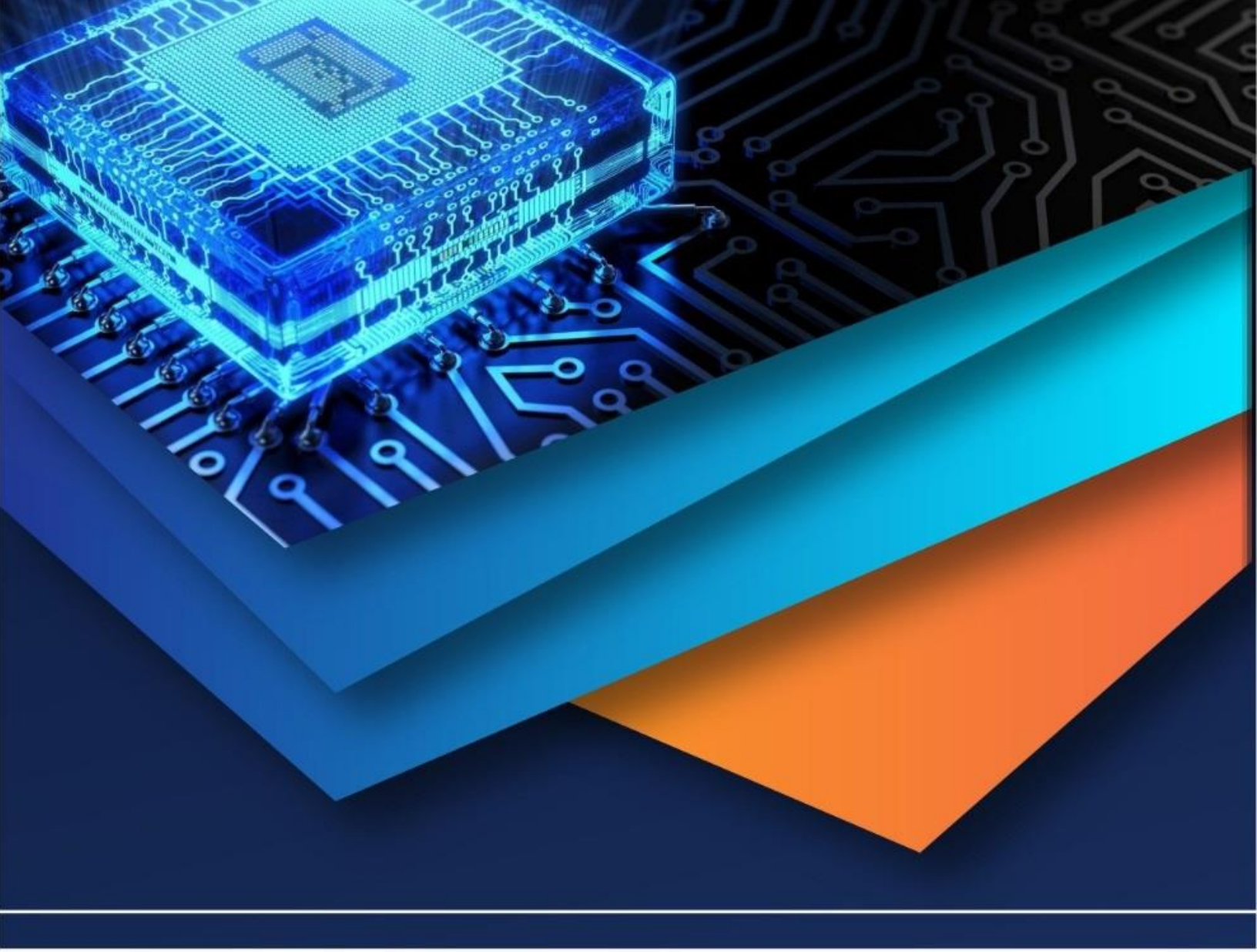
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