SCHEDULING AND IMPLEMENTING VARIOUS TYPES OF ALGORITHMS IN CLOUDSIM

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Abstract

Cloud Computing refers to delivery of both the software as a service and the infrastructure and the platforms that provide those services. In other words , Cloud computing is that service that enables us to use computing resources such as processing entities, storage and applications as on-demand services over the internet.

We have worked on Cloudsim which one such toolkit which covers the basic functions of a cloud. We have used CloudSim to perform analysis of our project, to put a step forward in the development of Cloud Computing.

Our project focuses on the following topics:-

1. What is Virtual Machines and do we need them?
2. Comparison of the existing cloudlet execution algorithms.
3. Allocation of Processing Entities to the Virtual Machines that are being created inside the Datacenters.
4. Proper Assignment of the Created Virtual Machines to the Cloudlets for achieving maximum number of Cloudlets execution.
5. Checking the change in execution time by changing no. of vms, cloudlets and host in a heterogeneous manner.
6. We worked on different types of Task Scheduling algorithms to see the execution time in each case like:
   - TimeShared Scheduling.
   - SpaceShared Scheduling.
   - First Come First Serve(FCFS) Scheduling.
   - Shortest Job First(SJF) Scheduling.
   - Round Robin Scheduling.

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1 Cloud Computing and CloudSim

1.1 Introduction

Cloud Computing refers to delivery of both the software as a service and the infrastructure and the platforms that provide those services. In other words, Cloud computing is that service that enables us to use computing resources such as processing entities, storage and applications as on-demand services over the internet.

Cloud computing technology is still deficient of the proper standards, tools for analysis, and proper approaches that can handle the complexities at infrastructure and application level. That's why, in future there will be lots of research work going on both in the academic institutions and industry towards defining core algorithms, policies, and application benchmarking based on execution contexts.

CloudSim[1] is one such toolkit which covers the basic functions of a cloud. We have used CloudSim to perform analysis of our project, to put a step forward in the development of Cloud Computing.

1.2 History

The history of cloud computing is dated back to 1950's when large scale mainframes were available in the academic institutions and corporations. Then in the 1960s, John McCarthy got the idea that someday computing resources can be organized as a public utility.

In the 2000s, Amazon played an important role in the development of clouds and bringing it in for commercial purposes.

1.3 Future

Cloud computing, today is in the spotlight. It is getting the attention of large Technology Giants. The features of this new technology are explored, the mainissues are being addressed and now it is ready for exploitation in the market.

Still all the problems associated with cloud are not solved yet. That's why it is curiously being examined by the researchers as it is getting carefully speculated by the businessmen.

The cloud computing technology is still deficient of the proper standards, tools for analysis, and proper approaches that can handle the complexities at infrastructure and application level. That's why, in future there will be lots of research work going on both in the academic institutions and industry towards defining core algorithms, policies, and application benchmarking based on execution contexts.

1.4 Project Outline

CloudSim, which is a simulation [5] toolkit as we have mentioned earlier. Our project focuses on the following topics:-
i)What is Virtual Machines and do we need them?
ii) Comparison of the existing cloudlet execution algorithms.
iii) Allocation of Processing Entities to the Virtual Machines that are being created inside the Datacenters.
iv) Proper Assignment of the Created Virtual Machines to the Cloudlets for achieving maximum number of Cloudlets execution.
v) Checking the change in execution time by changing no. of vms,cloudlets and host heterogeneous.

2 Basic approaches for cloudlet execution

Cloudlets are jobs or tasks that are being assigned to a virtual machine for execution which are:-
i) Time Shared
ii) Space Shared

2.1 Cloudlet Scheduling Policies

In **Time-Shared scheduling policy** [6], the resources are being shared among the cloudlets. Each cloudlet gets the resources for execution for a certain period of time. After that period of time the resources are taken away from that cloudlet and are assigned to another cloudlet.

In **Space-Shared scheduling policy**, the resources are not shared among cloudlets. A cloudlet owns the resources until it gets executed. We have compared these two scheduling policies. The same policies are applied for scheduling of Virtual machines which are running inside a host. In time shared the resources of the hosts are being shared by the virtual machine for a timely basis, but in space shared a virtual machine can run on a Host only if free processing entities are available.

2.2 Output of Time-Shared

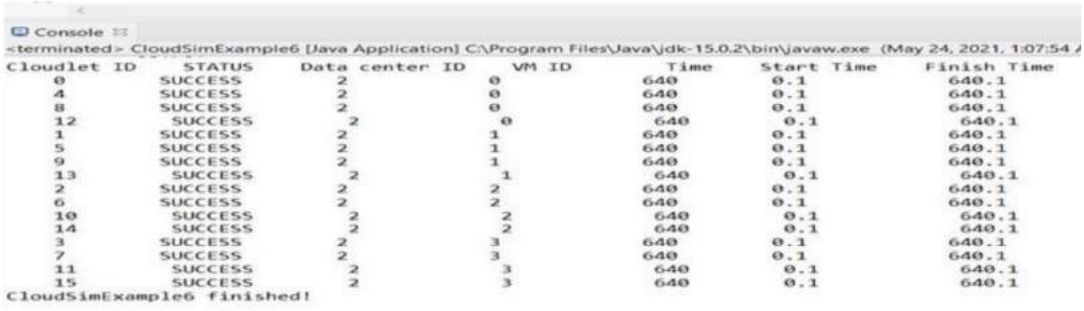


Figure 1: output of time-shared

2.3 Output of Space-Shared

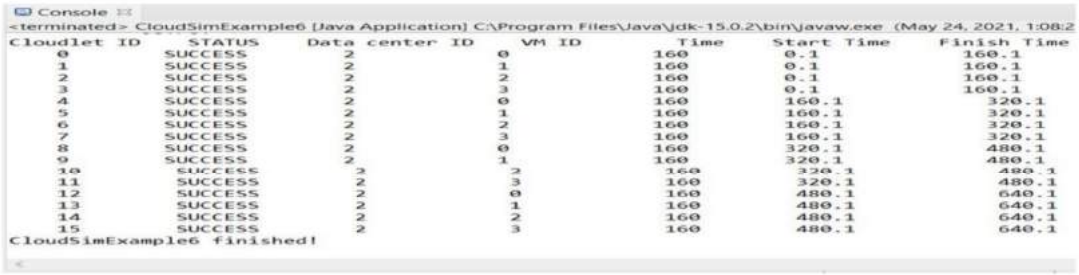


Figure 2: output of space-shared

Table 1: Result of Execution time of each cloudlet in both the cases

No. of cloudlets	No. of VMs	Time-Shared	Space-Shared
16	4	160	640
50	8	160	959.98
100	12	160	1600
200	16	160	3200
400	20	160	6400

2.4 Simulation plot

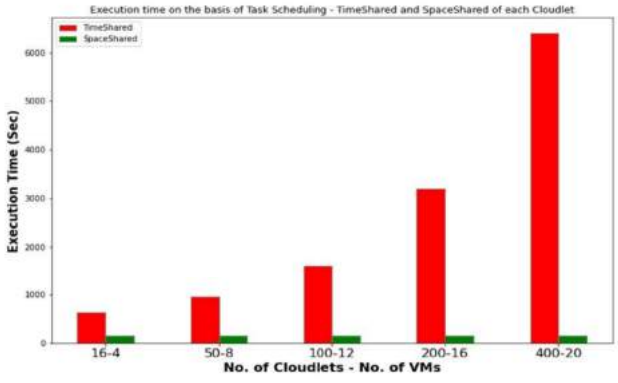
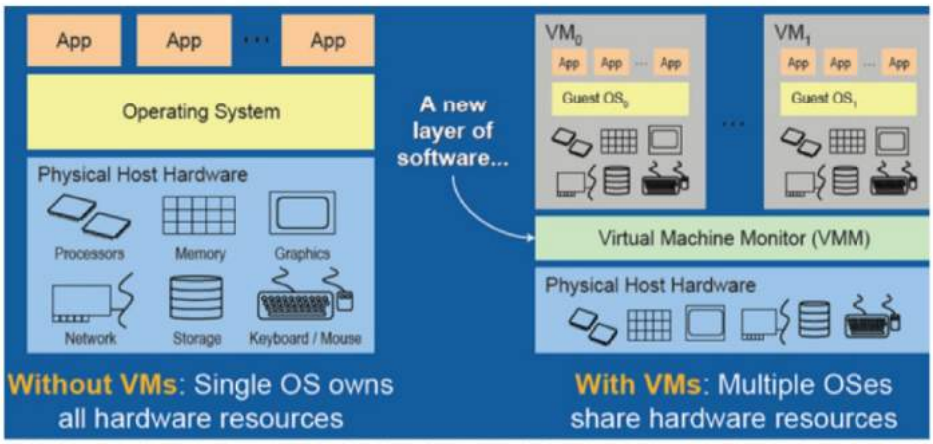


Figure 3: Simulation Plot

3 Simulation

3.1 Virtual Machine



[Ref: https://software.intel.com/en-us/articles/the-advantages-of-using-virtualization-technology-in-the-enterprise .]

Figure 4: Virtual Machine

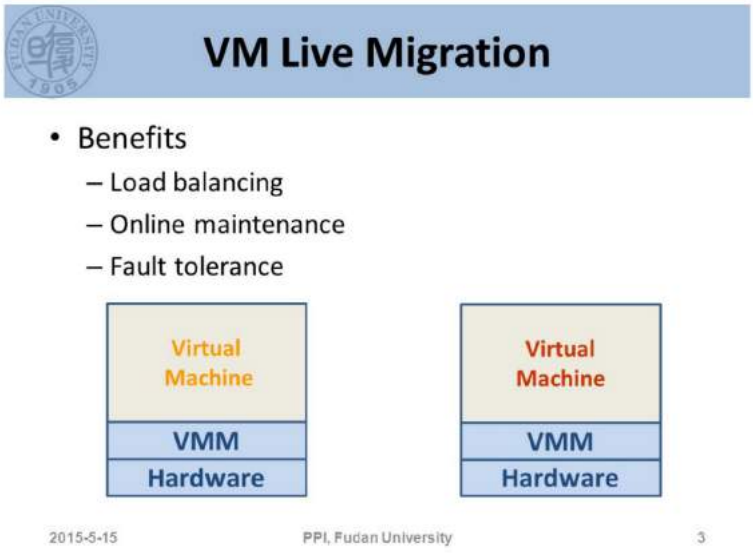


Figure 5: VM Migration

3.2 VM Scheduler

The VM Scheduler is an abstract class that defines and implements the policy used to share processing power among virtual machines running on a specified host.

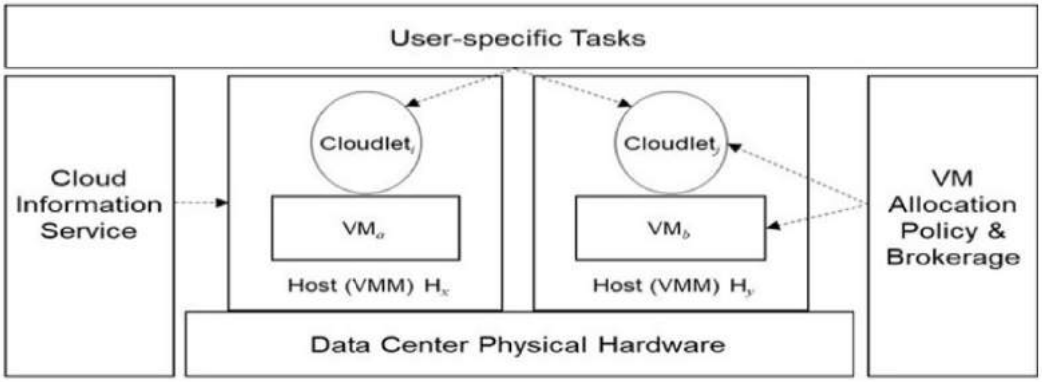


Figure 6: VM simulation in CloudSim

VmSchedulerTimeShared

The VM scheduling policy that allocates processing elements to a single Virtual machine and allows the sharing of processing elements by multiple virtual machines with a specified time slice.

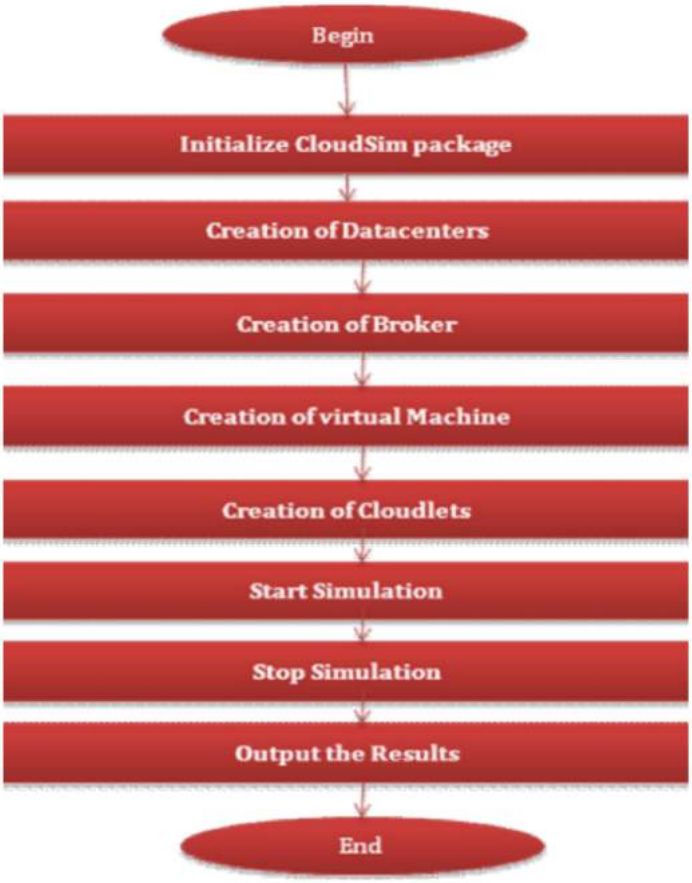
VmSchedulerSpaceShared

The VM scheduling policy that allocates processing elements to a single virtual machine, but this policy implementation does not support sharing of processing elements, all the requested resources will be used by the allocated VM till the time the VM is not destroyed.

```
hostList.add(
new Host(
hostId,
new RamProvisionerSimple(ram),
new BwProvisionerSimple(bw),
storage,
peList2,
new VmSchedulerTimeShared(peList2)
new VmSchedulerSpaceShared(peList1)
```

));

3.3 Simulation Process in Cloudsim[3]



3.4 Simulation Data

The performances based on the average waiting time of Cloudlets in completely time shared and completely space shared environments were measured. The data was generated by conducting simulations in cloudsim [7] with 2 datacenters, with 1 host each and 1 virtual machine running inside each host.

The scheduling policy implemented by the Host for the scheduling of Virtual machines is Space Shared. As there is only one virtual machine it doesn't matter which virtual machine scheduling policy is implemented. The scheduling policy is significant only if there two or more VMs.

3.5 Two Datacenters with 1 Host each and Cloudlets of 2 users

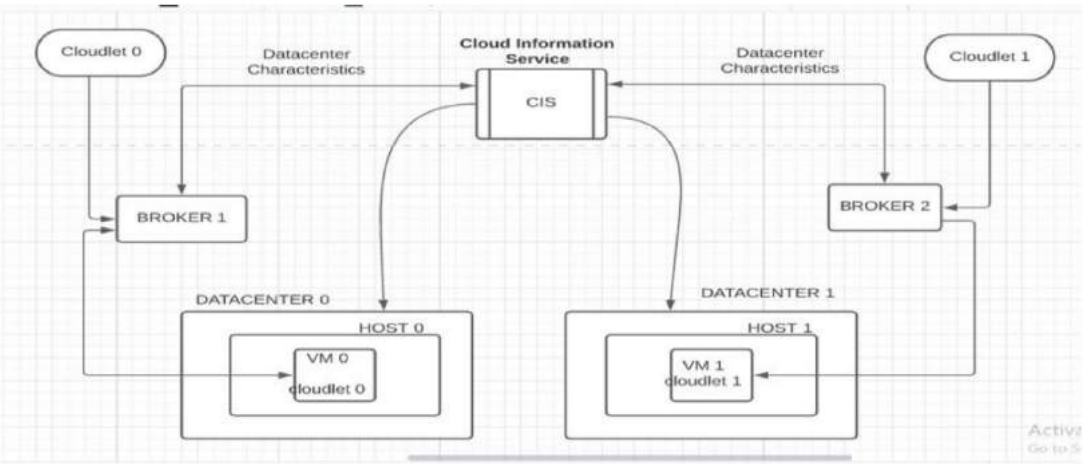


Figure 7: Working explained for 2 datacenters

4 Experimentation & Discussion

4.1 Experiment Parameters [2]

DataCenter Characteristics :-

```
int mips=1000; //Millions of Instruction
peList.add(new Pe(0, new PeProvisionerSimple(mips)));
int hostId=0;
int ram = 2048; //host memory (MB)
long storage = 1000000; //host storage
int bw = 10000 //bandwidth
```

Characteristics of Host (Each datacenter has a host.):-

Ram: 1024 MB
Storage: 500000 MB
Number of Processing Entities: 1 MIPS rating of Processing

Virtual Machine Requirements(Each host has a virtual machine):-

```
long size = 1000;//image size(MB)
int ram = 512; //vm memory (MB)
int mips = 1000;
long bw = 1000;
int pesNumber = 1;//number of CPUs
string vmm = "Xen"
```

Heterogeneity of Virtual Machine

```
for(int i=0;i<vms;i++) {
        int max = 1024;
        int min = 512;
        Random r = new Random();
        int addlenn = r.nextInt(max-min) + min;
        Log.printLine("New mips after the seed is :" +(mips +addlenn));
       vm[i] = new Vm(i, userId, mips+addlenn, pesNumber, ram, bw, size, vmm,new
CloudletSchedulerTimeShared());
        list.add(vm[i]);
    }
```

Heterogeneity of Cloudlet

```
for(int i=0;i<cloudlets;i++)
   {
      int max = 128;
      int min = 64;
      Random r = new Random();
      int addlen = r.nextInt(max-min) + min;
      Log.printLine("New length after the seed is :" +(length +addlen));
      cloudlet[i] = new Cloudlet(i, length+ addlen, pesNumber, fileSize,  outputSize,
utilizationModel, utilizationModel, utilizationModel);
      cloudlet[i].setUserId(userId);
      list.add(cloudlet[i]);
    }
```

4.2 Results of execution of cloudlets

4.2.1 Factors affecting Total Execution Time

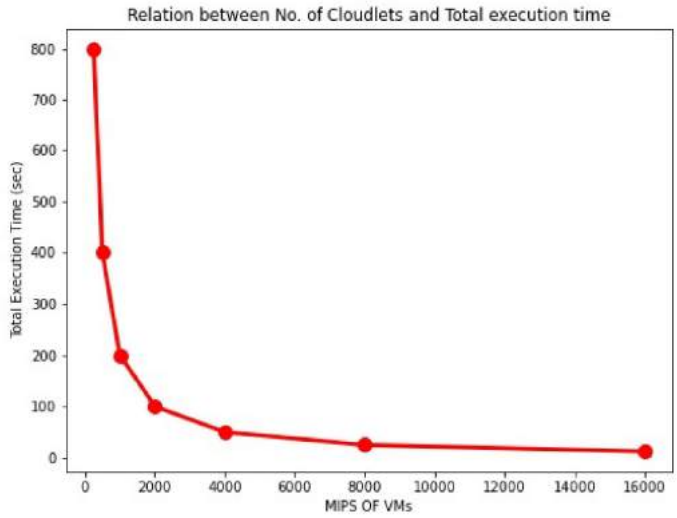


Figure 8: Effect of No. of cloudlets

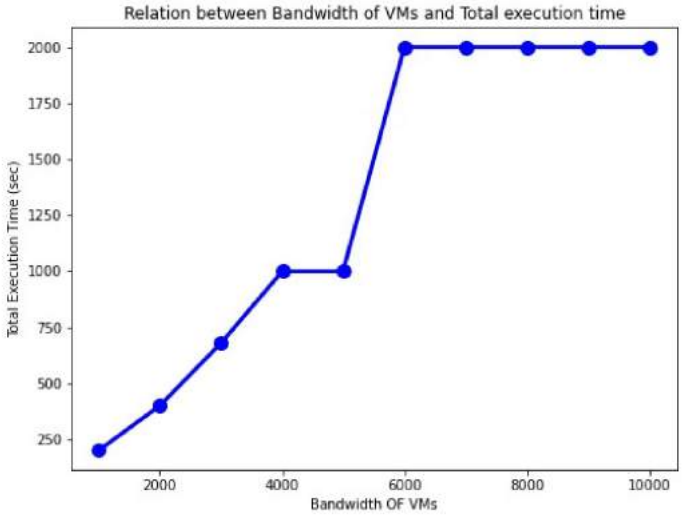


Figure 9: Effect of bandwidth of Vm

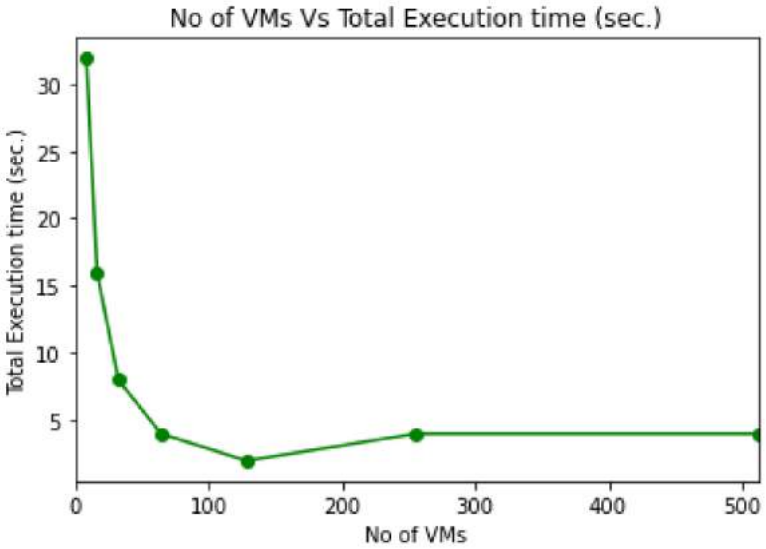


Figure 10: Effect of no. of Vms

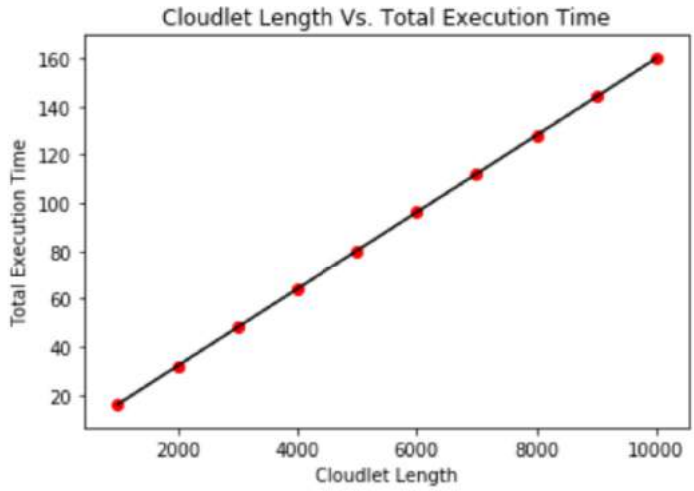


Figure 11: Effect of cloudletLength

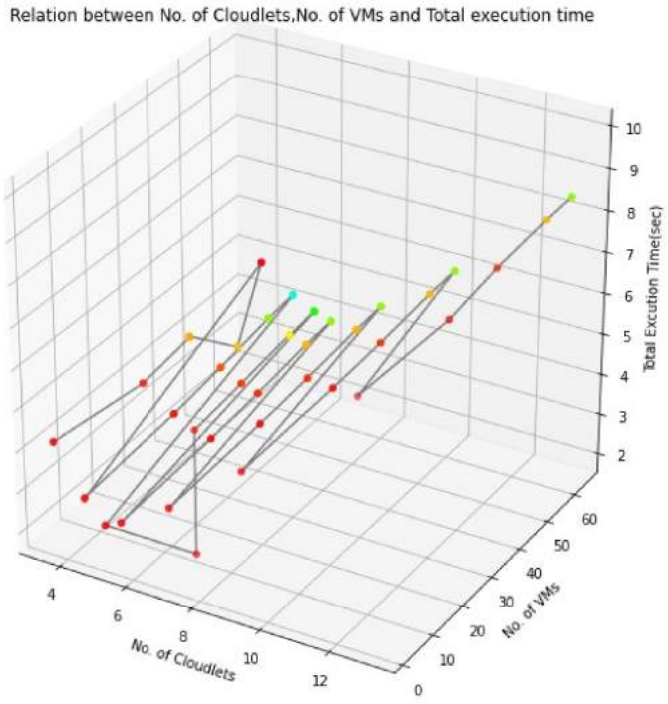


Figure 12: Relation between no. of cloudlets, Vms and total execution time

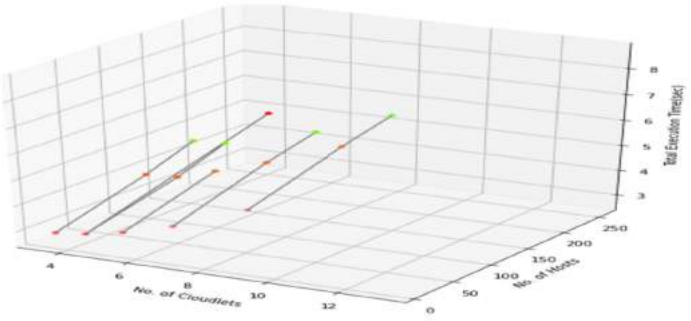


Figure 13: Relation between no. of cloudlets, hosts and total execution time

4.3 Task Scheduling Algorithms in Cloudsim [4]

First Come First Serve(FCFS) Scheduling

The order of tasks in task list is based on their arriving time then assigned to VMs which is based on FIFO rule in scheduling task

Shortest Job First(SJF) Scheduling

Tasks are sorted based on their priority. Priority is given to tasks based on tasks lengths and begins from (smallest task highest priority)

Round Robin Scheduling

The round robin algorithm allocates task to the next VM in the queue irrespective of the load on that VM. It does not consider the resource capabilities, priority, and the length of the tasks.

Table 2: Tasks lengths: assume we have 15 tasks with their lengths.

Task	Length
task1	100000
task2	70000
task3	5000
task4	1000
task5	3000
task6	10000
task7	90000
task8	100000
task9	15000
task10	1000
task11	2000
task12	4000
task13	20000
task14	25000
task15	80000

Table 3: Six VMs with their respective MIPS

VM	MIPS
VM1	500
VM2	500
VM3	1000
VM4	1000
VM5	2500
VM6	2500

Table 4: Table for Working of FCFS

Task	Execution Time	Waiting Time		
t1	400	VM0		
t2	280	VM1		
t3	20	VM2		
t14	04	VM3		
t5	12	VM4		
t6	40	VM5		
t7	360	wait(400)	VM0	
t8	400	wait(280)	VM1	
t9	60	wait(20)	VM2	
t10	04	wait(04)	VM3	
t11	08	wait(12)	VM4	
t12	16	wait(40)	VM5	
t13	80	wait(760)		VM0
t14	100	wait(680)		VM1
t15	320	wait(80)		VM2

4.3.1 FCFS Implementation

Table 5: Sorting of tasks in increasing order of their lengths

Task	Lengths
03	1000
09	1000
10	2000
04	3000
11	4000
02	5000
05	10000
08	15000
12	20000
13	25000
01	70000
14	80000
06	90000
00	100000
07	100000

4.3.2 SJF Implementation

Table 6: Table for Working of SJF

Task	Execution Time	Waiting Time		
t3	02	VM0		
t9	02	VM1		
t10	1.33	VM2		
t04	02	VM3		
t11	1.6	VM4		
t02	02	VM5		
t05	20	wait(2)	VM0	
t08	30	wait(2)	VM1	
t12	13.33	wait(1.33)	VM2	
t13	16.67	wait(2)	VM3	
t01	28	wait(1.6)	VM4	
t14	32	wait(.2)	VM5	
t06	180	wait(22.00)		VM0
t00	66.67	wait(14.67)		VM2
t07	200	wait(32.00)		VM1

Table 7: Table for Working of Round Robin

VMID	Lengths	Waiting Time	Execution Time
03	1000	00	04
03	1000	04	04
10	2000	12	8
04	3000	0	12
05	4000	40	16
02	5000	00	20
05	10000	00	40
02	15000	20	60
00	20000	0	400
01	25000	680	100
01	70000	00	280
02	80000	80	320
06	90000	400	360
00	100000	00	400
01	100000	280	400

4.3.3 Round Robin Implementation

4.3.4 Results

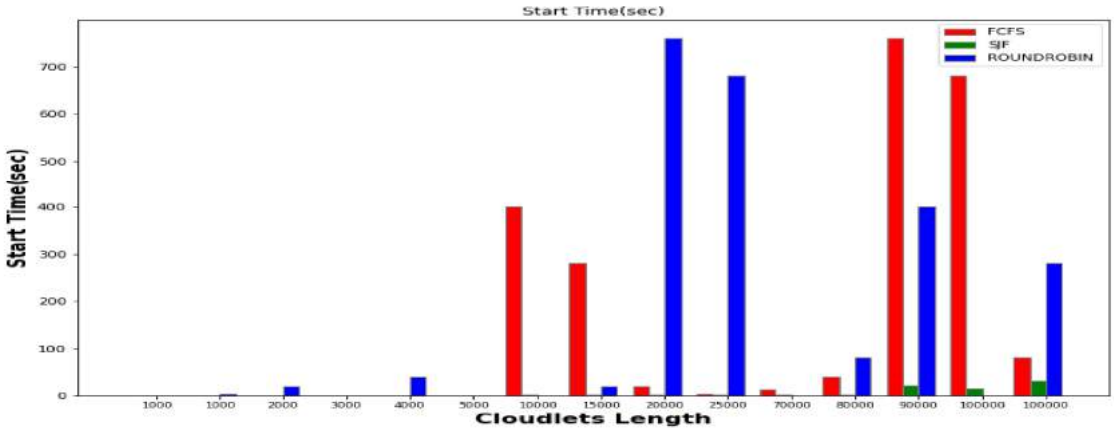


Figure 14: Comparision of Start Time of Task Scheduling algorithms.

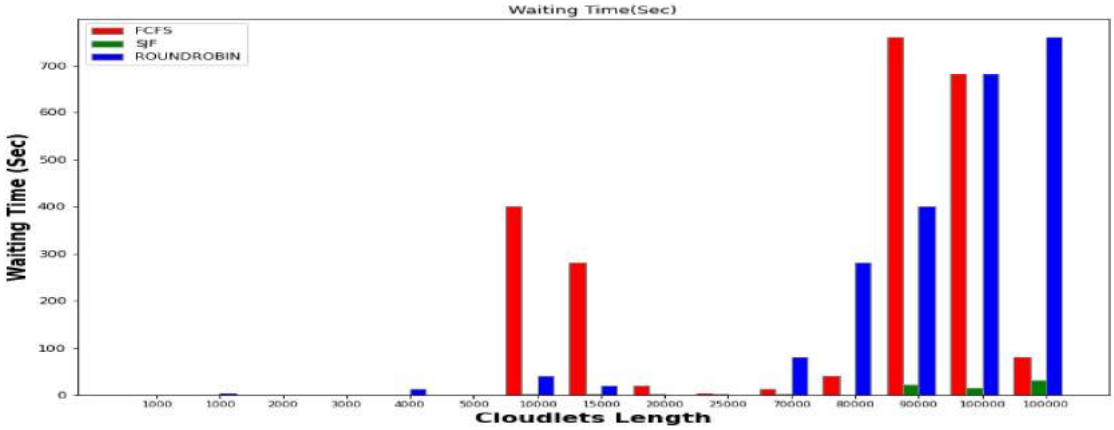


Figure 15: Comparision of Waiting Time of Task Scheduling algorithms.

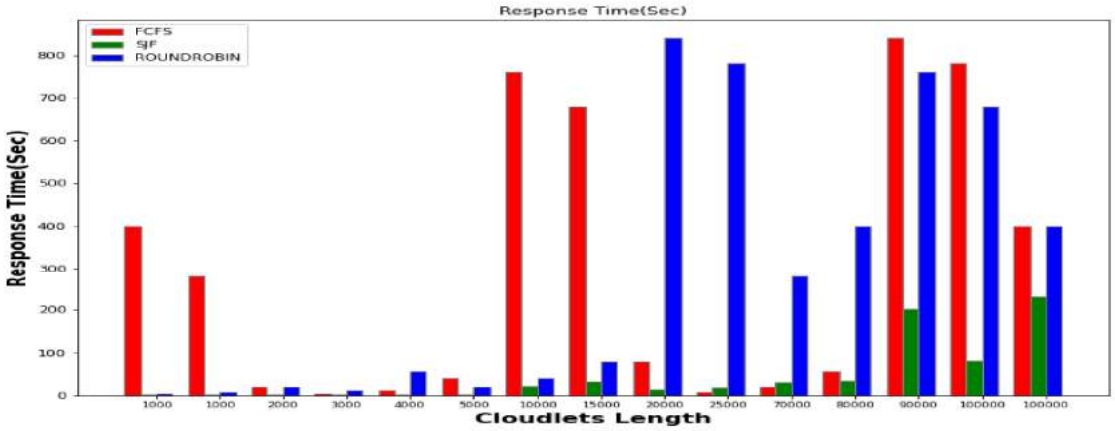


Figure 16: Comparision of Response Time of Task Scheduling algorithms.

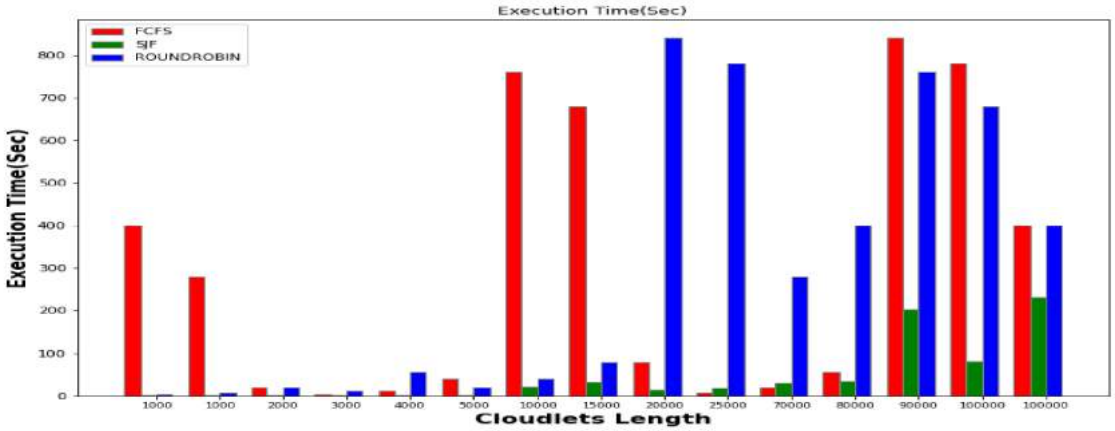


Figure 17: Comparision of Execution Time of Task Scheduling algorithms

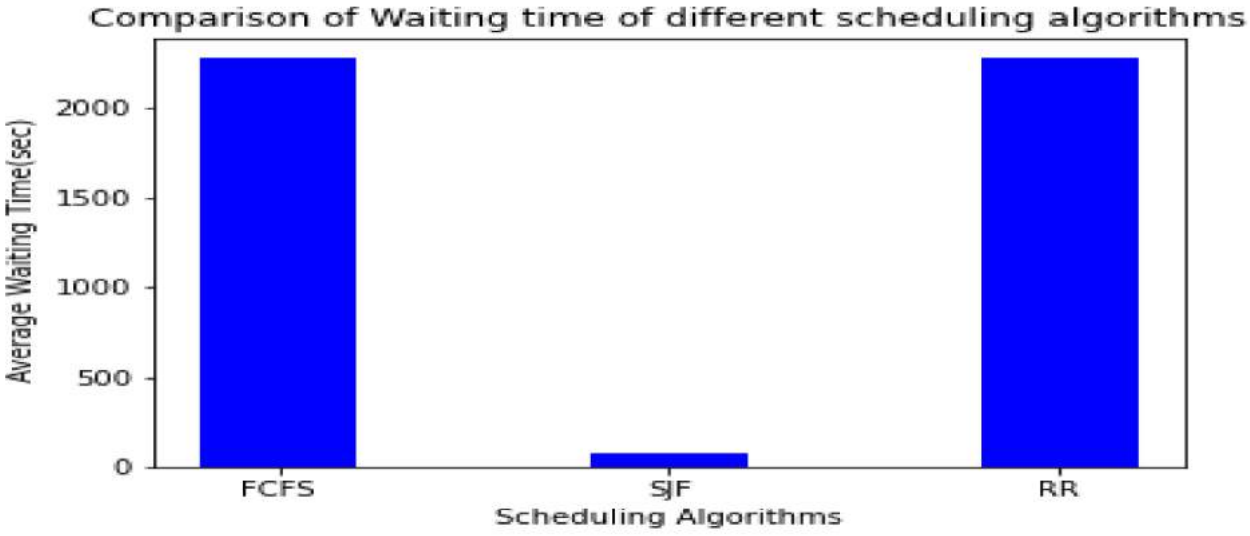


Figure 18: Comparision of Average Waiting Time of Task Scheduling algorithms.

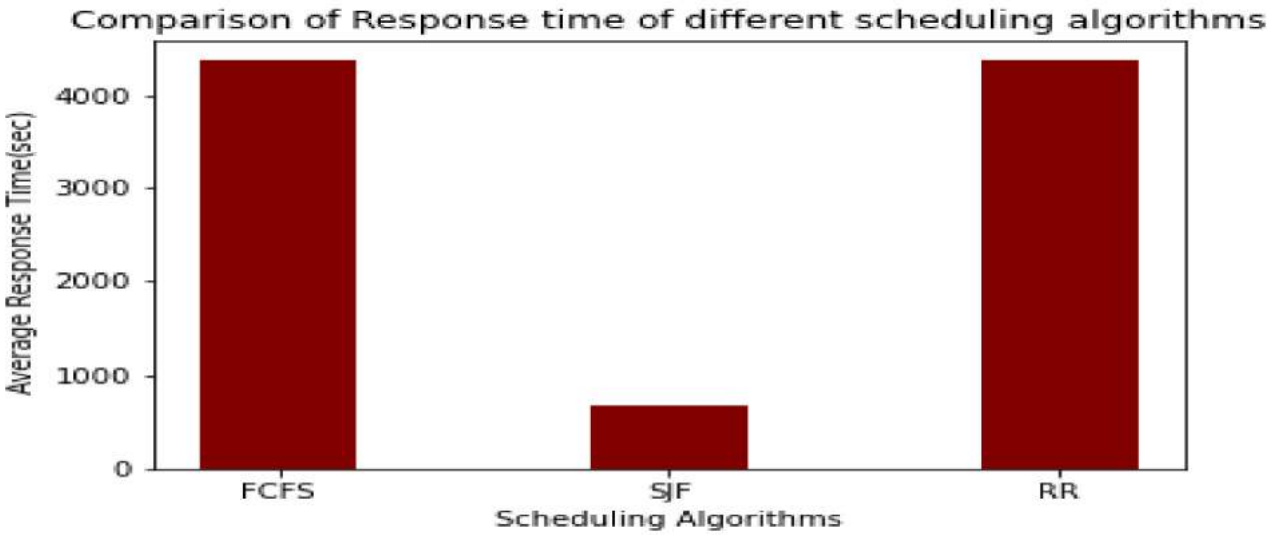


Figure 19: Comparision of Average Response Time of Task Scheduling algorithms.

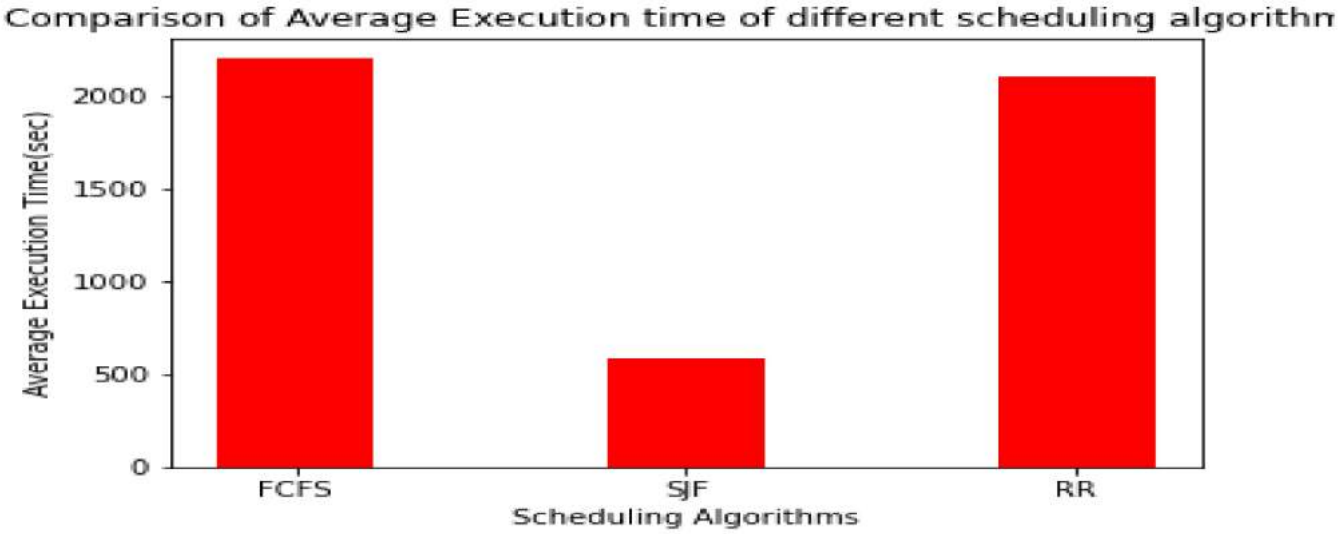


Figure 20: Comparision of Average Execution Time of Task Scheduling algorithms.

5 Conclusion and Future work

5.1 Conclusion

- Cloud Computing refers to delivery of both the softwares as a service and the infrastructure and the platforms that provide those services.

- We have used Cloudsim as simulation toolkit for simulating Cloudets by making Virtual Machine and run on it.

- Concluded on what factor the Execution time of running Cloudlets on VM depends.
- We have successfully compared the scheduling algorithms the **Cloudlet scheduler space shared**, **Cloudlet scheduler time shared**, **FCFS**, **SJF**, and **Round Robin** and saw that time has performance degradation in cases in which we compare the overall execution time taken by the cloudlet.
- We conclude that we have successfully simulated a heterogeneous cloud environment in which we discarded the assumption that all the processing entities inside a host are of the same MIPS rating and have successfully allocated processing entities with different MIPS ratings to virtual machines which need of processing entities.

5.2 Future Scope

- We are looking forward for the implementation of **post-copy** and **pre-copy** algorithm in Virtual Machine Migration [8].

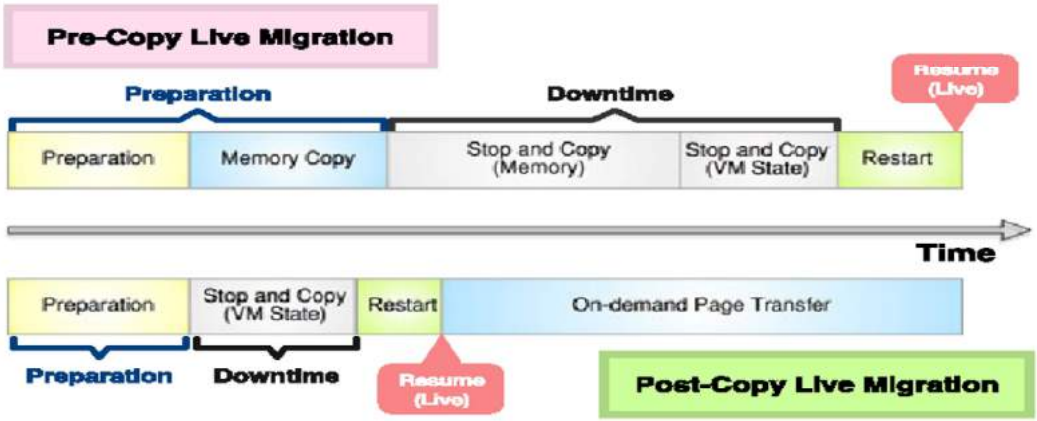


Figure 21: VM simulation in CloudSim

- We are also seeing to proposed solution for Virtual Machine Migration from one Physical Hardware into another.

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