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DIFFERENT TASK SCHEDULING ALGORITHMS IN CLOUD COMPUTING

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Abstract- Cloud Computing is a phenomenon in the current IT industry. It offers resources on a pay per user basis. Due to its benefits of high computing power, low service value, higher performance, accessibility in addition as availability makes it a power tool for users. Current work on task scheduling involves various algorithms like FCFS(First Come First Serve), Round-Robin, Priority Based Scheduling and SPF(Shortest Path First). The simulation has been done in Cloudsim. This work provides a comparative analysis of above algorithms on the basis of various quantitative metrics. From the analysis it has been observed that the Shortest Job First Algorithm is better among all these scheduling algorithms on the basis of minimum average waiting and turnaround time.

Keywords- Cloud computing, Task scheduling, Scheduling algorithms, FCFS, Round Robin, SPF.

1. INTRODUCTION

Cloud Computing is a technology that provides different services related with infrastructure, platform and applications to the clients via Internet. Clouds are made inside the data center premises using infrastructure like routers, servers, switches, network racks, SANs etc. Clients get benefits like they can totally focus on the businesses and all the IT related work can be managed by the cloud service provider like Amazon or Microsoft. Cloud is made up of multiple servers connected with each other and storage. Under the compute node, multiple Virtual Machines(VMs) are created so that all the CPU and disk resources can be utilized in a proper manner. Cloud Computing offers three major services i.e. Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS). IaaS means client is using the infrastructure services of the cloud service provider and application and OS related work can be configured with clients only, examples can be Microsoft Azure, Amazon EC2, Rackspace etc. PaaS offers a platform where web application can be built, deployed. Example of PaaS are Microsoft Azure, AWS Elastic Beanstalk etc. SaaS provides software services on demand. Example can be like Microsoft Office 365, Google Apps, Box etc.

2. PROPOSED WORK

2.1 Cloud computing characteristics-

- On-demand self-service- All the computing related capabilities are customizable and client can use it according to his/her requirements. One can easily upgrade and degrade their server configuration in a matter of few clicks.
- Broad Network access- To access the cloud, only internet enabled device along with a browser is needed. So if a client has internet access, then he/she can use the cloud services using any device like Laptop, Workstation, Mobile, Tablets etc.
- Resource pooling- Computing resources inside a data center are pooled to get the most of the use. Computing resources are shared for different clients and major focus is towards virtualization to get most of the benefits from the hardware.
- Elasticity- Clients can easily provision the resources and most of the up-gradations involves zero-downtime.
- Geographical independence- Client can access the cloud using internet from any location using any device.

2.2 Cloud Architecture-

Cloud Architecture is built with two vital parts i.e. it's front-end and the back-end.

- Front End – It is that part of the cloud which is seen by the end user or client. All the applications that client is using over the cloud are accessed using internet and over a web browser.
- Back-End – It is the cloud service provider's Data Center where all the infrastructure devices like Servers, Switches, Routers, Storage, Firewalls etc are placed.

Below figure shows cloud computing architecture:

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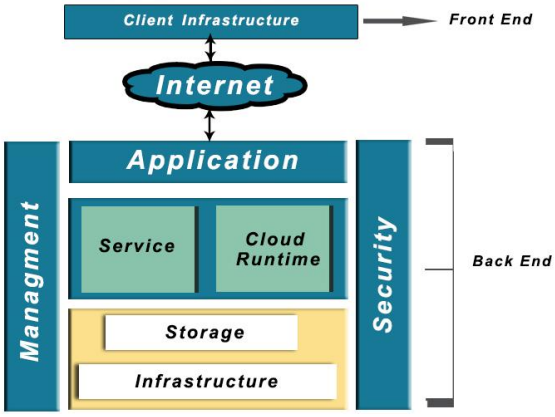


Figure 1. Cloud Computing Architecture

2.3 Types of Cloud computing-

Cloud computing have four types i.e. public, private, hybrid, community cloud which are shown in Fig. 2.

- Public Cloud- Public Cloud has access to general public and public cloud service provider provides all the services to the public which also includes the responsibility to manage the data center where all the data is stored.
- Private Cloud- This cloud computing infrastructure is used within a particular company and not shared by any the other company. It is much safer to use a private cloud than public ones as the data center is managed by the enterprise itself.
- Hybrid Cloud - It is an integrated solution of public and private attributes. It provides both in-house and external services.
- Community Cloud- This cloud is generated where many organizations have similar uses and explore advantages from cloud computing profit by sharing the infrastructure.

3. TASK SCHEDULING

Cloud Service Provider's Data Center has large number of Servers and other computing infrastructure. Thousands of Virtual Machines runs inside a data center to utilize the resources in best possible manner. Task Scheduling can be done to efficiently utilize the resources by allocating specific tasks to specific resources. It automatically improves the quality of service and performance. These task scheduling algorithms are categorized into two different categories, one is Batch Mode Heuristic Algorithms finds the task with lease execution time and then assigns the resource to that task which produces least execution time. If multiple resources provides the same amount of execution time, then resource is selected on a random basis. Various BMHA examples are FCFS Algorithm, Round-Robin Algorithm, Min-Min Algorithm and Max-Min Algorithm. Online Mode Heuristic Algorithms works in a way that tasks are scheduled as they are arrived in the system.

Some Important Terms that are used in these scheduling algorithms-

A.T= Arrival Time

B.T= Burst Time

C.T= Completion Time

T.T = Turnaround Time = Completion Time - Arrival Time = C.T - A.T

W.T = Waiting Time = Turnaround Time - Burst Time = T.T - B.T

4. EXPERIMENT AND RESULT

Different Task Scheduling Approaches-

4.1 First-come-first-serve scheduling Algorithm-

In this algorithm, tasks that arrived first are served first. Jobs when enter the queue are inserted into the tail of the queue. One by one each process is taken from the head section of the queue. This algorithm is straightforward and quick.

Characteristics-

- There is no prioritization at all and this makes every process to eventually complete before any other process is added.
- This type of algorithm does not work well with delay sensitive traffic as waiting time and delay is relatively on the higher side.
- As context switches only occurs when a process is terminated, therefore no process queue organization is needed and there is very little scheduling overhead.

4.2 Shortest Job First scheduling Algorithm-

SJF Algorithm is a pre-emptive that selects the waiting process that has the least execution time. The process is then allocated to the processor that has the least burst time.

Characteristics-

- One of the problems that SJF algorithm is that it has to get to know about the next processor request.
- It reduces the average waiting time as it executes small processes before the execution of large ones.
- When a system is busy with so many smaller processes, starvation will occur.

4.3 Round Robin scheduling Algorithm-

In this type of algorithm, processes are executed just like in FIFO, but they are restricted to processor time known as time-slice. If the process is not completed before the expiration on processor time, then the processor takes the next process in the waiting state in the queue. The preempted or new process is then added to the rear of the ready list and then new processes are inserted in the tail of the queue.

Characteristics-

- If we apply a shorter time-slice or quantum, then in that case there will be lower CPU efficiency.
- If we apply a long time-slice or quantum, then it will result in poor response time.
- As waiting time is high, there will be a very rare chance that deadlines met.

4.4 Priority scheduling algorithm-

In this algorithm, priority is assigned to each process and processes are executed on the basis of priority. Priorities having same priority use FCFS.

Characteristics-

- If there is a large number of equal priority processes, then it results in large waiting time.
- Processes with higher priority results in least waiting time and lesser delay.
- Low prioritized processes can see starvation.

  Implementation of various task scheduling algorithms by using cloudsim for different data sets is as follows -

  First Data Set Without Arrival Time-

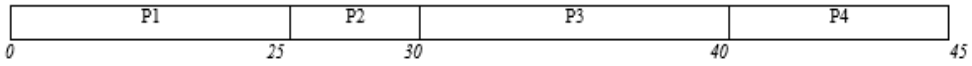
  1. A Gantt Chart with Waiting Time and Turnaround Time is computed.

  Consider the set of processes given below with the CPU-burst time in ms as shown in table 1 :-

Table -1 Process Id And Burst Time

Process ID	Burst Time (ms)
P 1	25
P 2	5
P 3	10
P 4	5

a. Gantt chart for FCFS-



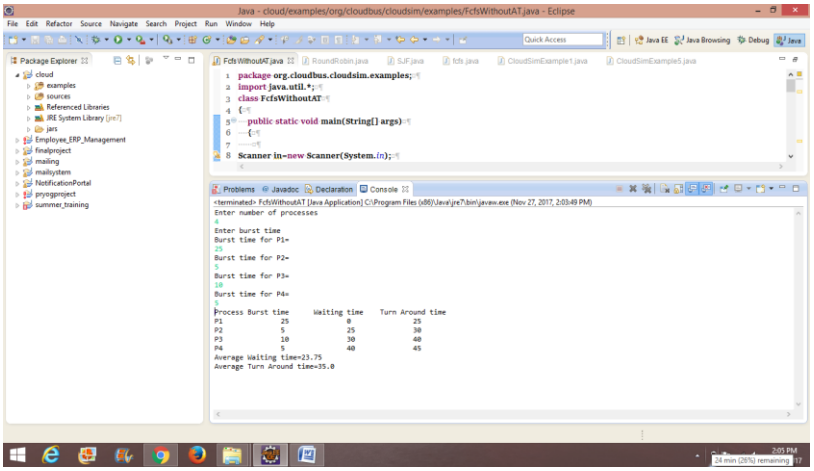
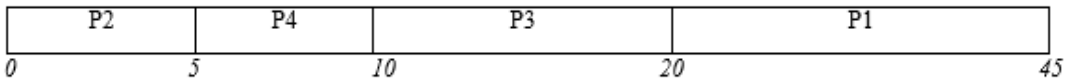


Figure 2. Snapshot Of FCFS

b. Gantt chart for Shortest Job First (SJF)



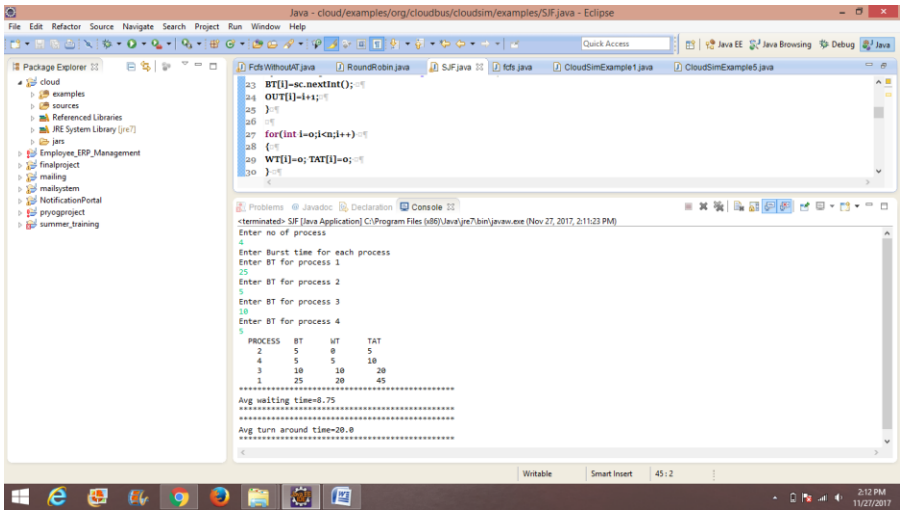
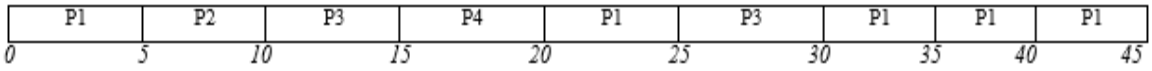


Figure 3. Snapshot Of SJF

c.Gantt chart for Round Robin(RR) - 5 ms



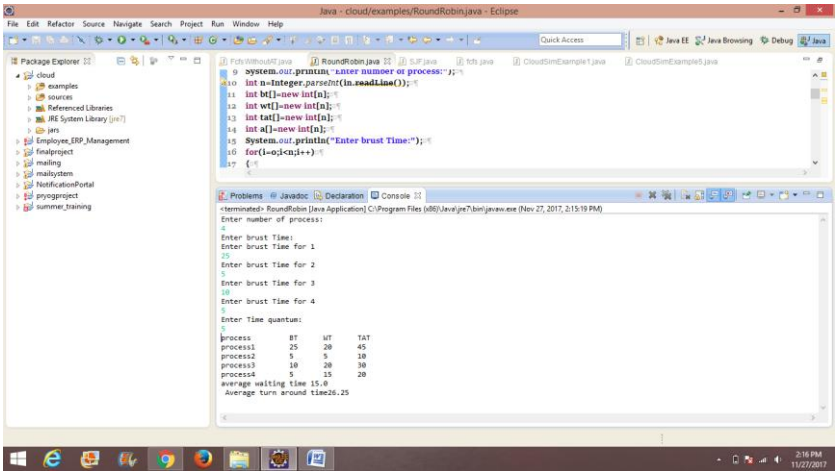
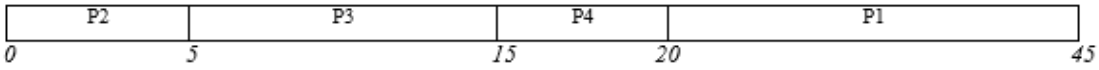


Figure 4. Snapshot Of RR

d. Gantt chart for Priority Scheduling-
Priority is assigned to every process :
Table -2 Process Id, Burst Time And Priority

Process ID	Burst Time (ms)	Priority
P1	25	4
P2	5	1
P3	10	2
P4	5	3



Calculation of turnaround and waiting time for all other algorithms is in below Table 3 and 4. From above results it is clear that FCFS and SJF works well in batch systems, while Round Robin and Priority Scheduling provides time sharing abilities. SJF is suitable for almost all type of scenarios. We have taken 30 data sets to see the result and there are few examples of scheduling algorithms as below:

Table -3 Waiting And Average Waiting Time Of Every Process
For All Scheduling Algorithms

Process ID	FCFS	SJF	RR	Priority Scheduling
P1	0	20	20	20
P2	25	0	5	0
P3	30	10	20	5
P4	40	5	15	15
Average Waiting Time	23.75	8.75	15.5	10

Table - 4 Turnaround And Average
Turnaround Time Of Each Process For All Scheduling Algorithms

Process ID	FCFS	SJF	RR	Priority Scheduling
P1	25	45	45	45
P2	30	5	10	5
P3	40	20	30	15
P4	45	10	20	20
Average Turnaround Time	35.0	20.0	26.5	21.5

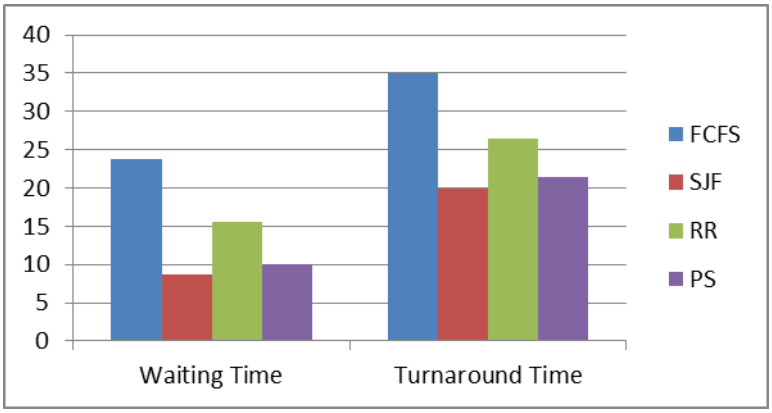
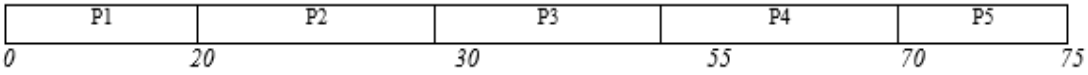


Figure 5. Comparison Of Avg. Waiting Time And Turnaround Time Second Data Set When Arrival Time Is Also Given-

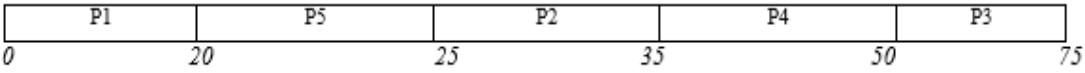
Table - 5 Process Id, Burst Time, And Arrival Time

Process Id	Arrival Time	Burst Time	Given Priority
P 1	10	26	22
P 2	12	2	7
P 3	20	16	25
P 4	26	8	26
P 5	17	13	20

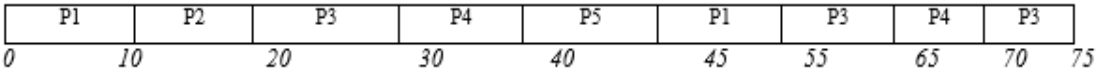
a. Gantt chart for FCFS



b. Gantt chart for SJF



c. Gantt chart for RR = (Time Slice = 10)



d. Gantt chart for Priority Scheduling(PS)

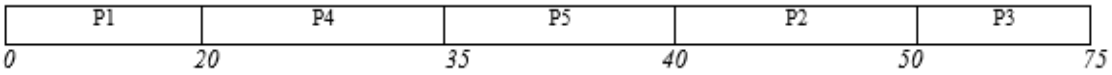


Table - 6 Average Waiting And Turnaround Time

	FCFS	SJF	RR	Priority Scheduling(PS)
Average Waiting Time	33	24	36	27
Average Turnaround Time	48	39	51	42

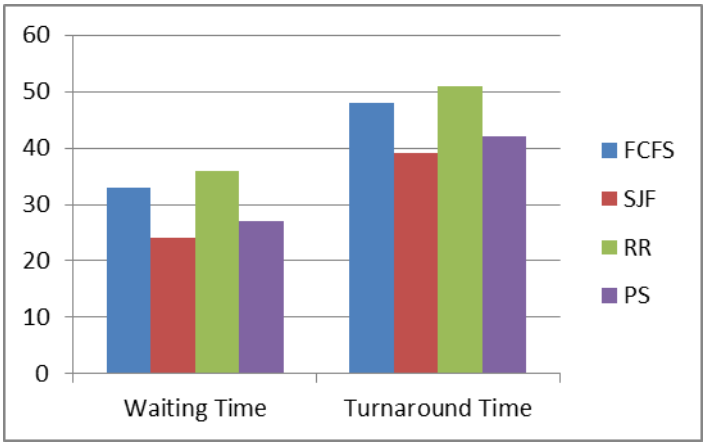


Figure 6. Comparison Of Avg. Waiting Time And Turnaround Time

5. RESULTS AND DISCUSSION

It is find out that SJF provides a better turnaround and waiting time than all other algorithms. Throughput and CPU utilization with SJF is also seems to be optimum. FCFS involves largest waiting and turnaround time as it has short processes wait for a longer intervals. With large waiting time even for smaller processes, it is not recommended where delay sensitive traffic is involved. In RR, each job gets an equal amount of time, but there are some cases where average waiting time can be a problem. Time Slice or Quantum has to be decided carefully, otherwise a larger time-slice or quantum can affect the processing. Priority Queuing can become problem if there are large sets of processes with similar priority as then it can work like FCFS too.

Table -7 Experiment Result

S. No.	Algorithms	Evaluation Criteria	Advantages	Disadvantages
1	First Come First Serve	Waiting and turnaround time is high, Low Response Time	Easy implementation	No other criteria for scheduling

2	**Round Robin**	**Medium waiting time, medium turnaround time, High Response time**	**Less complex and Appropriately load is balanced**	**Preemption is required**
3	**Shortest Job First Scheduling**	**Less waiting time, Small execution time, maximum throughput**	**CPU is allocated to the process that has the minimum amount of burst time.**	**Difficult to understand**
4	**Priority based**	**High turnaround time and high response time**	**It is designed on the basis of multiple criteria decision making model.**	**Difficult to understand and code**

6. CONCLUSION

The work analyses the different types of scheduling algorithms and also compared them with each other. In this paper, it is analyzed that FCFS algorithm has several disadvantages like higher waiting and turnaround time and the processing time of every job must be known in advance. In SJF, any longer jobs will have to wait for completion of smaller processes. Round Robin algorithm provides equal amount of time intervals to every process, these processes can be smaller or larger ones, but they get the same set of time-slices. Priority Scheduling Algorithm appends priority to the processes and processes with higher priority have a lower waiting time. Problem occurs when large number of processes with same set of priorities are in the queue, then priority queue works like FCFS. SJF algorithm works best as it has least average waiting and turnaround time. But still the performance requirements of current cloud service providers need does not met. This leads to the desire and need to propose a replacement scheme that provides a much better performance.

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