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Cloud Task Scheduler for Large-Scale Massive Data

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ABSTRACT: Cloud computing provides facilities for processing massive amounts of data. Task scheduling refers to a set of techniques for assigning a group of tasks to the available virtual machines (VMs). The main challenge of the task scheduling mechanism is to increase resource utilization without affecting the quality of services. In this project, an enhanced parallel scheduling algorithm is proposed called TOPE (Two-phase Optimization for Parallel Execution).The algorithm is based on the distributed multi-objective PPSO algorithm and aims at scheduling a large number of tasks without affecting the system performance.The proposed algorithm divides the submitted tasks into a number of batches in a balanced and dynamic way.

I. INTRODUCTION

Cloud computing is a concept which has a number of computers that have real-time connection through the Internet. Cloud computing, which allows users to pay only for the resources they use and use can be measured at a granular level [5]. Cloud computing has three types of cloud models which are

- Private Cloud
- Public Cloud
- Hybrid Cloud

Cloud computing is a distributed computing which mainly focuses on providing service to the customers and it provides computational as well as storage resources to users. ”Cloud computing” is a term, which involves virtualization, distributed computing, networking, software and web services. A cloud consists of several elements such as clients, datacenter and distributed servers. It includes fault tolerance, high availability, scalability, and flexibility, reduced overhead for users, reduced cost of ownership, on demand services.

Services of Cloud Computing

Cloud Computing provides three types of service models [1]. The three service models (SPI) are:

Cloud SaaS

The capability provided to the consumer is to use the provider’s applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser. The consumer does not manage the underlying cloud infrastructure [5].

Cloud PaaS

The capability provided to the consumer is to deploy onto the cloud infrastructure consumer created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure, but has control over the deployed applications and possibly application hosting environment configurations.

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Cloud IaaS

The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of selected networking components. Cloud Computing Architecture is shown in the Fig 1.

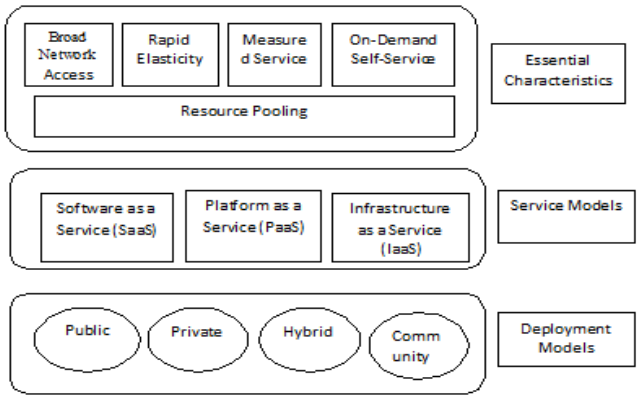

Fig 1. Cloud Computing Architecture

II. LOAD BALANCING

Load balancing is used to distribute a larger to smaller load for the extend of the overall system performance. In between all the nodes, the dynamic workload can be uniformly distributed to get required load can be balanced.

Load balancing possible fair allocation of computing resource to attain a high user needs and properly utilize the resources to minimize resource consumption. It assists in performing failover, scalability, and avoiding congestion. Load Balancer helps to achieve load balancing in an efficient way [7] as shown in Figure 2.

Metrics for load balancing in cloud

- Throughput
- Overhead Associated
- Fault Tolerance
- Migration time
- Response Time
- Resource Utilization
- Scalability
- Performance

Throughput is used to calculate the no. of tasks whose execution has been completed.

Overhead Associated determines the amount of overhead involved while implementing a load-balancing algorithm. It includes overhead due to movement of tasks, inter-processor and inter-process communication.

Fault Tolerance is the ability of an algorithm to perform uniform load balancing in case of link failure [9]. The load balancing should be a good fault-tolerant technique

Migration time is the time to migrate the jobs or resources from one node to other. It should be minimized in order to enhance the performance of the system.

Response Time is the amount of time taken to respond by a particular load balancing algorithm in a distributed system.

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Resource Utilization is used to check the utilization of resources.

Scalability is the ability of an algorithm to scale according to the requirement.

Performance is used to check the efficiency of the system. This has to be improved at a reasonable cost, e.g., reduce task response time while keeping acceptable delays.

Goals of Load balancing

- To enhance the performance significantly.
- To have a backup plan in case the system fails partially
- To sustain the system security.
- To provide space for modifying the system in the future.

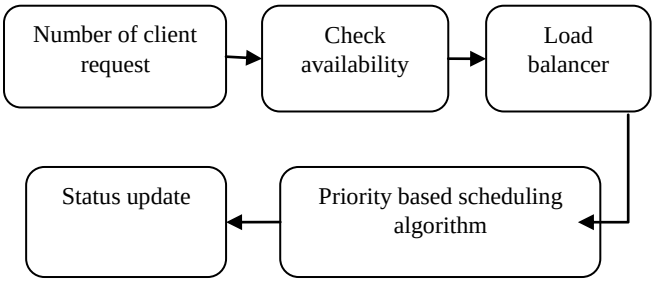

Fig 2. Load Balancer

Load balancing can be categorized into two categories which are

- Static load balancing
- Dynamic load balancing

A. Static Load Balancing Algorithm

Static load balancing is VM placement issue in which the host on which VM can be placed before it begin based on the load on the network which is the host with significant system operation runs the VM. Load balancing in a static environment, cloud provider initial knowledge about nodes such as Processing power, capacity, storage memory and user requirement [6]. Resources on the cloud are not flexible and cloud provider which provides a homogeneous pool of resource with the same configuration. This type of load balancing algorithms is easy to implement, but restriction is, it cannot modify load at run time. It is mostly for homogeneous pool of resource.

Round Robin Algorithm

Round Robin Algorithm is best for static environment. In this algorithm, time is separated into several time quantum. Time quantum can be assigned to each node during its operation. Here resources are assigned to the tasks on FCFS (First Come First Serve) basis. After expiration of the time quantum next request in queue is served for the same time quantum[9]. When the request is not completely within the time quantum, it has to wait to its next turn.

Opportunistic Load Balancing Algorithm (OLB)

In opportunistic Load Balancing, each task can be scheduled in random order to the next machine in which the task does not depend on run time on that machine. The aim of OLB is too busy all machines as much as possible. One advantage of OLB is its simplicity, but the drawbacks are same as Round Robin. The current workload cannot examine of the Virtual Machine. It makes each node to be busy. The non executed tasks are allocated to the nodes which are not in order.

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Min-Min Algorithm

In Min-Min Algorithm, begins with a set of all unassigned tasks. First of all, minimum completion time for all tasks is found. Then among these minimum times the minimum value is selected which is the minimum time among all the tasks on any resources. Then according to that minimum time, the task is scheduled on the corresponding machine. Then the execution time for all other tasks is updated on that machine by adding the execution time of the assigned task to the execution times of other tasks on that machine and assigned task is removed from the list of the tasks that are to be assigned to the machines[6]. Then again the same procedure is followed until all the tasks are assigned on the resources. But this approach has a major drawback that it can lead to starvation.

Max-Min Algorithm

In Max-Min Algorithm, the larger and smaller tasks will be assigned based on task priority. This algorithm is used to the minimize the waiting time for the short jobs across larger tasks can be executed first by slower resources and short jobs with fastest resources where the execution time can be differ from Meta tasks. With the minimum execution and maximum completion time where the tasks can be completed. The efficiency can be improved in Max-Min algorithm.

B. Dynamic Load Balancing Algorithm

Dynamic load balancing allocate VMs based on the performance of the overall system at runtime using the attribute of transfer the load. In Dynamic Environment, initial knowledge cannot be a need for a cloud provider doesn't need prior knowledge of nodes; it depends on run-time. Implementation will be difficult, but the variation in load can be adapted at run-time. In this load balancing, the cloud provides a heterogeneous pool and also enhances flexibility of resources.

Load Balance Min-Min Algorithm (LBMM) algorithm

Load Balance Min-Min Algorithm (LBMM) algorithm is proposed that the resource utilization will be increased and makespan can be reduced. The algorithm can be categorized into two phases. In first phase, LBMM executes Min-Min algorithm. In the second round, it chooses the resources with heavy load and reassigns them to the resources with light load. In LBMM, Min-Min can be produced the resource with high makespan in that resource with a heavy load can be identified. It then the tasks will be allocated in that resource and the task with minimum execution time will be closed on that resource.

III. OPTIMIZATION LOAD BALANCING ALGORITHMS

A. Ant colony optimization algorithm

This algorithm is mainly for load balancing of nodes. The intention of this algorithm, the workload can be distributed between the nodes. When the request is initialized, the ant will reach the food source from the head node. Ant updates their information for further decision making and save the information for each node and its visit to the information. Every ant is forged their own individual result and supply with the complete solution, then update with this result. Cloud computing is a concept which has a number of computers that have real-time connection through the Internet [3]. In cloud computing, users will pay for the resources itself. This ant colony is processed with foraging behavior and will look for new food sources with the use of existing food sources to hive. This algorithm does not give an optimal solution when balancing the load in heterogeneous virtual machine.

B. Honey bee behavior inspired load balancing algorithm

Load balancing aims to load balance throughout virtual machines in a heterogeneous environment. The current workload can be computed in a virtual machine and it determines about the load or unloads. This load balancing algorithm uses the ideas of natural foraging behavior of honey bees. The honey bees called the removal of tasks from the overloaded VM's and the food source called the low loaded VM's. In an under load VM, the task can be accepted and it would update the load and number of different task's priority of that VM as the main VM selection factor [8]. It aims to maximize the throughput and response time of the tasks will be reduced. The honey bee algorithm contains three groups of bees.

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- Scout Bees
- Forager Bees
- Onlooker Bees

Scout bees

Scout bee is a soldier sent to collect the information from the food resources and will update the information to bee hive, then inform forager bees for further process.

Forager bees

The bee visited the food source by scout bees previously is forager bee.

Onlooker bees

It does not participate but will watch and then waiting in the dancing area called Onlooker bees.

Food sources can be searched by scout bees, when it's found, they move towards to the hive to inform this using a "waggle dance". This dance displays the amount of the food source. Forager bees then follow the scout bees back to find the food source and start to collect it. The present amount of food available is determined in their waggle dances, remaining bees will be sent to food source, or utilized food sources will be discarded.

Over loaded VM

The load in VM which exceeds the threshold value is called Overloaded Virtual Machine.

Under loaded VM

The load in VM which is less than the threshold value is called Overloaded Virtual Machine.

Load Balanced VM

The load which is equal to the threshold value is called Overloaded Virtual Machine.

Threshold Value

The interval between 0 to 1 [0-1] will be the threshold condition set.

C. Firefly algorithm

The firefly algorithm is a metaheuristic algorithm, of extraordinary quality which is the flashing behavior of fireflies. The main aim to attract other fireflies where firefly's flash can be act as a signal system. Then, we consider the optimality related with balancing exploration and exploitation, all metaheuristic algorithms can be necessary. By comparing with irregular search strategy, we decide that metaheuristics such as firefly algorithm are finer than the honey bee search strategy.

IV. CONCLUSION

Cloud computing concept has a number of computers that have real-time connection via the Internet. In cloud computing environment, which allows users to pay only for the resources. It is a fast growing and very diverse area. Cloud environment provides number of facilities to its users, but still there are many challenges. Load balancing is an approach in which the load can be distributed among individual nodes to maximize throughput and to minimize response time. In this paper discussed the various assessments of load balancing algorithms. The above study showed that static load balancing algorithms are more stable compared with dynamic and it is also easy to get the behavior of static, but at the same time dynamic algorithms are always better than static algorithms. Because dynamic algorithms provides efficient load balancing than static algorithms.

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