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Genetic based Task Scheduling Algorithms in Cloud Computing Environment

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Abstract: ***Cloud computing is widely utilized in companies and enterprises. However, there are some challenges in using Cloud computing. The most challenge is resource management, where Cloud computing provides IT resources (e. g., CPU, Memory, Network, Storage, etc.) supported virtualization concept and pay-as-you-go principle. The management of those resources has been a topic of much research. During this paper, a task scheduling algorithm supported Genetic Algorithm (GA) has been introduced for allocating and executing an application's tasks. The aim of this proposed algorithm is to attenuate the completion time and cost of tasks, and maximize resource utilization. The performance of this proposed algorithm has been evaluated using CloudSim toolkit.***

Keywords: cloud computing, task scheduling cloudsim toolkit

1. Introduction

When we have the Internet as cloud, then we are representing abstraction, which is one among the most important and essential property of cloud computing. Within the Internet, which is named as cloud, resources are pooled and partitioned as required and communications are based on some standards [1]. A replacement type of computer model i.e. Cloud provides the user with convenient and ever-demanding access of network for various computing resources over the web. Cloud computing which may be a huge distributed computing environment contains a large amount of virtualized computing resources available for individual or an organization. Reason behind development or introduction of cloud computing is to supply the guarantee of Quality of Service (QoS) which is quite challenging. Scheduling of job and maintaining load is becoming a main issue in cloud environment. This will be achieved by adopting appropriate task scheduling algorithm.

Cloud computing basic component: during this section, we'll discuss the basic components on which cloud computing deployed. These components contain a wide range of services that we can use all over the internet. Here we discuss some important component

- **Virtualization**: It plays a crucial role in deploying the cloud. it's the strategic component in the cloud, which allows the physical resources by multiple consumers. It creates the virtual instance of resource or device like operating system, servers, network resources and storage devices wherein the framework utilize the resources into quite one execution environment.
- **Multi-tenancy**: Multi-tenant environment can have multiple customers or users who doesn't see or share each other's data but can share resource or application in an execution environment, whether or not they may not belong to the same organization. Multi-tenancy results the optimal utilization of hardware and data storage mechanism. This thesis address issues associated with this area.
- **Cloud storage:** it's a component, which maintained, managed, and protected remotely and it made available over the network where the users can access data.
- **The hypervisor:** The So called virtual machine monitor or manager may be a key module of virtualization. It allows multiple Virtual Machines (VMs) to run on one hardware host. It manages and monitors the varied operating systems, which run during a shared physical system.

2. Related Work

A. Scheduling in Cloud Computing:

The most objective of task scheduling algorithms is to maximize the resource utilization in cloud environment. Minimizing the waiting time of resources in cloud data centre is that the main goal of scheduling, an honest scheduling algorithm always yields good system performance, within the cloud there are numerous and distinct resources available. The value of performing tasks in cloud depends on which resources are being used so the scheduling in a cloud environment is different from the traditional scheduling, during a cloud computing environment task scheduling is a biggest and challenging issue.

A Cloud provider first constructs a computer system called cloud, during this we have several virtual machines interconnected and the provider processes the task of the users. "Cloud computing isn't a well behaved model for providing wanted, user-required, flexible access to a shared pool of configurable computing resources which will be quickly provided and released with low care effort or service are going to study the divisible task scheduling of high performance computing algorithms" [2]. Cloud computing environment where multiple virtual machines (VMs) can share physical resources (CPU, memory, and bandwidth) on one physical host and multiple VMs can share the bandwidth of a data center by using network virtualization. Because many users and applications essentially share system resources, a correct task-scheduling scheme is difficult to

resource utilization and system performance. Many system parameters, like processor power, memory space, and network bandwidth, affect the efficiency of task scheduling.

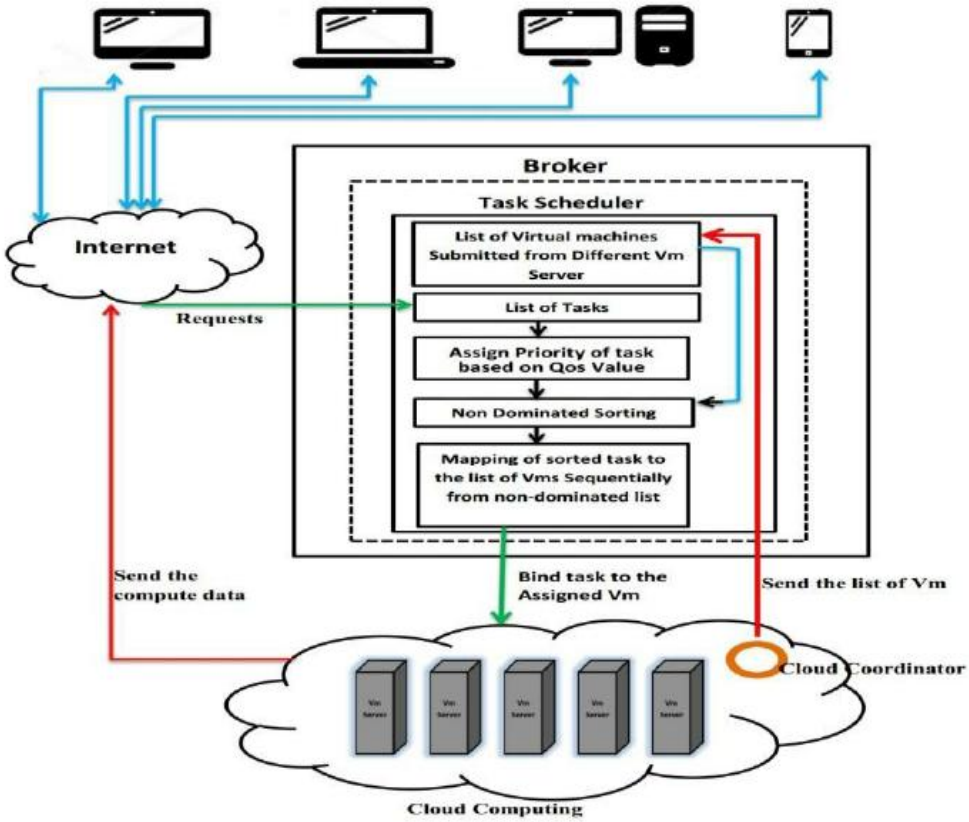
In addition, difference in computing sources in several nodes adds to the complexity of task scheduling. Furthermore, frequent data exchange among nodes, hosts, and clusters in data-intensive cloud applications makes the task-scheduling procedure extremely complicated. Most of those methods focus on allocating CPU and memory resources to various cloud-computing tasks, assuming that each one physical nodes and VMs have unlimited network bandwidth. The multidimensional task scheduling algorithm is predicated on the availability of CPU, memory, and VMs. This algorithm considers the limitation of resources, and provides resources consistent with task needs and resource loads. Computing resources like CPU, memory and bandwidth are employed by many users, so it's little difficult to construct an efficient task scheduling algorithm. The efficiency of the algorithm is suffering from many things like the processor power, speed, space and memory [3]. On behalf of this the heterogeneity of computing sources also causes damage to the efficiency of algorithm.

Generally, task scheduling is that the main process in structure as a service model. While cataloging the task we consider virtual machines as scheduling machines. The most end of task scheduling algorithms in pall terrain is to maximize the application of coffers, effectiveness and to gauge back their task prosecution time. Task operation is a marquee exertion comprising of colorful stages of coffers and workloads from workload submission to workload prosecution.

Task Scheduling in Cloud includes two stages
i) Resource provisioning and
ii) Task scheduling.

Task Scheduling is defined to be the stage to spot acceptable coffers for a given task grounded on QoS conditions described by pall consumers whereas resource scheduling is mapping and prosecution of pall consumer workloads grounded on named coffers through resource provisioning as shown inFig.1.2. Originally, pall consumer submits request for task/ workload prosecution within the form of workload details. Supported these details broker (resource provision or) finds the suitable resource (s) for a given task and determines the feasibility of provisioning of coffers grounded on QoS conditions (4). Broker sends requests to resource scheduler for scheduling after successful provisioning of coffers. Other liabilities of broker include release of fresh coffers to resource pool, contain information of provisioned coffers and cover performance to point or remove coffers. After resource provisioning, resource scheduling is completed in alternate stage.

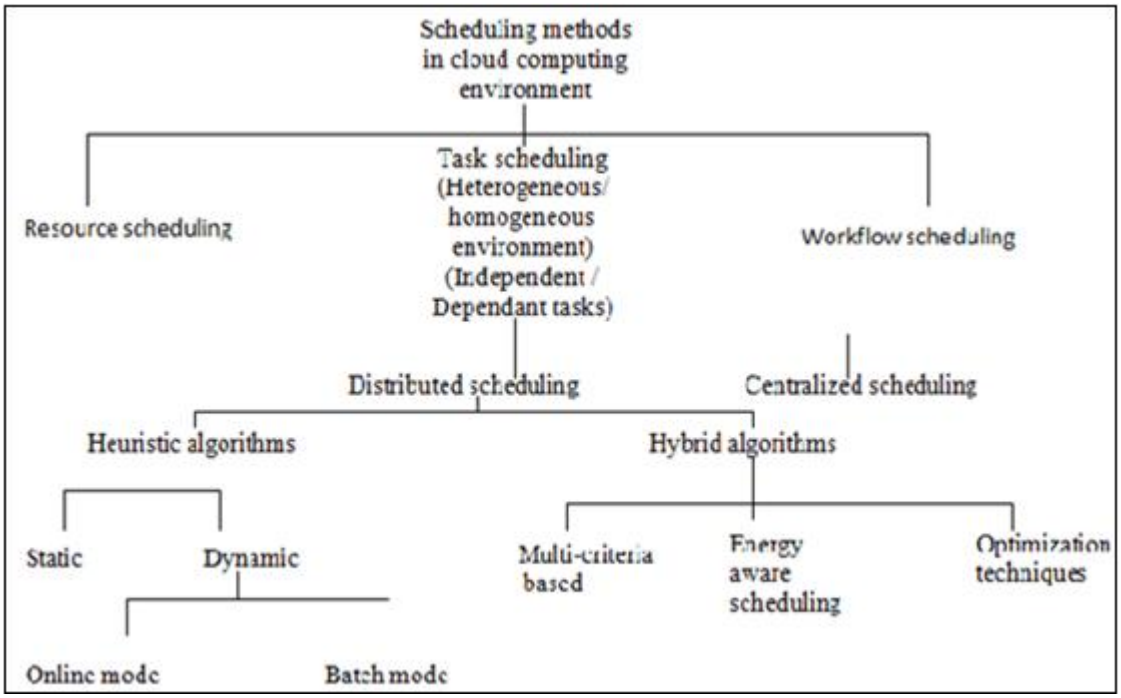
All the provisioned coffers are kept in resource line while other remaining coffers are in resource pool (5). Submitted tasks are reused in task line. During this stage, cataloging agent maps the provisioned coffers to given tasks, execute the tasks and release the coffers back to coffers pool after successful completion of tasks. Supported QoS conditions, scheduling of coffers for acceptable task may be a grueling issue. For an effective scheduling of coffers, it's necessary to consider the QoS conditions (6). Effective task scheduling algorithms reduces prosecution cost, prosecution time, energy consumption and considering other QoS conditions like trust ability, security, vacuity and scalability.



In cloud environment, cloud consumer and cloud provider are two parties. Cloud consumer submits tasks while cloud provider provides resources for execution of tasks. Both the parties have different requirements: provider wants to earn as much profits as possible with lowest investment and maximize utilization of resources while consumer wants to execute their tasks with minimum cost and execution time. However, executing number of tasks on one resource will create interference among tasks which leads to poor performance and reduces customer satisfaction. To maintain the service quality, providers reject the requests that result in unpredictable environment [7]. Providers also consider unpredictable resources for scheduling and execution of the tasks. Scheduling of tasks to proper resources becomes more challenging because both user and providers are not willing to share information with each other. The challenges of resource scheduling include dispersion, uncertainty and heterogeneity of resources that are not resolved with traditional algorithms in cloud environment. Therefore, there is a need to execute cloud tasks in an efficient way by taking care of these properties of the cloud environment.

B. Types Scheduling In Cloud Computing

Scheduling methods in cloud environment generally have been divided into three groups: Resource scheduling, Workflow scheduling and Task scheduling, in which only the task scheduling approaches are focused in this thesis. The entire classification is portrayed in Fig.2. Resource scheduling performs mapping of virtual resources among physical machines and workflow scheduling is done to schedule workflows constituting an entire job in a suitable order. Task scheduling methods may be centralized or distributed. It can be performed in homogeneous or heterogeneous environment on dependent or independent tasks. In centralized scheduling a single scheduler is there to do all mappings whereas in distributed, scheduling is partitioned among different schedulers. Scheduling methods in distributed environment can be of two types: heuristic and hybrid techniques. Heuristic methods are classified into static as well as dynamic scheduling. Dynamic scheduling can be performed in online mode or batch mode. In static scheduling all the tasks are known a priori to scheduling and they are statically assigned to virtual resources. In dynamic scheduling all the tasks are scheduled instantly, as they arrive in the system. Dynamic scheduling mechanism performs better when compared to static algorithms. But the overhead of dynamic algorithms are high as we want to decide the schedule and update the system information instantly.



First Come First Serve (FCFS), Round robin, Max-Min are the samples of batch mode heuristic algorithms. It initializes the scheduling of tasks after a specific time period and it put all incoming tasks into the queue. within the cloud, scheduling is completed in three steps which are discovery and filtering of resource, selection of resource and mapping of the task. Resources available within the system are discovered by Datacenter Broker and it also gathers the related information such as a status of the resource, etc. The second step is that the selection of resource among all available resources and this selection is takes place by considering definite parameters of both resource and task. The last step is to map the task to the chosen resource [9].

C. Task Scheduling Approaches

There are different scheduling algorithms available for cloud computing, during this paper we will discuss about five scheduling algorithms they are First Come First Serve (FCFS), Round Robin (RR), Genetic algorithm, Match-making algorithm and generalized priority algorithm.

First come first serve (FCFS) Algorithm: FCFS is especially used for parallel processing, it's selected for incoming task and it is aimed at resource with smallest waiting queue time. The CloudSim toolkit supports FCFS scheduling strategy for internal scheduling of jobs. Allocation of application-specific VMs to host during a cloud based data center is the responsibility of the virtual

machine provisioned component. The default policy of implemented by VM provisioning is simple policy that allocates a VM to the host in FCFS basis. The disadvantage of FCFS is its non-preemptive algorithm [10]. The shortest tasks which are at the rear of the queue have to wait for the long task at the front finish. It's rotate and response time is low.

Round Robin (RR) Algorithm: The Round Robin algorithm focuses on fairness and on distributing the load equally to all or any nodes. Each job during a queue has same execution time and it will be executed in turn. The scheduler starts assigning VM to every node and move further for next VM to place in next node. Algorithm is applied for all the nodes until one VM is assigned to every node. Again it goes to the primary node repeat this process to the next VM request [10]. The advantage is that it utilizes all the resources within the balanced order. Disadvantage is high power consumption as many nodes are turned on. If four resources need to be run on a single node, all the nodes are going to be turned on when Round Robin is used. This consumes high power. Supports RR CloudSim toolkit supports RR scheduling strategy for internal scheduling of jobs. CloudSim toolkit supports RR scheduling strategy for internal scheduling of jobs.

Genetic Algorithm

Genetic algorithms are stochastic search algorithms supported the mechanism of natural selection strategy. It starts with a group of initial solution, called initial population, and can generate new solution using genetic operators. The genetic algorithm approach computes the impact beforehand that it will have on the system after the new VM resource is deployed in the system, by utilizing historical data and current state of the system. It then picks up the answer, which can have the least effect on the system. The advantage of this system is it can handle a large searching space, applicable to complex objective function and may avoid trapping by local optimum solution. Authors of [11] have developed a cost-based job scheduling algorithm, which give a multi QoS scheduling in cloud computing environment.

3. Various Improved Task Scheduling Algorithms

Following are the scheduling algorithms that are presently utilized in cloud. the target of these scheduling algorithms are proper use of resources.

- **Multi Level Feedback Queue (MLFQ)** [12] This scheduling method use M/M/C queues for grid computing. the planning of MLFQ is divided into multiple prioritized queues. This approach provides resources to gridlets that starve within the lower priority queue for while to get resources. As a result, the reaction time of the starved gridlets decreases and overall turnaround time of the scheduling process decreases. Comparison of FCFS and machines used via MLFQ are quite FCFS.
- **Preemptable Shortest Job First Scheduling• Algorithm** [13]
  This algorithm was projected during a private cloud. It's the combination of the preemption techniques of Round-Robin algorithm with Shortest Process Next (PSN). This algorithm improves the reaction time and execution time. This algorithm also produces cost benefits
- **Shortest Task Scheduling Algorithm** [14]
  This algorithm was proposed during a public cloud environment. During this algorithm the allocation of resources on dissimilar clouds under overloads conditions. This algorithm also includes the allocation of resources on dissimilar clouds under load conditions also.
- **Optimized Activity based Costing Algorithm** [15]
  Activity-based costing may be a method for measuring both the cost of the items and the exhibitions of exercises and it can gauge the cost more precise than traditional ones in cloud computing. The most goal of this optimized algorithm is to have more profit as compare to the traditional methods.
- **Min-Min scheduling Algorithm** [16]
  This algorithm was done on the idea of Min-Min algorithm. Min-Min algorithm starts with a group of all unmapped tasks. The machine that has the minimum completion time for all jobs were selected. Then the roles with the overall minimum completion time were selected and mapped to that resource. An improved load balanced algorithm was introduced. Min-Min algorithm considers all which aren't assigned tasks in each task mapping, Min-min algorithm will execute until the full tasks set is empty. Min-min will execute short tasks in parallel and therefore the long tasks will follow the short tasks. In-min can cause both the full batch tasks executed time get longer and unbalanced load. Even long tasks can't be executed. The most goal of this algorithm is to maximize the use of resource and minimize the make span.
- **Ant colony Optimization (ACO) based modified pheromone rule algorithm** [17]
  Properties of Ant Colony System are utilized to conquer the issues looked by conventional ACO algorithm. There are three primary modifications during this algorithm. Firstly, pseudorandom proportional rule is employed to select the next node an ant should travel which is used in Ant Colony System. Second, so as to expel the stagnation conduct of the algorithm and to expand its investigation for the arcs that have not been visited yet, an area pheromone update is done. Third, the simplest visit found from the beginning of the execution of algorithm is provided with extra pheromone deposition in order to expand its convergence speed. But this algorithm was found to be working within the grid environment.
- **Improved Cost Based Algorithm** [18]
  This algorithm improves the normal cost-based scheduling algorithm for making appropriate mapping of tasks to resources. This algorithm groups the tasks consistent with the processing capabilities of available resources.
- **Workflow Scheduling Algorithms in Cloud Computing** [19]
  Gives a review of various types of workflow scheduling algorithm in cloud computing and compares different types of workflow scheduling algorithms. There working with reference to the resource sharing. Workflow is defined because the automation of a business process, in whole or partially, during which documents, information or tasks are passed from one participant to a different for

action, consistent with a set of procedural rules. When speak about cloud, the main advantage of cloud is its application scalability or elasticity. This elastic nature of cloud facilitates changes of resource and characteristics at run time. They methodize the scheduling problem in cloud computing and present a cloud scheduling hierarchy, mainly rending into user-level and system-level

4. Comparison of Existing Scheduling Algorithms

A good scheduling algorithm always considers benefits of both the parties the cloud users and the service providers. The algorithms should attempt to reduce both the cost and power consumption as well as provide better performance. Scheduling algorithms must consider Load balancing and energy consumption as there two main parameters. Moreover, it should provide the user's fairness and security while providing services. A future enhancement in developing an appropriate algorithm is by considering the combination of some important parameters together which can be deployed in a cloud environment for providing better cloud services to the users. [19]

The main scheduling parameters considered in the previously mentioned methods are listed below:

- **Makespan**: it's the aggregate consummation time of all tasks in the job queue. An honest scheduling algorithm dependably tries to diminish the makespan.
- Deadline: it's characterized as the timeframe from presenting a task to the time by which it must be finished. an honest scheduling algorithm dependably tries to keep the tasks executed with in the deadline constraint.
- **Execution Time**: this is often the exact time taken to execute the given tasks. An honest scheduling algorithm ultimately aims to minimize execution time.
- **Completion Time:** Completion time is that the time taken to finish the whole execution of work. It incorporates the execution time and delay caused by the cloud system. Variety of existing scheduling algorithms considers minimizing completion time of tasks.
- **Energy Consumption:** Energy utilization in cloud data centers may be a present issue that ought to be considered with more care nowadays. Numerous scheduling algorithms were developed for diminishing power consumption and enhancing execution and consequently making the cloud services green.
- **Performance**: Performance shows the by and enormous productivity given by the scheduling algorithm all together to give good services to the clients according to their necessities. an honest scheduling algorithm ought to consider the execution at the client end and in addition the cloud service provider end.
- **Quality of Service:** SLAs is defined as a contract document defined between the cloud user and cloud service provider. Input constraints like meeting execution cost, deadline, performance, cost, makespan, etc enhances quality of service.
- **Load balancing**: it's the strategy for dissemination of the whole load in a cloud network crosswise over various nodes furthermore, connects in order that at once no nodes and connections remain under loaded while a few nodes or connections are over-loaded. Most of the scheduling algorithms attempt to keep the load balanced in a cloud network in order to increase the efficiency of the system.

From the various task scheduling algorithms discussed in this paper, the overall rate of each scheduling parameters considered in various techniques are combined in Fig.3. This investigation is restricted to the strategies explained during this paper. It recognizes the scheduling traits which are considered most and which all are less noteworthy in various schedules in order that better algorithms can be created by varying slightly considered parameters or joining them with different parameters in existing calculations to get a good general scheduling.

5. Conclusion and Future Work

Scheduling of task in cloud environment is extremely challenging issue in cloud computing. In today's time to satisfy thousands of user requests while making best possible use of available resources as well as fulfill the both user and service provider request, it's challenge for task scheduler. This paper provides a review on many task scheduling algorithms used for solving the problems while scheduling of tasks is done. In future, the further work are going to be proceed by using new algorithm for solving the task scheduling problems in multiobjective such as minimizing time, energy, cost and cargo balancing.

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