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A study on Particle Swarm Optimization Scheduling for cloud computing environment

Kirti Bala
CET Department, GNDU Amritsar
kirti.may1893@gmail.com

Abstract: This paper represents cloud computing has become popular due to its attractive features. The load on the cloud is increasing tremendously with the development of new applications. Load balancing is associate degree necessary a part of cloud computing surroundings that ensures that each one devices perform same quantity of labour in equal quantity of time. Different models and algorithms for load balancing in cloud computing has been developed with the aim to build cloud resources accessible to the end users easily. The overall objective is to represent the comprehensive overview of the research on load balancing algorithms in cloud computing. So it shows that one of the technique i.e. particle swarm optimization algorithmic rule has been wide accepted as a global improvement algorithmic rule of current interest for distributed improvement and management

Keyword: Cloud computing, Load balancing, ACO, PSO, Red black tree, Bayesian Classifier, Flow Time, Makespan.

INTRODUCTION: The dream of Computing as a Utility has been realized by Cloud computing. Cloud computing provides us the various methods to access the applications as utilities over the internet[11]. According to the NIST, the definition of cloud computing has the five important features: On demand, Self Service, Scalability of resources, measured services, access to broad network. The services of Cloud can be divided into three categories: Software as a service (SaaS): This model impart various software as a service to the end user over the internet ,for example: SalesForce.com, Google App. Platform as a service(PaaS): This model provides the runtime environment for applications, development & deployment tools, etc. For example: Microsoft azure, GAE provides PaaS. Infrastructure as a service (IaaS): this model provides access to basic hardware resources such as physical device, virtual machines etc. Some of the IaaS providers are GoGrid, Layered Technologies. All these services are provided as utilities. Reducing cost to provide better performance and enhancing response time, energy efficiency are some of the objectives of cloud computing. [5] **Load balancing** : The load balancing is used for sharing the load of virtual machines across all the nodes equally to have better energy efficiency management.

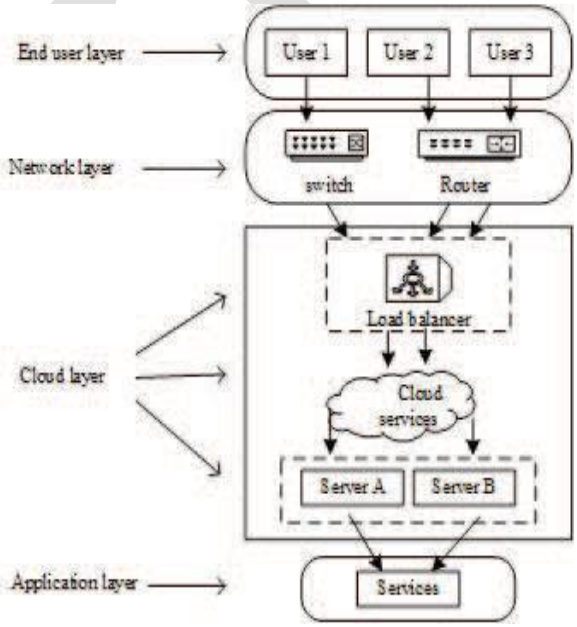

Fig. 1: Load balancing in cloud computing

A load can refer to the number jobs waiting in the queue to be assigned a processor. Due to load balancing, load across the nodes is shared due to which every node can work with full capability. There is no delay due to data being received and sent. Minimum number of machines will be active at any instance at the cloud data centers. There are various algorithms for load balancing which

can be carved up in two classes : static and dynamic . In static class of algorithms all the information required for the purpose of scheduling is provide prior to the scheduling job. These algorithms are non preemptive by nature. The major drawback of this approach is that it does not take into account the current state of the load for making the decision of load balancing. In Dynamic Load balancing algorithms decisions are prepared at the time of current load balancing. There are various problems in load balancing. These can be estimation of load, a perfect load balancing degree, partitioning of tasks to be performed. There are a significant number of algorithms that help to balance the load in completely parallelized system. [1]

Technologies used: Particle Swarm Optimization(PSO): Particle swarm optimization was brought to lights by Eberhart and Kennedy. The standard PSO algorithm is not commonly used in the field of discrete space but is used in continuous space. So Kennedy and Eberhart worked out a binary particle swarm optimization to still widen the scope of PSO to enable it to improve the results of the combination problems. The methodology of binary particle swarm optimization algorithm discussed in [6] is as follows: In this technique, every particle is made up of D elements each one of which represents a candidate solution. A fitness function is utilized with the intention to evaluate the correctness of all the solutions. All the particles are thought of in the role of a location in a D-dimensional MATRIX and the binary value for each of the element of the particle position can be 0 or else 1 where 1 represent "included" along with 0 indicating "not included". All particles of the elements possess a D- dimensional velocity vector. The elements of velocity vector are in the range of [-Vmax,Vmax].The probabilities which represents that a bit will be present in one state or the other ,makes up velocities. A considerable variety of particles as well as their velocity vectors are initiated arbitrarily so as to start out the algorithmic program. Then using fitness function the optimal solution is calculated in next iterations. For updating the positions the velocity vector in each step contains two parameters for positions .i.e. pbest and gbest. The pbest i.e. Personal Best represents the best position the particle has ever experienced .The gbest represents the best position which particle and its neighbors have been from the time of first step. [3] It has been observed that running time of the PSO is too high. Thus an improved PSO is discussed [1]. Improved PSO: PSO is intended for designing computing workstations in the environment of cloud computing. But still the time complexity for the algorithmic rule is directly proportional to the variety of tasks and variety of computing nodes. The division operation of the linear growth, leads to large CPU time. Thus to solve this problem the procedure followed is: the flow time of the summation process should be used instead of the flow time of the original process by making use of improved makespan. The flow time can be defined as the total time required carrying out or performing the whole task. The makespan parameter represents the longest time at each machine to finish the task. Thus one moves to calculate the required parameters and then perform the remaining part of the PSO algorithm to perform the load balancing. Based on the ETC (expected time to compute) a calculation for each resource node is carried out at the backend. This leads to addition of cloud tasks allocated which consume the resources. Afterward each machine performs division in order to deduce the time which each node takes to complete the last task which leads to reduction in the time complexity to a considerable value .Then the division time of machine is added to calculate the flow time . The maximum value out of this is makespan. [1] But this Improved PSO algorithm has still scope for improvement in terms of the time complexity improvement.

PSO coalesced with the Red Black Tree: The improved execution time of PSO is still more as compared to red black trees algorithm and naïve Bayes classifier algorithm (assuming that the training time required for bayes classifier in not considered in the time complexity). The major return for considering the PSO algorithm is that the load equalization degree of the PSO algorithmic program is extremely worth implementing. The red black tree algorithm does not perform the optimized load balancing across each node. This algorithm divides the computing nodes into four queues for assigning the tasks, but the problem is that this algorithm uses random ways to assign the tasks to the queues which causes unsatisfactory levels of load balancing performance. Thus it is combined with the improved PSO. Linear addition of PSO algorithm is used to additionally cut down the time (the overall execution time of the algorithm is the sum of the four sets of PSO's flowtime; thus it is more synchronized than the simple red black tree algorithm). [1].

Ant Colony Optimization Algorithm: Load balancing is also implemented by one of the significant methods which is called as Ant Colony Optimization Algorithmic rule.

1. Load balancing by the underload node: The underload node sends an ant from time to time in order to balance the workload evenly across all nodes on the open cloud computing federation. This technique also allows to keep the strength of the complex network alive by updating the pheromone (the chemical secreted by the ants on their movement) with the help of following two methods: (A) On one while when the ant starts its journey , after each progress of the ant , the likelihood that an ant will stop at node Nj starting from Node Ni is given by the following function:

$$P_{ij}(t)=\begin{cases}\dfrac{[\tau_{ij}(t)]^{\alpha}[\eta_{ij}(t)]^{\beta}[D_{ij}(t)]^{\lambda}}{\sum_{j\in N_n}[\tau_{ij}(t)]^{\alpha}[\eta_{ij}(t)]^{\beta}[D_{ij}(t)]^{\lambda}} & \text{if } j \in N_n \\ 0 \quad \text{if } j \notin N_n & \end{cases}$$

Where the variable N_n stands for the neighboring nodes of node N_i which have not been visited by the node N_i, Γ_{ij} stands for the pheromone value at the edge(i,j) of length d_{ij}. The value of D_{ij} is calculated as :

$$D_{ij}=d_j/\square d_k$$

□□□□□□□□□□□□□□□□□□□□*k NBi*

NBi is the set of neighborhood nodes of N_i.

(B). In order to update the pheromone the ant during its visit, keeps notice of the node which has the maximum and minimum workload and denotes the as N_{max}, N_{min} respectively and uses them to balance the load

Load Balancing through the Overload node: If a node finds its own workload to be above some threshold value W, then same procedure can be followed as in underload node's case except that the source node can be selected as the N_{max} .[2]

RELATED WORK:

Yongfei Zhu_et al. [1] proposed a neoteric algorithm which makes use of the Particle Swarm optimization algorithm and the classifier along with red black tree in the cloud computing environment. Zehua Zhang_et al. [2] presented a novel load balancing technique based on Ant Colony Optimization and complex network theory for the realization of the open cloud computing federation. Hesam Izakian_et el [3] introduced a new adaptation of the Dynamic Particle Swarm Optimization algorithm for planning the grid job execution. Sidra Aslam_et el [4]. This paper realized the significance of the field of the cloud computing and the technique of load balancing for solving the problem of rampantly increasing load on the cloud. Dr. Naveen Kumar Gondhi_et el [5]. To do away with the hazards and problems in cloud computing, this paper presented a customized method taking Ant Colony Optimization as the heart Jianhua Liu_et el [6]. In this paper the binary particle swarm optimization algorithm was studied under changing experimental conditions. Xuesong Yan1_et el[7]This paper studied the disadvantages of the standard particle swarm optimization algorithm provided improvements over the standard particle swarm algorithm. Ren Gao_et el[8] This paper discussed the facts to disseminate and to synchronize the nodes in a cloud computing environment so that the resources are used optimally and overloading is avoided. So in this paper a new approach is discussed for load balancing through the ant colony optimization(ACO). Wei Zhang_et el[9]. This Paper threw lights upon Naïve bayes classifiers which have a wide range of applications in the field of text classification in machine learning. Rodrigo. Calheiros_et el[10]. This paper discussed Cloud sim which is a toolkit for simulation and modeling of the system and behavior of the cloud computing environment including data centers, virtual machines provisioning as well as resource distribution.

Comparison Table:

Sr. no.	Year	Paper Title	Techniques used	Benefits	Limitations
1	2016	A Novel Load Balancing Algorithm Based on Improved Particle Swarm Optimization in Cloud Computing .	Particle Swarm Optimization, , Naïve Bayesian algorithm, Red Black tree algorithm	Time Complexity of PSO algorithm is improved.	The PSO is focused on initial set of particles.
2	2010	A Load Balancing Mechanism Based on Ant Colony and Complex Network Theory in Open Cloud Computing Federation	Ant Colony optimization, complex network theory	The complex network theory allows the qualitative analysis through prototype and simulation which proves better than only ACO.	The Prototype developed may not reflect the original changes taking place in the network.
3.	2010	A discrete particle	Discrete particle	DPSO provides a	The DPSO

		swarm optimization approach for grid computing.	swarm optimization technique- for grid computing.	superior method for grid computing which is heterogeneous in nature to curtail the makespan and flow time.	algorithm suffers from the problem of very high time complexity.
4.	2015	Load Balancing Algorithms in Cloud Computing: A survey of modern techniques.	Static load Balancing, Round Robin, Min- Min, Max – Min, Dynamic load Balancing, Honey Bee, Ant - Colony Carton, Throttled load Balancing	The limitations and advantages of these algorithms is presented in a comparison table.	The shortcomings of the existing work is that it does not deal with the connected issues like high throughput, fairness and equality.
5.	2015	Local Search based Ant Colony Optimization for scheduling in cloud computing.	Ant Colony optimization algorithm and local search algorithm	Better virtual machine allocation process to physical machines eventually leading to more efficient usage of physical resources.	This approach provides the users with single optimal solution at the end.
6.	2009	The Analysis and Improvement of Binary Particle Swarm Optimization	Improved Binary particle optimization	It lets the particle to converge to a optimal particle and also the local exploration of binary PSO is improved.	The original BPSO is lacking ion local explorations.
7.	2013	An Improved Particle Swarm Optimization Algorithm and Its Application	Improved particle swarm optimization algorithm	The disadvantages of PSO are done away. Capability of global searching is improved.	Newly developed algorithm is discussed only through the few optimization problems like TSP.
8.	2015	Dynamic Load Balancing Strategy for Cloud Computing with Ant Colony Optimization	forward-backward ant mechanism and max-min rules,	Dynamic load balancing. High network performance under varying load.	The pheromone update can be time consuming, leading to more time to search the candidate node .
9.	2011	An Improvement to Naive Bayes for Text Classification	Naïve Bayesian classifier	This technique selects the feature from a list of feature and then uses the feature to reclassify the text.	Time complexity of naïve Bayesian classifier is high.
10.	2010	CloudSim: a toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms	CloudSim: A Simulation toolkit.	This toolkit provides the support of the integral features of behavior and system modeling of the components of the cloud computing components.	Factors like socio economic and environmental conditions which affect the processing speed also need to be studied.

GAPS IN LITERATURE

1. On account of huge capability for being channelized in complex problems, Particle

swarm optimization algorithm has been widely accepted as a global optimization algorithm of current interest for distributed optimization and control.

2. Particle swarm optimization is limited to initial set of particles, wrongly selected particles tends to poor results. The improved particle swarm optimization still has a large scope for improvement. It initially selects the tasks for a particular computing node without taking into consideration of any feature of the participating particles.

CONCLUSION: Cloud computing is becoming hottest technology in these days. Cloud computing is becoming more and more popular among the business institutions and research institutions, from some time. The main objective is to use the computing resources in virtualization. Also with the load balancing mechanism running the focus is to distribute the resources in data centre virtualization. It has focused on the different swarm intelligent based techniques called Random forest and Particle swarm optimization based techniques comparison which has benefits and limitations so one of the main limitation in survey is i.e. particle swarm optimization is limited to initial set of particles, wrongly selected particles tends to poor results. In order to overcome these constrains a new hybrid Particle swarm optimization and Random forest algorithm for cloud computing environment will be propose to enhance the energy consumption rate further.

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