Load Balancing Algorithm for Resource Management in Cloud Data Center

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Abstract

Load balancing is a challenging issue in cloud data centers. This paper proposes a load balancing algorithm to efficiently utilize the resources of the server nodes and a bio inspired algorithm for migrating virtual machines from overloaded to under loaded servers. A flower pollination algorithm (FPA) which is nature inspired algorithm is extended for the multi objective optimization by calculating the fitness value. The results from simulation prove that FPA algorithm gives better results to balance the load in data centers.

INTRODUCTION

Many real world scenarios are facing the problems regarding load balancing and VM migration. Data center systems utilize a range of resources (including CPU, memory, storage and network) that depends upon the workload. Many resource management algorithms have been proposed to solve the load balancing issues in cloud data centers. Data centers use for effectively sharing resources is load balancing tries number of data centers which consist of huge numbers of physical machines with the overloaded and under loaded, to maintain the Qualities of resources needs to make those resources are completely utilized and make sure that it consuming less power and virtualization is the most organizational factor. to distribute all the resources to all the running servers in the data center. Cloud computing provides a large A load balancing is designed and implemented for efficient migration of virtual machine and assure that migration of virtual machine from physical machine with overloaded to physical machine which is less utilized. This process of transferring a virtual machine from one physical machine to another is called as migration. Virtualization technologies can be used to improve resource, simplify deployment, and to increase the data centers. The purpose of this paper is to avoid over utilized resources that may use create migrations due to unpredictable workloads. The results have shown how efficiently resources could be managed, allocated and migrated among the servers. For load balancing paper proposing some mathematical equations that will classify the overloaded and under loaded server. And for migration proposing the flower pollination algorithm by calculating the fitness value which isgoing to help in migration process and make the servers which present in the data center are efficiently utilized. The main objective of this paper is to propose a method for achieving load balancing in cloud data centers. The paper proposes about how efficiently resources is

utilized, and how the process works all explains in the sections below section(2) literature survey, section(3) describes about the load balancing algorithm how the load classifies the overloaded and under loaded section(4) explains about the identification of Target Server, section(5) calculates the fitness of the VM and checks which VM is efficient to migrate, section (6) describes about the flower pollination algorithm, section(7) results and discussion , section(7) presents conclusion.

LITERATURE SURVEY

Load balancing in cloud computing is very essential and offers for user needs. Load balancing in clouds could be a mechanism that distributes the dynamic native work equally across all the nodes, ensuring that no single node is weak, thus raising the general performance of the system. Cloud computing is economical and scalable maintaining the capability of process such that a large amount of woks within the cloud computing environment could be a advanced drawback with load balancing receiving a lot of attention for researchers. A load balancing method has been designed and implemented for migration of virtual machine [1]. The load balancing algorithm classify and balance assured the migration of virtual machine from physical host with overloaded to physical host with under loaded [2]. It also gives the mathematical steps for migrating VM between two physical hosts. In this work for viable load adjusting ascertain uneven use of assets among VMs and it gauges in skew esteem. Subsequent to ascertaining skew estimation of VM by skewness calculation[3], as indicated by skew of VMs sort VM list in consenting request. In the subsequent stage, scheduler role out assignment to VM as indicated by need. Each distribution of asset to errand in VM framework checks accessible asset and anticipate future load to dodge over-burden on server. Migration is an efficient management activity in datacenters for load balancing, server consolidation [4]. Load-balancing and Controlling Scheme of Virtual Machine Migration is introduced by Zou *et al*. [5] which improve overall load balancing performance, When compared to the CPU based strategy, it assures well balanced storage. Archer *et al*. [6] explains strategy which checks CPU and RAM utilization to find out the load among VMs. Migration performs in such a conditions where even after checks the available resources. It gives the performance of the virtual machine in terms of cpu utilization and the memory and distributes the load across the servers. Razali *et al*. [7] describe a strategy for improving overall load balancing is

implementing the migration of virtual machines across hosts, in which utilization of CPU   can be optimized. The results provide the efficient utilization of resources. The latest nature inspired algorithm is Flower Pollination Algorithm which was proposed by Xin-She Yang in 2012 [8]. Pollination itself as a natural phenomenon constitutes a process of transferring pollen grains from the stamens, the flower parts that produce them, to the ovule bearing organs or to the ovules (seed precursors) themselves [9]. It is crucial for fertilization and reproduction of flowering plants also known as the angiosperms – the largest and most conspicuous group of modern plants [10].The paper proposes about efficient resources utilization and efficient migration using the flower pollination algorithm.

LOAD BALANCING ALGORITHM

Load Balancing is a technique in where the dynamic local workload is divided equally across the nodes in cloud in order to avoid the situation where few nodes are overloaded while few are idle. The only purpose of load balancing is to optimize the resource's performances. The node will calculate load by considering the parameters and classifying the physical host into over loaded and under loaded. The load balancing algorithm uses two parameters 1). CPU   2) Memory. The CPU utilization is calculated as given in equation (1).

$$CU = \text{Total CPU usage of server / no. of servers} \quad\longrightarrow\quad (1)$$

$$AC = \sum_{s=1}^{n} Csi/n; \quad\longrightarrow\quad (2)$$

Where AC = average CPU utilization.

n= no. of servers;

Cs =CPU utilization of the server;

i= servers list

The threshold is calculated by multiplying CPU utilization as in equation (2) and the result of threshold is mentioned in equation (3)

$$T = Cu* Ac; \quad\longrightarrow\quad (3)$$

Where T= threshold;

Cu= CPU utilization;

Ac=average CPU utilization;

$$Skew = \sqrt{\sum_{i=1}^{n}(ci/c - 1)^2} \quad\longrightarrow\quad (4)$$

c_i= resource utilization of the ith server ;

c= total resource utilization of server;

$$FITNESS = 1/((1-C)*(1-M)*10); \quad\longrightarrow\quad (5)$$

$$M = (tm-um)/tm \quad\longrightarrow\quad (6)$$

Where C=CPU utilization of server;

M=memory utilization of server;

The threshold value obtained from (3) is used to classify the servers to overloaded and under loaded. The servers are sorted in ascending order based on the resource availability. The resource availability is calculated by getting the skew value from (4) and the source server and the destination server is found. The virtual machines are migrated by finding the fitness value (equation 5) .If the fitness value is less than the threshold value ,the virtual machine is migrated from the under loaded server and it is turned off.

Algorithm 1 Overloaded source server selection


I/p: Number   of servers   list in the   cloud   computing {s1,s2,s3,……..sn}.

O/p: Overloaded server .

1.   Overloaded server ⟵ 1;

2.   Under loaded server ⟵ 0;

3.   Threshold ;

4.   for(each server in the host){s1,s2,s3,…….sn}

5.   Get CPU utilization of servers ;

6.   Get average CPU utilization of all servers;

7.   If(utilization > threshold)

8.   OS ⟵ server (return 1);

9.   If(utilization < threshold)

10.   US ⟵ server(return 0);

11.   Process continues until servers list;

12.   for (servers --- > null)

13.   Break ;

14.   End ;

Algorithm 1 explains about the overloaded detection of the servers in the cloud data center. The given input is the number of servers in the cloud data center in line 3. Then the threshold value is calculated by using the equation(3) .The servers in the list is compared with the threshold value to compute whether the server is overloaded or under loaded by using line 7. And the process continues until the server list reaches null. If the server is under loaded, is will be stored in the US, else it will be overloaded .It will be stored in the OS as shown in the flow diagram fig1.
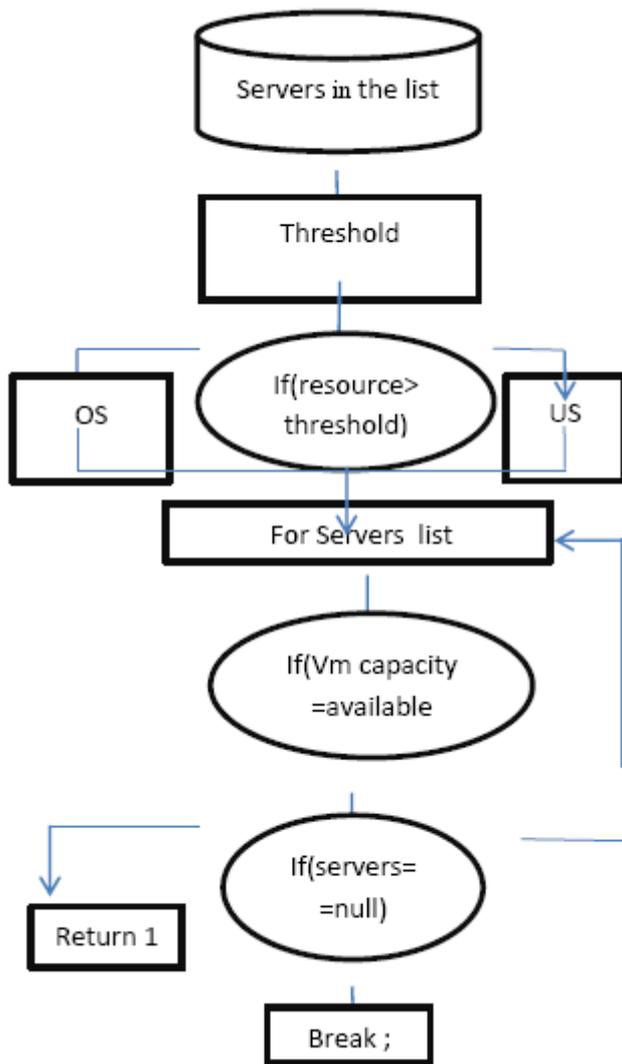
Figure1. Flow diagram of server detection and identification of target server

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Algorithm 2: For Identification of Target Server

Input: host list;
 Output: normal server;
1. Arrange the servers in the ascending order w.r.t. resource availability.
2. for each host in the server list {s1, s2, s3 ….sn}
3. get resource utilization of vm ;
4. get Skewness values ;
5. if(VM capacity == available capacity)
6. return 1;
7. else
8. return 0;
9. Check for next servers in the list
10. if(servers==null)
11. break;
12. end ;

The Algorithm 2 gives the list of servers which have resources available as shown in   line 2. The resource utilization of the servers is computed .The servers are sorted in ascending order based on the resource availability and by using the equation (4) the Skew value is to be calculated. By checking the   condition with VM capacity and the available capacity, the Skew will return "1". If the returned value is "0", then the algorithm search for the available capacity of the unlisted servers and the search continue until the servers in the list reaches null .When it reaches null, the condition will break.
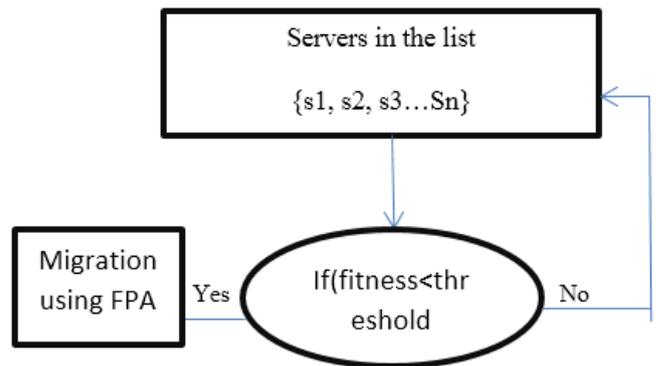
Figure 2. Fitness calculation flow diagram

Fig2. explains about the flow diagram of the fitness calculation by using equation (5) .Virtual machines are checked for migration with the condition if fitness value is less than the threshold .If the condition is true the virtual machine is migrated from the overloaded server to the under loaded server by using the FPA (flower pollination algorithm) which is explained in the algorithm (4). The fitness of virtual machine is calculated by using equation (5) and the steps of migration are explained in algorithm (3).

Algorithm 3: Modified Flower Pollination Algorithms for VM Migration

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INPUT: SERVERS in the list;
OUTPUT: VM MIGRATION WITH EFIICIENTLY;
1.   for each all the servers in the list{s1,s2,s3} ;
2.   get CPU UTILIZATION ;
3.   get MEMOERY ;
4.   get FITNESS;
5.   if(FITNESS<THRESHOLD)
6.   MIGRATE by using the flower pollination algorithm ;
7.   if(FITNESS>THRESHOLD)
8.   break;
9.   PROCESS CONTINUES UNTIL IT REACH NULL;
10.   break;
11.   end;

Algorithm 3 describes the VM migration where the   input is servers present in the list. The CPU utilization and memory is calculated by using the equation (1) and (6). By using equation (5) we will get the fitness value. The line (1-4) calculates the CPU utilization and memory.   Then the

algorithm checks if the fitness value is less than the threshold value. If the condition is true, then the virtual machine is migrated from source server to target server for migration. If the fitness value is greater than the threshold value, then that VM is said to be fully utilized and for migration of VM is done by using flower pollination algorithm.

FLOWER POLLINATION ALGORITHM FOR VIRTUAL MACHINE MIGRATION:

Flower pollination algorithm is inspired by the flower pollination process. This process of transferring and depositing of pollen grains from anther to the stigma of flower is pollination. Some flowers only attract particular spices for an efficient pollination process. In pollination two major processes are biotic and abiotic process. In biotic, pollen grains are transferred by pollinator's insects. In a-biotic does not require pollinator. This flower pollination process use in solving many complex and distributed problems in cloud data center. And also it helps in solving problems like resource management, optimization and efficient migration in cloud data center. By taking inspiration from the flower pollination process this paper proposes an algorithm which ensures that all the servers present in the cloud data centers are efficiently used and managed.

Algorithm 4: flower pollination algorithm

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1. Initialize the list of n flowers (here servers)

2. Find the best VM (via above mentioned fitness formula)

3. Define a switch probability $p \in [0,1]$

4. While (t<MaxGeneration)

5. if rand<p,

6. for (i = 1 : n (all n flowers(here servers) in list)

7. Draw a (d dimensional) step vector L which obeys Levy's distribution

8. Global Pollination via

$$X_i^{t+1} = X_i^t + L(g_* - X_i^t)$$

9. Else

10. Draw $\in$ from a uniform distribution in [1,0]

11. Randomly choose j and k among all the solutions(j and k are available solutions)

12. Do local pollination via $X_i^{t+1} = X_i^t + \in \left(X_j^t - X_k^t \right)$

13. end if

14. Evaluate new solutions

15. If new solutions are better, update them in the population

16. end for

17. Find the current best solution g_*

18. end while

The above algorithm explains the flower pollination algorithm which helps to get the best solution by using the fitness formulae given in equation (5).

Where xt_i is the pollen i or solution vector x_i at iteration t, and g_* is the best VM found among all VM's at the present iteration. The proposed flower pollination algorithm is based on the selection of the targeting server for migration. This algorithm is very efficient and can outperform compared all bio inspired algorithms.

RESULTS AND DISCUSSION

The algorithm is implemented using cloudsim tool kit. The cloudsim has Policies for allocation of servers to virtual machines and policies for allocation of resources to virtual machines. The designed data center consists of 100 physical servers. Threshold (T), CPU utilization and memory are three parameters considered. The results obtained from the implementation are discussed below in fig(3) and fig(4)
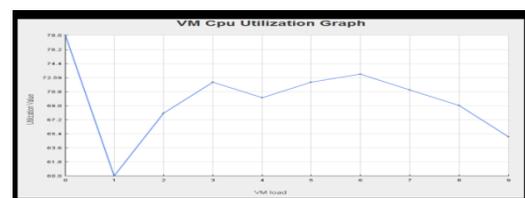

Figure 3. VM CPU utilization graph

Fig 3. Explains about the CPU utilization with respect to VM load. This is measured using the mathematical equation of CPU utilization (1)

Figure 4. Fitness graph for target server selection

Fig4. Explains about the finding the fitness values for targeting the servers for VM migration. The fitness value is found out using the equation (5) by using the CPU and the memory. The migration is carried out by using the fitness value; fitness value is compared with the threshold then by using the algorithm 3. The migration is taken care by the flower pollination algorithm. This is explained in the algorithm (4)

CONCLUSION

Paper presented a load balancing algorithm for classification of overloaded and under loaded server detection in a data center. The paper proposes how efficiently resource is utilized among the CPU ,memory ,and for identification of targeting the server made an equation and For migration

paper proposes the flower pollination algorithm .For calculating the fitness the paper proposes the equations calculated and based on the fitness availability of VM's .For migration paper used flower pollination algorithm and the results are tested by using a software called cloudsim tool kit simulator.

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