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FUZZY LOGIC CONTROLLED RESOURCE ALLOCATION FOR EFFICIENT LOAD BALANCING IN CLOUD COMPUTING ENVIRONMENT

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ABSTRACT
This paper address the problem of managing cloud system, consisting a set of virtual machines (VMs), operating under dynamic workloads conditions. The objective of the paper is to find the best workload-VM pair in such a way to give a guarantee on his Quality-of-Services (QoS) and, at the same time, to minimize the energy consumption of the physical infrastructure running them. For that we propose a fuzzy controller, which is able to allocate the best VMs to each cloud application in such a way that the minimum amount of physical capacity needed to meet its QoS requirements. In this way the VMs are dynamically selected hence the number of physical resources that needed to be active at any given instant of time is reduced in comparison to the statically provisioned systems. This reduces the energy requirement to run a given cloud workload. We implemented a prototype of our controller on CloudSim, and tested it over different load conditions in which we compare the proposed technique against, state-of-the-art techniques. Experimental results show that proposed technique outperforms state-of-the-art techniques in terms of QoS and the amount of physical resources required.

KEYWORDS— Cloud Computing, CloudSim, Cloud Load Balancing, Fuzzy Controller.

INTRODUCTION
Many modern Internet services is to be implemented as cloud applications, which consist of a set of Virtual Machines (VMs) allocated & run on a physical infrastructure, having to possessed by an Infrastructure Provider (IP), managed by a virtualization platform. The IP are bounded to provide a specific level of Quality-of-Service (QoS), usually expressed as guaranteed Service Level Objective (SLO); failing to do so may results a penalty. A possible approach to fulfill the SLOs, especially in presence of time-varying workloads, is estimating and allocating the proper amount of physical capacity for the stated workload are required to meet its SLO.

For the purpose to perform this suitable scheduling mechanisms are used by the cloud manager. In most cases, each VM is connected with a maximum quantity of CPU that the VM will be able to consume, no matter the host system has not in use CPU cycles.

Providing for peak demand, however, during the off-peak workloads the VMs looks over-allocated.

Because of over-allocation, less VMs can be placed on the same physical machine, and more physical machines must be active to run the workload that, in turn, induces a higher power consumption.

To avoid such situations, the IP must dynamically adjust the amount of physical capacity allocated to each VM to match the current workload demand. This can balance the need of reducing the number of active physical machines with the one of ensuring that the VM receives enough physical resource capacity to meet its SLOs.

In this paper, we proposed a Fuzzy control system that is able to meet the SLOs of cloud applications by dynamically allocating to their VMs just the amount of physical capacity i.e required to arrive at the SLOs for current workload conditions. In this way, it reduces the average resources allocated to the various VMs on the cloud, thus enabling a greater utilization level on the machines and hence reduces the number of active machines. We implement a prototype of proposed approach on CloudSim, and tested it over timevarying workload conditions.We also compare our controller against state-of-the-art controllers.

The rest of the paper is arranged are as follows. In the Section II, a literature review is presented. In the Section III, we explain the design of the proposed system. In the Section IV, Present the results obtained from an experimental evaluation. Finally, in the Section V, we infer the paper and to talk about possible future works.

LITERATURE REVIEW

The problem of assigning proper load to virtual machines in the cloud network with constraints on virtual machines and virtual links can be deliberated the NP-hardmulti-way assignment problem [9]. To reduce the complexity of the stated problem most of the proposed approaches splits the problem into two phases known as (1) node mapping and (2) link mapping.

Generally the greedy heuristic approaches are preferred for node mapping, while for link mapping the (k) shortestpath or similar flow algorithms are applied.

Some of the recent proposals try to solve both the problems either simultaneously [6] or using some type of coordination mechanism among the two phases [7]. Other ways to reduce the complexity of the problem is to limit the search space dimensions. Like in [2] [3] [4] where the admission control is removed by considering infinite capacity on the substrate network. In [5] virtual network embedding requests are handled offline while in [6] methodologies for handling virtual network requests as they arrive are presented. In [7] LB3M technique is presented to select appropriate node for executing a task to enhance the performance of large-scale cloud computing environment. The LB3M scheduling algorithm, combines minimum completion time and load balancing techniques thus the LB3M can provide efficient to make use of cloud computing resources & maintain the load balancing in cloud computing environment.

FUZZY CONTROL SYSTEM

Fuzzy logic is the act of coming near to computer science that behaves the manner a human brain to form idea in one's mind and solves problems [11]. The opinion of fuzzy logic is to approximate decision making using natural language terms in place of relating to quantity terms. It is usually deliberated as modeling of information where it not able to be defined precisely, but considerable wide definitions can be formed because of its effectiveness & simplicity, Fuzzy-logic technology has to obtained many applications in the scientific & industrial applications.

A typical architecture of FLC is shown below, which comprises of four principles comprises: a fuzzifier, a fuzzy rule base, inference engine, and a defuzzifier.

Fuzzifier: It is used to change the form of crisp measured data (example speed is 5 mph) into suitable linguistic values (i.e. fuzzy sets, for example, speed is very low).

Fuzzy Rule Base: It can supply the empirical knowledge of the operation of the process of the domain skilful.

Inference Engine: It is the most important part of a Fuzzy Logic Controller, and it has the capability of simulating human decision making by doing approximate reasoning to gain a desired control strategy.

Defuzzifier: is utilized to yield a non fuzzy control action or decision from the inferred fuzzy control action by the inference engine.

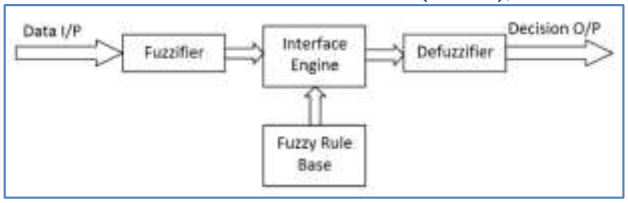

Figure 1: Block Diagram of Fuzzy Controller

THE SYSTEM ARCHITECTURE

We consider a physical computing infrastructure, managed by a virtualization platform CloudSim that specify and enforce limitations on the maximum amount of CPU capacity allocated to each VM running on them. We adopt that the infrastructure hosts a set of multi-tier cloud applications (each one consisting of the set of VMs), that give the services to the population of clients issuing streams of requests. We also assume that the number of virtual machines to forming each application are statically fixed (i.e., it is not varied at run time to track changes in the intensity of the workload), and that the capacity available on each physical machine is sufficient to accommodate the total demand of all the virtual machines it hosts. In order to guard against a possibility the total demand exceeds the available capacity, either some of the virtual machines have to change place of abode, or at virtual machines must be spawned, on other physical machines. We assume that the initial placement of the virtual machines on the physical machines, in addition to their migration or the spawning of additional VMs, is performed by the Cloud Service Provider by using a suitable algorithm.

PROPOSED ALGORITHM

This section presents the proposed work and algorithm has to be conquer the entirely the related problems which has to be detailed in the earlier sections. The scheduler uses the fuzzy logic to gain all the goals. The benefits of using the fuzzy logic is that it can be designed for complex problems with only logical rules for this reason it does not need complex mathematical calculation.

The proposed algorithm can be written are as follows:

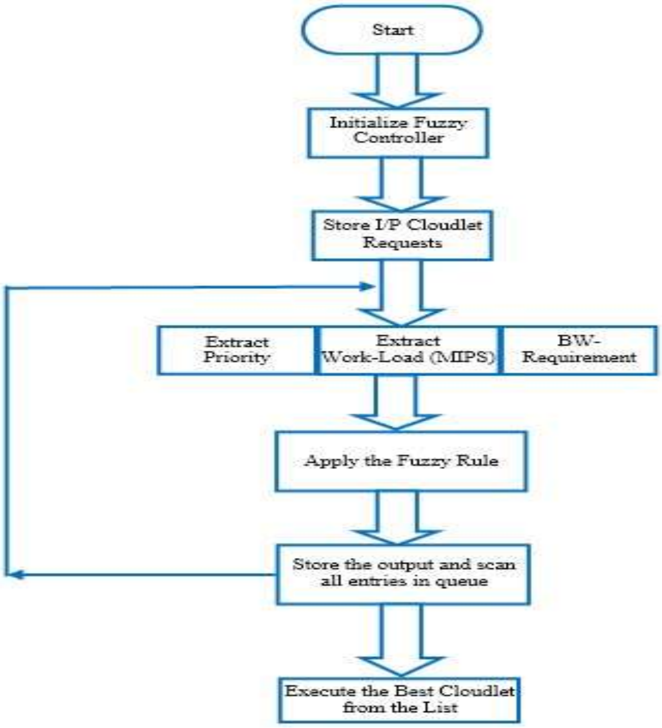

Figure 2: Flow Chart of the proposed Algorithm.

Algorithm:

Start:

1. *List the Available VMs with their Bandwidth (BW) and Processing Capability (MIPS);*
2. *Generate the Queue of the Streaming Traffic (Cloudlets) Load into the Cloud;*
3. *Check the requested data to be transmitted*
4. *Check the Cloudlets in the queue with their priority, Workload Size (MIPS) and BW-requirements;*
5. *Apply fuzzy rule for each Cloudlet entry in the queue;*
6. *Select the Cloudlet which According to fuzzy Controller output;*
7. *Repeat the Process until the queue ends.*

End

Fuzzy Logic Scheduler: that is used in step 5 of main algorithm

Start:

1. *1. Apply fuzzy logic with priority, work-load size and BW-required in the succeeding way.*
   a.) A fuzzy rule in the form of "If…. Then";
   b.) To discover membership function;
   c.) To maintain fuzzy table from fuzzy matrix;
2. *Repeat the procedure for all entries.*
3. *Go to step (6) of main algorithm;*

End

The algorithm starts with the curved rectangle box which initializes the Fuzzy Controller by loading the pre-defined rules. Next box of flow chart is to read data of the input queue to checking the requests in waiting conditions.Now from the requests the importance of priority, work-load size and the required BW is extracted. After that the available VMs and Cloud condition is analyzed. Now the fuzzy rules are applied to each request. After completing this phase provide the execution priority to each request in proportion to fuzzy output.

SIMULATION RESULTS

In this section we can presents the performance evaluation for the proposed scheme. The metrics used here in for the evaluation in terms of QoS are delay and request execution rate and load execution rate.

The simulation of the system is performed in Cloudlet with different number of Cloudlets varying from 60 to 100.

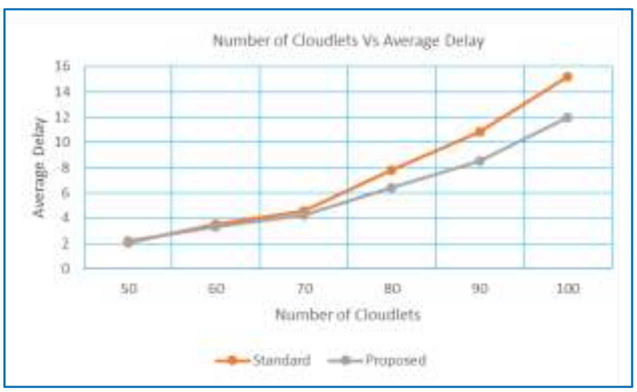

Figure 3: comparison of average delay for different numbers of Cloudlets

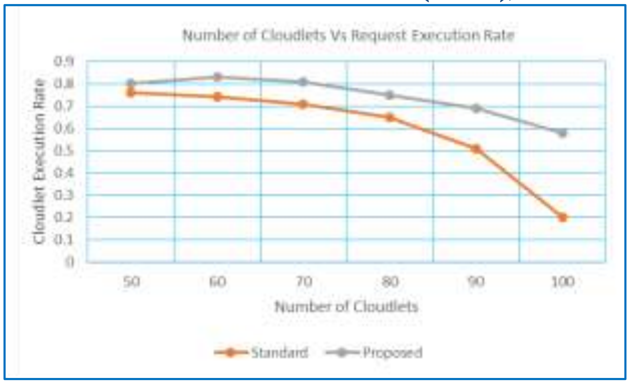

Figure 4: comparison of request execution rate for different numbers of Cloudlets

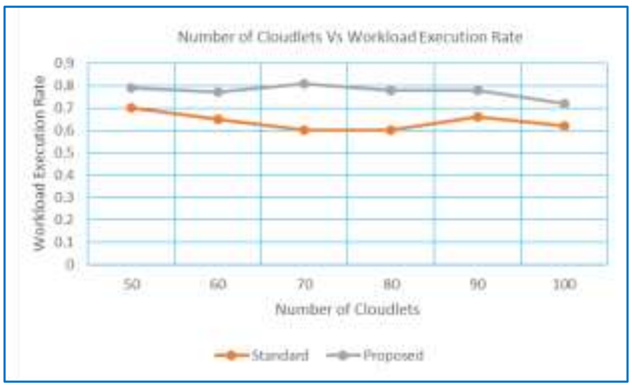

Figure 5: comparison of work load execution rate for different numbers of Cloudlets.

CONCLUSION

In this research paper, we can presented the fuzzy logic based work-load scheduling scheme for Cloud. The presented algorithm can be useful for the optimal resource utilization where time, priority and bandwidth of applications (work-load) are the most important constrains. The implementation & simulation of the proposed algorithm with distinct workload shows that the proposed algorithm improves the execution rates from 40 to 60 at same workload also the request execution rate and work load execution rate gets increased by acceptable margin. Fortunately, proposed scheduling algorithm works locally hence no communication overhead required and each. The achieved results also encourage the application of non conventional system (i.e fuzzy scheduler) for such applications. In spite of the fact that the further modifications & improvements on the fuzzy rules may be performed in future work.

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