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A survey on energy aware consolidation algorithm based on K-nearest neighbor regression for cloud data centers

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ABSTRACT

In this paper, we advise a dynamic digital gadget consolidation set of rules to minimize the number of active bodily servers on an information center if you want to reduce electricity cost. The proposed dynamic consolidation method uses the k-nearest neighbor regression set of rules to predict resource utilization in each host. Based on prediction utilization, the consolidation approach can determine (i) whilst a host turns into over-utilized (ii) whilst a host becomes under-utilized. Experimental effects on the actual workload strains from more than one thousand Planet Lab virtual machines show that the proposed method minimizes strength intake and continues required performance levels.

Index Terms: Cloud computing; Energy efficiency; Green IT, Dynamic consolidation, K-nearest neighbor regression.

INTRODUCTION

Energy aware consolidation

As strength intake of ICT infrastructures has expanded considerably inside the recent years, the research community and organizations are working on strength aware resource management strategies. A 3% reduction in strength cost for a huge agency like Google can translate into over one million dollars in fee savings [1]. Moreover, excessive power intake by using the data center leads to huge carbon dioxide (CO_2) emissions contributing to the greenhouse effect. Dynamic consolidation is certainly one of the maximum promising answers to optimize useful resource usage and reduce energy intake in virtualization technology [2]. It switches the idle hosts to the sleep mode to remove the idle power consumption after Virtual Machine (VM)consolidation. In this paper, we proposed a dynamic consolidation set of rules that minimizes the quantity of energetic hosts in step with the modern and destiny useful resource usage. There is an in depth quantity of proposals on virtualization technology that relates to dynamic VM consolidation, and the maximum recent techniques goal to lessen electricity intake even as meeting performance requirements. In a few approaches, the VM consolidation have formulated as an optimization trouble [3][4]. Although an optimization trouble is associated with constraints.

Like facts center capability and SLA. Therefore, these works utilize a heuristic approach for the multidimensional bin packing problem as a set of rules for the workload consolidation. Data centers are containers and VMs are objects, with each facts being one size of the size. Algorithms

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clear up this trouble to limit the number of containers even as packing all of the objects. In addition, the Virtual Power architecture [5] utilizes a strength control gadget primarily based on nearby and international policies. On the nearby level, the gadget leverages guest operating system's power control strategies. Global coverage applies VMs live migration to reallocate the VMs. In a preceding work [6], we applied linear regression to expecting an under loaded or overloaded host. Experiments display that the prediction approach can significantly lessen the strength consumption and SLA violation rates.

Block diagram

As the computational international has grown to be very big and complex, cloud computing is a popular computing version to provide big statistics facilities for external users. Cloud statistics facilities are provided clients in a bendy and service oriented way on a pay-as-you-go basis [1]. We consider the cloud architecture with three layers relies upon on the different varieties of services offered (Figure 1). Software-as-a service (Saas) provides trendy utility software functionality as provider on demand. Platform-as-a-provider (Paas) gives computational resources thru a platform upon which programs and services may be developed. Infrastructure-as-a-service (Iaas) delivers basic infrastructure aid offerings. This layer can use virtualization capabilities for enhancing accessibility of cloud information center infrastructure. Virtualization [2] generation addresses the performance of useful resource utilization by using sharing a physical server (host) among multiple performance-remotes structures called digital machines (VMs).

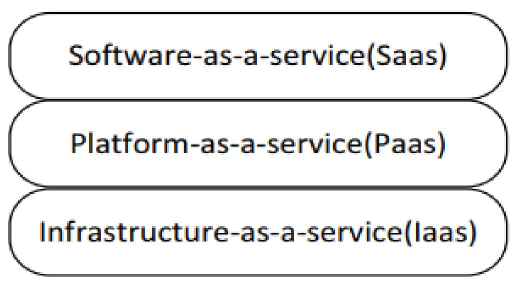


Figure 1. Cloud layered architecture

Virtual machine consolidation

VM consolidation in Compute Clouds has been tackled in both commercial merchandise and studies paintings. Representative merchandise consists of VMWare's Distributed Resource Scheduler (DRS) [24] and IBM Server Planning Tool (SPT) [7]. Most work in the studies literature [1, 13, 18, 20, 26] formulate it as a minimization problem with the number of required servers as the goal and with the constraints imposed by way of server ability, service-level-agreement, etc. Previous work do not keep in mind the network ability limit, and denotes the resource needs of VMs with the aid of deterministic values. They use various algorithms with a nature just like bin packing heuristics such as First Fit Decreasing (FFD) [1].

Bin packing

In the classical NP-hard bin packing problem, a list L with actual numbers between 0 and 1 have to be assigned to bins with unit ability such that the sum of the numbers in each binis not any extra than 1 and the quantity of bins used is minimal, denoted via OPT. Let B (L) denote the quantity of containers used with the aid of a packing set of rules, then the worst case performance ratio of this algorithm is described as lime OPT HXl supdB(L)/Opt. Various heuristic algorithms [3, 9, 10, 11, 27] had been proposed. FFD has a worst case performance ratio of 191 [5, 28], that is later shown to be tight [4]. MFFD [12], a variance of

FFD will have a ratio of 6. These algorithms require first sorting the items, and are not relevant for an internet binpacking problem. An online set of rules is required to procedure L in order.

LITERATURE REVIEW

Fahimeh Farahnakian (2013), achieved Virtualization is a critical technology of cloud computing which enables the partition of a physical host into several Virtual Machines (VMs). The wide variety of lively hosts can be reduced in step with the resources necessities using live migration which will reduce the energy intake in this technology. However, the Service Level Agreement (SLA) is important for maintaining reliable high quality of carrier between information facilities and their users inside the cloud environment. Therefore, discount of the SLA violation level and power costs are taken into consideration as two goals in this paper. We gift a CPU utilization prediction method primarily based on the linear regression technique. The proposed method approximates the short time future CPU utilization based at the records of utilization in each host. Itis employed inside the live migration process to expect over loaded and under-loaded hosts. When a host will become over-loaded, a few VMs migrate to different hosts to keep away from SLA violation. Moreover, first all VMs migrate from a host at the same time as it becomes under-loaded. Then, the host switches to the sleep mode for reducing power consumption.

Meng Wang (2011) has a view for Recent advances in virtualization technology have made it a not unusual practice to consolidate digital machines (VMs) into a fewer variety of servers. A green consolidation scheme calls for that VMs are packed tightly, yet obtain resources commensurate with their demands. However, measurements from production information centers display that the network bandwidth demands of VMs are dynamic, making it hard to symbolize the demand by the way of a set cost and to apply conventional consolidation schemes. In this work, we formulate the VM consolidation right into a Stochastic Bin Packing problem and recommend an online packing algorithm with the aid of which the quantity of servers required. In addition, the consolidation algorithm is used.

Michael Cardosa (2009) experimented on Virtualization technologies like VMware and Xen offer functions to specify the minimal and most amounts of assets that can be allocated to a virtual machine (VM) and shares based totally mechanism for the hypervisor to distribute spare assets amongst contending VMs. However lots of the existing paintings on VM placement and electricity consolidation in statistics centers fails to take gain of these functions. One of our experiments on a actual testbed indicates that leveraging such capabilities can improve the overall software of the facts middle by way of 47% or even higher. Motivated through these, we present a novel suite of strategies for placement and strength consolidation of VMs in records centers taking advantage of the min-max and shares capabilities inherent in virtualization technology. Our techniques offer a smooth mechanism for energy-overall performance tradeoffs in modern information centers walking heterogeneous applications, wherein the amount of resources allotted to a VM may be adjusted primarily based on available sources, power costs, and alertness utilities. We examine our strategies on a selection of big synthetic statistics middle setups and a small real information center test bed comprising of VMware ESX servers. Our experiments affirm the give up-to-quit validity of our approach and reveal that our very last candidate algorithm, Power ExpandMinMax, consistently yields the satisfactory usual application across an extensive spectrum of inputs – various VM sizes and utilities, varying server capacities and varying power costs – thus providing a realistic answer for administrators.

Aameek Singh (2008), has describes the design of an agile data middle with incorporated server and storage virtualization technologies. Such records facilities form a key building block for new cloud computing architectures. We also display how to leverage this included agility for non-disruptive load balancing in records centers throughout multiple useful resource layers servers, switches, and garage. We recommend a novel load balancing algorithm referred to as Vector Dot for handling the hierarchical and multi-dimensional aid constraints in such systems. The algorithm, inspired by way of the hit Toyoda method for multi-dimensional knapsacks, is the first of its kind. He evaluate the device on a range of artificial and real information middle testbeds comprising of VMware ESX servers, IBM SAN Volume Controller, Cisco and Brocade switches. Experiments below varied situations exhibit the cease-to-give up validity of our gadget and the capacity of Vector Dot to effectively remove overloads on server, switch and storage nodes. With growing scale and complexity of cutting-edge enterprise records centers, directors are being compelled to rethink the design of their records centers. In a traditional records center, utility computation and utility records are tied to specific servers and garage subsystems which might be often over-provisioned to deal with workload surges and surprising failures. Such configuration stress makes records centers highly-priced to maintain with wasted power and ground space, low aid utilizations and sizeable management overheads.

SYSTEM ANALYSIS

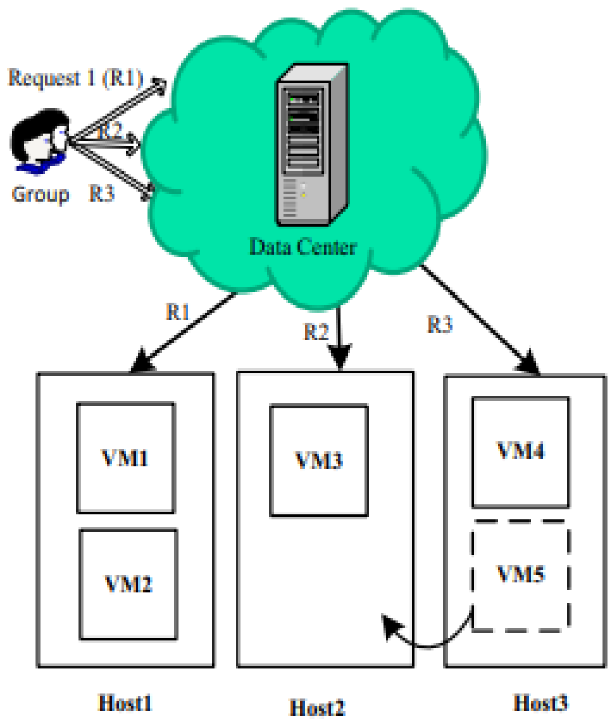
Current system

An optimization hassle is associated with constraints like statistics middle ability and SLA. Therefore, these works utilize a heuristic approach for the multidimensional bin packing hassle as an algorithm for the workload consolidation. Data centers are bins and VMs are objects, with each records center being one size of the size. Algorithms solve this trouble to reduce the number of packing containers whilst packing all the objects. In addition, the Virtual Power architecture [5] makes use of an electricity management machine primarily based on local and global policies. On the nearby level, the system leverages visitor operating system's energy control strategies. Global coverage applies VMs live migration to reallocate the VMs. In a preceding work [6], we applied linear regression to predict an under-loaded or overloaded Host. Experiments show that the prediction technique can significantly reduce the electricity consumption and SLA violation rates.

Proposed system

Linear regression

Regression is a popular statistical approach to estimate the connection between one or more enter variables and the output variable. The case of one input variable is called easy regression. More than one input variable is multiple regressions. In all cases, regression approximates a function (regression function) that it could be considered as linear or non-linear. Thus, minimization of the residual is an objective for obtaining regression coefficients. The most popular approach to minimize the residual is the least squares approach [19, 21], where the coefficient parameters of the fashions are chosen such that the sum of the squared residuals over all statistics points is minimized. The VMs experience dynamic workloads, which imply that the CPU usage by means of a VM arbitrarily varies over time. The power intake is in most cases calculated based totally on the CPU, memory, disk storage and network interfaces in the data center. Since the CPU consumes the main a part of energy, in this take a look at the strength measured based totally at the CPU usage. It indicates the CPU usage has an impact on strength consumption, the effect is linear when dynamic voltage and frequency scaling is applied.



Expand min max algorithm

GMM does well at picking the right combination for each VM mainly when some VMs are more worthwhile at their min even as a few are greater profitable at their max. However, it nonetheless misses out on two qualitative phenomenon. One, even as the VMs which might be greater worthwhile at min get positioned at min, they do now not get a risk to get additional assets even when the incremental cost they provide past min is much higher than other VMs. Second, it misses out when a few nodes nonetheless have room left after the first-in shape packing. A extra efficient method would be to expand one or extra VMs to apply that area on every node. Instead of choosing the node for every VM in a first-fit fashion, the ExpandMinMax (EMM) algorithm first computesan expected utility for every node if the brand new VM had been added to that node and selects the node that offers the exceptional software improvement. The application for every node is computed by using first setting all the VMs assigned there to be at min, and then expanding the VMs that supply the most incremental utility per unit potential until both the node's capacity is reached or no extra expansion is possible.

Power expand min max algorithm

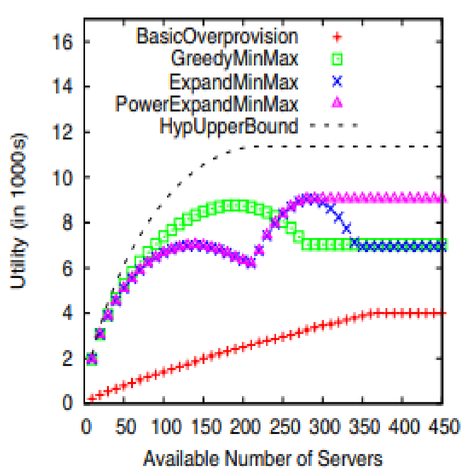
A trouble of EMM, however, is that it tends to use all of the servers that it has access to. For example, if a further empty server were available, EMM could likely pick that server due to the fact placing the new VM there could provide a better utility gain as it could not have to cut back any current VMs on other nodes. This may be a disadvantage in phrases of energy fees if it opens extra nodes than necessary. The perfect algorithm would automatically discover the "sweet spot" number of nodes and use handiest that many nodes despite the fact that extra ones are available. However detecting whether to start a new node or now not – primarily based on local knowledge simplest (placement of the contemporary VM) without a look ahead for VMs being packed later – is a complex question. The Power Expand Min Max (PEMM) approach we propose uses the following strategy to cope with this aspect. It is similar to EMM, besides that the comparative measure it uses are the node utility benefit minus the proportional power value incurred (if any) on the brand new node. The latter amount applies best when a new node is being started, and in this example the power fee of the machine is scaled down to a size utilized by the VM and this is taken into consideration the proportional strength fee for the VM.

Stochastic bin packing

VMs with acknowledged bandwidth demands need to be consolidated onto a number of servers (or chassis, racks) with equal potential limit. We count on an internet consolidation situation that every VM have to be consolidated once a request is made. In reality server consolidation usually happens at weekly or month-to-month timescale. At such a huge timescale, we believe the VM bandwidth usage can be approximated by means of a Gaussian distribution. One optimal strategy to pack item one to four in one bin, object 5 to 13 in one bin and the rest in a single bin. It takes3 bins and there's no residual capacity in two boxes. However, two gadgets inside the first kind and 4 items inside the second type and one item in the third kind can precisely in shape into one bin without a residual potential. If two boxes are packed in this way, the remaining gadgets can not healthy into one bin. Therefore, even though the primary two boxes are fully packed, we want 4boxes in this strategy. The total equivalent size here is larger than that in the optimal strategy.

Large synthetic data center experiments

Synthetic experiments allow us to examine the impact and Overall performance of techniques in huge statistics middle environments. Not gaining access to such huge live facts centers, we used a simulator written in Java to generate installations with hundreds of VMs and hundreds of servers, with configurable sizes, utilities and min-max inputs. A natural query that arises is a way to get the application and min-max inputs required for the algorithms. In actual installations, management interfaces consisting of VMware Virtual Center [13] provide a mechanism for administrators to specify the min-max values for each VM they create. Administrators set those numbers primarily based on either their expert information or from reading templates and lines of going for walks applications. These can also be derived from utility Service Level Agreement (SLA) information [14, 3]. Similarly, application management interfaces which include IBM EWLM (Enterprise Workload Manager) [15] provide mechanisms for directors to specify priorities for each utility. We envision extending such interfaces to specify a software price as nicely for each utility. Our awareness in this paper is not as a whole lot on how to acquire those inputs however more on how to use the inputs successfully to derive meaningful placement and consolidation plans.



CONCLUSION

In this paper, a dynamic consolidation technique is proposed to reduce power fee while assembly SLA. The experiments display that the proposed algorithm able to limit Energy intake and SLA violation fee more correctly than other dynamic consolidation methods. Since CPU consumes the main part of energy, the energy is measured primarily based at the CPU utilization in this paper. The proposed method expected the CPU utilization in every host based totally on the linear regression technique. This method used the remaining usage over one hour in the past and approximated a function. This paper studies VM consolidation hassle while network gadgets in records centers impose bandwidth constraints. We formulate the VM consolidation right into a Stochastic Bin Packing trouble which fashions the bandwidth needs of VMs as probabilistic distributions. Unlike existing research, our strategies take benefit of the min, max and shares features inherent in virtualization technologies and provide a clean mechanism for power-performance tradeoffs in modern statistics centers. Guided via software utilities, we are capable to carry out extra fine-grained aid allocation that exploits software heterogeneity, making sure that high utility applications get the most resources

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