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Virtual Machine Placement using Analytic Approach in Data Center

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Abstract

Cloud services are being used rapidly for various purposes and that leads to rapid growth of Data centers since Data Centers are serving as remote storage medium which is done by a group of servers. Virtual machines can also be considered as major reason for the success of cloud computing in such a large scale. Virtual machine requests are getting more day by day which directly implies that there is a need for allocation policy which can be efficient in dealing with the VM placement in data centers since placement of virtual machines plays a vital role in Data Centers. After a thorough consideration of the current scenario, it indirectly implies that a dynamic allocator which is aware of power needs to be studied. In this, every request for Virtual machine requests gets characterized based on four parameters. Those four parameters are disk, RAM, CPU and bandwidth. These allocators are designed in such a way that it accepts as many requests as possible. Here we tried various allocation strategies and these allocators are differing in terms of policies like different approaches. They are also differing in terms of policies like objective optimization or joint or disjoint selection of the resources. The behavior evaluation of this policy strategy is carried out in a way that varies the load in DC and also varies the quantity of virtual machines that are to be allocated. Furthermore, the results do clearly illustrate that disjoint approaches are outperformed by jointapproaches.

Keywords: *Cloud Computing, Virtual Machine, VM Placement, Data Center.*

1. Introduction

Nowadays Cloud Services are becoming more and more popular and many kinds of people are starting to use various types of cloud services for various purposes which ultimately led to the growth of cloud computing domain. Cloud Computing is based on the tagline “Pay as you go”. Despite all these, cloud computing domain is still one of the most trending and emerging technology fields. The rise in the usage of cloud services ultimately led to more number of cloud service requests to the cloud service provider who is also shortly known as CSP in technical field. Generally, all these cloud service requests are linked with the virtual machines and that is created from a physical machine. The more number of cloud service requests indicate the more number of virtual machine requests. Generally, these virtual machinesare Hosted from certain physical machines. This part is where an entity called Data Center plays its significant roles. Data center usually serves the purpose of maintaining these virtual machines in order to access and use it without any issues. In simple words, Data center is the place where all these virtual machines are placed. This particular process of placing the virtual machine from a physical machine to a data center is called virtual machine placement or virtual machine allocation. Usually these virtual machine allocation or placement happens using some algorithm which allows the virtual machine to be placed in data center. So, in other words, an efficient way of placement is needed to place the virtual machine in a data center in such a way that it makes it efficient. So in this paper, we are concentrating on a scheduling algorithm for virtual machine in data center.

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2. Literature Survey

There are various allocation strategies used for the purpose of virtual machine allocation in data center. Some of the allocation strategies that are used as follows,

[1] Authors studied about the network virtualization in the cloud computing. They also explained about key reasons for that and explained about the software defined network. Finally, they also illustrated the applicability with their application in cloud environment.

[2] Authors studied about the various approaches and used the strategy which is based on the concept of multiple knapsack and it was able to make the whole process efficient in a certainway.

[3] Authors studied about the various techniques used and were able to utilize the concept of power based approach. They mapped the virtual machines to make it more energy efficient and turned off the rest which is not used at particular moment.

[4] Authors studied about available techniques that are working in the favor of improving the balance in the process of virtual machine allocation and were able to come up with an approach that allows them to access various resource pools in order to deal with the complexity issue and also to make it better in certain parameters such as execution time span.

[5] Authors used the technique which is capable of making the process more efficient by certain level. They tried the method called ant colony optimization which actually allowed them to trace the shortest path to the data center using the artificial ants and it made the allocation process better.

[6] Authors tried the possible way to make the execution time more efficient by using the concept of artificial bee colony. They used three types of bee agents in order to find the path in an efficient manner.

[7] Authors studied about the various kind of scheduling algorithms that are used in the cloud computing domain for virtual machine placement and came up with survey that indicates the usage and makes it easier to understand the concept.

[8] Authors studied about the dynamic allocation policies that are used for virtual machine placement and also utilized the advantage of software defined networks to try out the improved versions of the methods.

[9] Authors studied about the allocation strategies for virtual machine and used the concept of ocrp in order to overcome the drawbacks which held back the process.

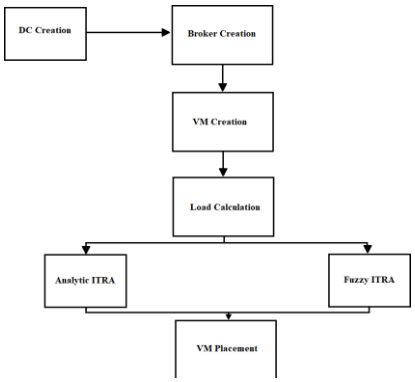
[10] Authors studied about the multi virtual machine concept and used it in a multi-purpose way for the virtual machine which also made the allocation process more apt.

3. Proposed Work

In this paper, we are proposing a strategy for virtual machine allocation. So what basically happens in theprocess called virtual machine allocation is stated here in simple terms. Virtual machine also shortly known as VM is a virtual device which has been created from a physical machine. According to the requests received from the user side to the cloud service provider also shortly known as csp, these virtual machines are created. These virtual machines need not have a static configuration and neither same configuration. These virtual machines can be used for various purposes like storing the data, accessing the stored data, doing any computational work that requires the computational resource etc.

The virtual machine allocation needs a strategy which will make the virtual machine allocation process happen without any troubles and flawlessly. The strategy we are using in order to make the virtual machine allocation process more efficient is by using the joint allocation strategy which will consider both the computational resources namely cpu, ram, storage or disk and also the network resource which is bandwidth. Another different approach is by only considering the computational resource namely cpu, ram and storage or disk, which means ignoring the network resource and this type of approach is called disjoint allocation.

A. Architecturediagram



The above given architecture clearly shows how the virtual machine allocation is happening in data center. The following table will explain the terms used in this paper in such a way that it gets easy to understand while using the short forms such as acronyms and abbreviations.

B. Joint Allocation

This allocation strategy considers two types of resources. They are,

- Computational Resource
- Network Resource

➢ Computational Resource
✓ CPU
✓ RAM
✓ Storage orDisk

➢ Network Resource
✓ Bandwidth

C. Disjoint Allocation

This allocation strategy considers only the computational resource.

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- ComputationalResource
  - ✓ CPU
  - ✓ RAM
  - ✓ Storage orDisk

D. Algorithm

Step 1: Cloud environment is simulated using Cloudsim.
Step 2: Gets the number of Cloud Data Centers and Brokers to be created.
Step 3: Gets the number of Virtual Machines to be created. Step 4: Virtual Machines get created in Cloud environment. Step 5: Shows the overall details of the Cloud environment.
Step 6: Using Analytic and Fuzzy approach the Virtual Machine get placed in Data Centers.
Joint A-ITRA
A_j=1/300[CPU + RAM + Storage(Disk)] + αPC/PC_S
Disjoint A-ITRA
A_{dj}=1/300[CPU + RAM + Storage(Disk)]
Joint F-ITRA
F_j=β[CPU + RAM + Storage(Disk)] + αPC/PC_S
Disjoint F-ITRA
F_{dj}=β [CPU + RAM + Storage(Disk)]

4. Implementation

In this paper, the allocation strategy we are using is joint allocation along with the help of Analytic ITRA.

A. Virtual Machine Placement

The virtual machine allocation mainly happens in the following way.
1) Check for an available server and if no server is available, reject therequest.
2) The server selection happens in the first come first serve basis as the very first server gets the VMrequest.
3) The best fit server is the one with less resources available.
4) The worst fit server is the one with most resources available.

B. Analytic ITRA

This analytic method is used with two types of allocation strategies. They are joint and disjoint allocation. The former one considers both the computational and network resource whereas the latter one considers the computational resource alone.

- Joint AnalyticITRA

A_j=1/300[CPU + RAM + Storage(Disk)] + αPC/PC_S
Where the constant value will be 1 for best fit and -1 for worst fit.

- Disjoint Analytic ITRA

A_{dj}=1/300[CPU+RAM+Storage(Disk)]

C. Fuzzy ITRA

This fuzzy method is included for the purpose of comparison with analytic ITRA method. This fuzzy method is also used along with both the joint and disjoint allocation.

- Joint FuzzyITRA

F_j=β[CPU + RAM + Storage(Disk)] + αPC/PC_S
Where the constant(α) value will be 1 for best fit and -1 for worst fit and the constant(β) will be varied according to the size ranging from 0.3 to 1.

- Disjoint FuzzyITRA

F_{dj}=β [CPU + RAM + Storage(Disk)]

Table1

Term	Explanation
VM	Virtual Machine
CSP	Cloud Service Provider
DC	Data Center
CPU	Central Processing Unit of the particular entity
RAM	Random Access Memory of the particular entity
Storage (Disk)	Disk size of the particular entity
RA	Resource allocator
PC	Path Cost
PC_S	Sum of the Path cost
A_j	Analytic Joint approach
A_{dj}	Analytic Disjoint approach
F_j	Fuzzy Joint approach
F_{dj}	Fuzzy Disjoint approach
ACO	Ant Colony Optimization
ABC	Artificial Bee Colony

Table2

DC	NODE	CPU	RAM	DISK(TB)	BANDWIDTH
DC 0	0	2	16384	2	25000
DC 0	1	2	4096	9	25000
DC 0	2	2	8192	9	25000
DC 1	0	2	16384	7	25000
DC 1	1	2	32768	3	25000
DC 2	0	1	16384	8	25000
DC 2	1	1	4096	2	25000
DC 2	2	1	16384	6	25000

The above mentioned tabular columns are to display the sample datasets which has been used as the configuration of data centers and also virtual machines. These values need not be same since the configurations can be dynamic when done in real world conditions. From the above displayed comparison between the graphs, it can be concluded that analytic strategy using joint allocation is better than either of the fuzzy strategy given that the required workload is less intensive.

Table 3

VM	CPU	RAM	DISK(TB)	BANDWIDTH
VM0	3	3072	4	5000
VM1	8	2048	6	5000

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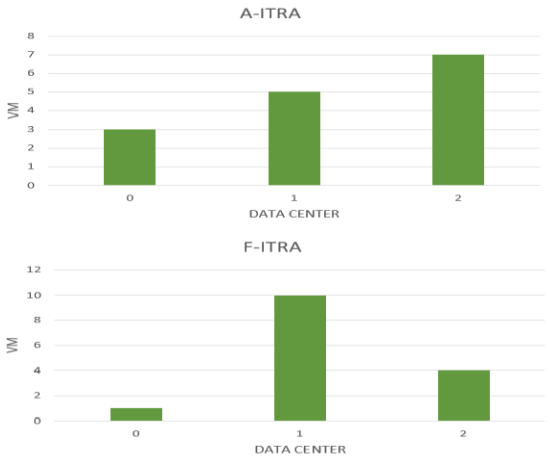
VM2	8	512	7	1000
VM3	8	3072	6	1500
VM4	4	2048	7	1000
VM5	8	2048	9	1500
VM6	5	1024	8	5000
VM7	6	1024	2	5000
VM8	9	1024	5	2000
VM9	7	512	4	1000
VM10	7	3072	2	5000
VM11	9	512	8	1500
VM12	5	2048	1	1500
VM13	8	2048	4	3000
VM14	6	512	8	5000

5. Results and Discussion

So far we have seen about the joint and disjoint allocation strategies using analytic and fuzzy method. Joint allocation strategy is the one which considers both the computational resource and network resource whereas the disjoint allocation considers only one type of resource. i.e Computational resource. The following comparison between the graphs will clearly illustrate the strategies.



6. Conclusion

In this paper we used the allocation strategy for virtual machine which is somewhat efficient than the regular ones and it also made the overall virtual machine allocation an efficient task which in turn improved the overall features. The main point which has to be noted is that when the computational resources namely cpu, ram, storage or disk were taken into account, it was possible to approach in a disjoint allocation method and the inclusion of a network resource such as bandwidth allowed to use the joint allocation strategy which clearly outperformed the former one. Along with these allocation strategies, whenever analytic IT resource allocator method is used, it was possible to make it more efficient given that the demand or the workload was kind of less for the cpu. So it is safe to conclude that the analytic approach along with the joint allocation strategy is a better approach as it shows when gone through certain parameter like the allocation time of a virtual machine in a data center.

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