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Process Allocation and Migration in Virtual Machines using Greedy Method in Cloud Computing

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Abstract: Cloud computing is a technology which uses web and central remote servers to maintain data and applications. It permits any user from any place to use its services. Virtualization technology has been broadly applied in cloud computing due to its inherent benefits such as elasticity, scalability, flexibility, and on-demand resource provision. It shows a simulated behaviour of a software system. Virtual Machine (VM) is a simulation of a computer structure. In order to balance the work load across VMs, process migration is a very useful mechanism. Migration of process helps to satisfy performance objectives, increase resource utilization, decrease energy consumption, and facilitate system maintenance activities. Devising an efficient migration scheme is a challenging problem because the technique must manage the resources in such a way that it does not result in wastage or underutilization of resources. It may result in poor service distribution in the data centers. This paper implements greedy method for allocating processes to VM. It also maintains a state that no resources are underutilised by migrating processes to another best fit VM when requested resource is not available as a whole.

Index Terms-Resource utilisation, allocation, process migration, memory size, greedy method

1. INTRODUCTION

Cloud Computing is a network based facility that offers common resources which are shared on demand. It is a composition of three service models, four deployment models and five essential characteristics. One of its main benefits is fast storage and retrieval of data. It is a computing technology that maintains computational resources on huge data centers which can be accessed through internet, rather than on local computers. As a result there is no necessity for customers to have their individual dedicated resources. They are provided on the internet by the cloud providers. Thus customers expends only for the required services without spending for infrastructure. On the other hand, the rising energy consumption of cloud data centers has become a prominent problem. In cloud computing, virtualisation is used for storage, application, server and network devices. To manage energy consumption, techniques such as migration, load balancing and maintenance of servers are used.

Virtualization is one of the pre-eminent technologies for consuming energy efficiently in data centers. Some of its advantages are resource utilization, portability, and application isolation, reliability of system, higher performance, improved management ability and fault tolerance. Resource usage optimization is one of the ways used for reducing energy consumption which also helps administrators to control the budgets of data centers.

Cloud contains a set of virtual machines which comprises both computational and storage capacity. Virtual Machine is a complete hardware system which is virtual software and runs in an isolated environment. Large servers can run several different VMs providing different services. Better server utilization is achieved with virtualization. It allows storing many operating systems and applications on distinct and shared computer which can be used over the network with the help of a browser and an internet connection. The processes can be migrated across VMs and also physical nodes to provide quality of service. It also helps in achieving various goals. Modern day data centers consist of hundreds of virtual servers. Migration of processes provides the capability of load balancing, system maintenance, etc. Virtualization technology gives power to cloud computing.

2. REVIEW OF LITERATURE

[2] presents a system that uses virtualization technology to allocate data centre resources dynamically based on application demands.[4] gives an overview of virtualisation techniques and explains different strategies used for migration across different virtual machines. [1][4] gives algorithms for migrating processes across machines based on many factors like bandwidth, downtime and memory etc. [13][17] and [18] are survey on different migration techniques and [17] discusses its related research challenges in data centers environments. [5] explains how to manage the resources for virtual machine migration whereas [6] provides an optimum resource

allocation method in virtual machines. Different methods are used for allocation of processes across virtual machines. [12] gives a study on different scheduling algorithms. [9][10][11] focuses on scheduling jobs using greedy method each with different parameters like energy consumption, completion time etc. [18]focus on a different algorithm for implementing process migration in order to balance the load.

3. VIRTUALIZATION

Virtualization offers an efficient solution to the objectives of the cloud computing paradigm by enabling creation of Virtual Machines (VMs) over the basic physical servers, leading to improved resource utilization and abstraction. Virtualization refers to creating a virtual form of a resource where the mechanism divides the resource into one or more execution environments. Applications, devices and end-users interact with the virtual resource as if it were a real single logical resource.

The purpose of Virtualization is to utilize the resource distribution, sharing and utilization to their maximum potential, reduce infrastructure costs in terms of physical resources, hardware, new network setups, system setups, and infrastructure maintenance. Virtualization hides the characteristics of the physical system from the user and as an alternative provides with another abstract computing platform.

To efficiently share system resources, virtualization abstracts the underlying hardware resource by placing a software layer between OS and the hardware. It also guarantees that the failure of one VM does not impact the proper functioning of the entire physical machine. However, co-hosting multiple VMs onto a single physical server is very challenging due to resource contention among co-hosted applications and system performance degeneration attributed to server overutilization.

4. RESOURCE ALLOCATION

In cloud computing, Resource allocation is the process of assigning available resources to the cloud applications. Cloud resources can be provisioned on demand to the business customers based on their needs. In cloud the resource allocation depends on the infrastructure as a service. In cloud platforms, resource allocation takes place at two stages:

- When an application is uploaded to the cloud, in order to balance the computational load of multiple applications across physical computers, the load balancer assigns the requested instances to physical computers.
- When an application receives multiple incoming requests, to balance the computational load across a set of instances of the same application, these requests should be assigned to a precise application instance.
- Resource allocation techniques should satisfy the following criteria:
- Resource fragmentation arises when the resources are allocated, freed and ultimately reallocated. There would be enough resources but cannot be allocated it to the required application due to fragmentation
- Scarcity of resources arises when the demand is greater than the available resources.
- The technique should satisfy that request of multiple applications.

The resource allocation algorithms take the resource requirements of a process into consideration and change the allocated resources, thus making it an on demand elastic cloud. Process placement and migration have become a major part of resource allocation in cloud data centers. Changes in the resource requirements of VMs are considered to be significant information for process placement and migration. Some of the resource allocation algorithms are first fit, worst fit and best fit algorithm out of which the best fit algorithm is the finest technique for utilising the resources in a beneficial way. It chooses the best fit VM for allocating the process.

5. PROCESS MIGRATION

Process migration is the transfer of a process from one VM to another VM within the same physical machine. It is a very useful mechanism for load balancing. Load balancing can be done by transferring a process from one VM to another. There are two types of process migration, Pre-emptive Process Migration and Non-pre-emptive Process migration. Pre-emptive process transfers involve the transfer of a process that is partially executed. Non-pre-emptive process involves the transfer of processes that have not begun execution and hence do not require the transfer of the state of the process. The information about the environment in which the process will execute must be transferred to the receiving node.

Total-copy algorithm is the basic algorithm for process migration. The mechanism of this algorithm is to suspend the process, transfer all state information, and then resume the process. The algorithm consists of following steps:

- Suspend process on source virtual machine.

- Source VM sends migration approval request message to destination virtual machine.
- Destination VM responds by accepting the request message.
- Then the source node will:

 Transfer process state with all the details and data up to which the execution is completed.

 Tell destination VM to restart process.

The major advantage of this algorithm is that it eliminates residual dependencies. A residual dependency means process information remains at the source VM after migration. A system is said to be fault tolerant only if there are no residual dependencies.

6. GREEDY METHOD

Greedy method is one of the approaches used to solve the job allocation problem. In this method, choice is made based on a criterion which gives the best solution i.e., it makes choice which seems to be the best at that moment. For a set of processes and virtual machines, allocation is done using Greedy- Based Algorithm which depends on the best fit allocation method. In this proposed system, greedy method is not only used for best fit allocation of processes but also for migration of the processes to the best fit VM. This algorithm is used for reducing the underutilisation of resources, resulting in an overall improvement of efficient allocation and execution of processes.

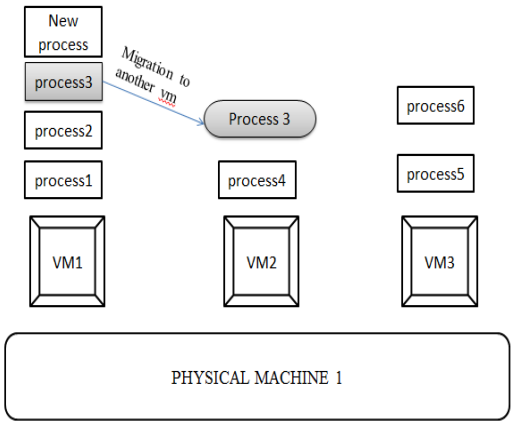

Fig. 1: Process allocation and migration across virtual machines

7. ALGORITHM

When a new process is requested, it is allocated to the best fit virtual machine using greedy algorithm. If no virtual machine has enough space for the new incoming process, then an existing process is migrated to another virtual machine which is found as a best fit for that process. Then the new process is allocated in the freed virtual machine. Only a particular set of VMs can be held by a physical machine.

Table 1: Keywords of algorithms

Keyword	**Description**
VM list	Collection of Virtual Machine in the physical machine say VM1,Vm2,…VMN
VM	Virtual Machine
RMS	Remaining memory size
TM	Total Memory
P1	New process which is to be allocated
IPMS	Incoming Process Memory Size
Limit	Limit of how many number of VMs a physical machine can have

Step 1: Calculate RMS in the VM list
Step 2: Calculate the total of values found in Step 1
i.e., TM=Sum of RMS in VM list
Step 3: If IPMS>TM and number of VMs <limit then

- Low memory state; create new VM with memory size of the VM which has maximum memory size; Add it to VM list
- Assign P1 to new VM
- Recalculate RMS in VM list
- Exit;

Step 4: If IPMS<TM then
If IPMS<=RMS of any individual VM in VM list then

- Find the best fit VM and assign P1
- Recalculate RMS in VM list
- Exit;

Else go to Step 5
Step 5: Calculate the best fit VM

- Find which process can be migrated to get enough memory
- Migrate the process to found VM
- Recalculate RMS in VM list
- Assign P1 to the freed VM
- Recalculate RMS in VM list
- Exit;
-

8. EXPERIMENTAL EVALUATION OF ALGORITHM

Three virtual machines (VM_1, VM_2 and VM_3) are considered in which processes can be allocated or migrated based on the memory size requirement. Greedy algorithm is used for the allocation and migration of process across the data centers.

Table 2: Virtual Machine initial allocations details

Master Table			
Memory	**VM_1**	**VM_2**	**VM_3**

Total Memory	35	30	26
Occupied Memory	23	15	20
Unoccupied Memory	4	15	6
Memory occupied by processes	{14,7}	{9,6}	{13.7}

Limit of VMs=5

Case 1: IPMS of Process P1= 30

Step 1: RMS {4, 15, 6}

Step 2: TM=25

Step 3: IMPS is greater than TM, so a new VM say VM_4will be created and P1 will be allocated to that VM. Then exit.

Table 3: Process allocation for case 1

Memory	**VM_1**	**VM_2**	**VM_3**	**VM_4**
Total Memory	35	30	26	35
Occupied Memory	23	15	20	30
Unoccupied Memory	4	15	6	5
Memory occupied by processes	{14,7}	{9,6}	{13.7}	{30}

Case 2: IPMS of Process P1= 5

Step 1: RMS {4, 15, 6}

Step 2: TM=25

Step 3: If condition fails

Step 4: IMPS< RMS of VM_3

So, P1 is assigned to VM_3

Table 4: Process allocation for case 2

Memory	**VM_1**	**VM_2**	**VM_3**
Total Memory	35	30	26
Occupied Memory	23	15	25
Unoccupied Memory	4	15	1
Memory occupied by processes	{14,7}	{9,6}	{13,7,5}

Case 3: IPMS of Process P1= 20

Step 1: RMS {4, 15, 6}

Step 2: TM=25

Step 3: If condition fails

Step 4: IMPS< TM but second if condition fails

Step 5: Best fit VM is VM_2 but it requires minimum 5 units to be free

The smallest process in $VM_2$is second process (6 units of memory) which can be migrated to VM_3 which has 6 units of memory unoccupied

So, it is migrated from VM_2 to VM_3

Table 5: Process allocation for case 3

Memory	**VM_1**	**VM_2**	**VM_3**
Total Memory	35	30	26
Occupied Memory	23	9	26
Unoccupied Memory	4	21	0
Memory occupied by processes	{14,7}	{9}	{13,7,6}

Now the new process P1 can be allocated to VM_2

Table 6: Process allocation for case 3

Memory	**VM_1**	**VM_2**	**VM_3**
Total Memory	35	30	26
Occupied Memory	23	29	26
Unoccupied Memory	4	1	0
Memory occupied by processes	{14,7}	{9,20}	{13,7,6}

9. CONCLUSION

Efficiency and utilisation of resources are important factors for processing jobs in cloud environments. As cloud is a business- oriented service, completion time, quality of service and load balancing has a major role. Virtualizations technologies can be used for improving resource management, simplify deployment, and increase efficiency of utilising modern data centers. The proposed system uses greedy algorithm for allocation and migration of processes across various virtual machines of a physical machine based on the requirement of memory size of processes. Overutilization of resources will lead to heavy workloads which may affect the efficiency. The purpose of this research paper was to reduce the overutilization of resources by allocating processes to VM using greedy method. It also maintains a state that no resources are underutilised.

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