Research Paper On ENERGY-AWARE VIRTUAL MACHINE MIGRATION FOR CLOUD COMPUTING

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Abstract:- In cloud computing, users tries to migrate the computations to the disperse environment that can use number of resources for completing execution rapidly. Virtualization can be defined on the basis of varied VMs (Virtual machines) on one PM (Physical machine). In the procedure of migration, VM moves one PM to other. In case of offline migration, procedure halts when VM continues on target machine, whereas, in case of live migration, procedure can be implemented without any interruption. Live migration is the migration process and the virtual machine always seems to respond to it from the perspective of the customer. In the data centre, real-time migration of virtual machines plays an important role. Live migration is widely used for load balancing, energy reduction, and dynamic resizing to increase availability and hardware maintenance. In this research, GA (Genetic algorithm) is used for optimization and ANN (Artificial neural network) for classification. Numbers of QoS parameters are used to evaluate the performance.

Keywords: *Cloud computing, VMM (Virtual machine migration), GA (Genetic algorithm), ANN (Artificial Neural Network), SLA violation, Energy consumption*

1. Introduction

With the advent of virtualization, the computation paradigm viz. Cloud computing has achieved huge success. The data centres of cloud utilize virtualization and host of VMs (virtual machines) in PM (Physical machines) with effective resource usage [1]. For the evolution of data centers, effective resource usage plays a significant role. With the data centres, one may lessen the hardware as well the computational cost with the environmental and energy consumption issues. The main objective of data centres is dependent on two types, namely, Migration and Virtualization.

VMs may shift from one PM to another. Generally, migration is an important tool for administrator of clusters and data centres. VM migration is apparent to modern technology of virtualization and applications that supports it. Migration occurs with the packaging cost of the data by means of VMs for migration and transferring that towards network from the PM source towards Destination PM [2]. Other issue with VM migration is the required workload hotspot detection which has to be migrates initially. Because of this issue, initialization of migration is considered as a manual task. Initiated manually migration may lack in essential reactivity for responding to abrupt workload variations and was error prone, as every re-shuffle may need migration or changing of number of VMs to re-balance the system load. For these issues, the academic researchers has emphasised on the improvement and making the process automatic for VM migration in data clusters and centres [3].

The issue of VM migration is certainly a decision making issue. On the basis of some response received from data centre, the policy has to fix when, how and which VMs need to be migrated on the basis of varied aims [4]. According to the solution of this problem and on the basis of realistic observations that the technology need to evaluate live migration, it is probable to consider the queries of “When to migrate”, “Which VMs should be migrated”. It is definitely a control issue and the technology provides live migration (actuator) that may be utilized for satisfying the objective of data centres owner. Number of probable formulations are there of this issue which are dependent on modelling methods, like, equations, queuing network, Markov models [5].

1.1 Virtualization

Virtualization is defined as the development of virtual resources like desktop, server, file, OS (Operating System), network or storage. The main aim of virtualization is the management of workloads by completely changing the existing computing for making it more scalable [6]. The general type of virtualization is OS level virtualization. In OS level virtualization, it is mandatory to execute variety of OS on single hardware piece. Virtualization divides physical software and hardware by following hardware with software. When varied OS operates on main OS by virtualization, then it is termed as VM (Virtual machine). VM is nothing but a form of data file on physical machine which could be moved and reproduced to some other computer like a normal data file. The machines in virtual environment utilize two types of file structures, namely, hardware and hard drive. The virtualization software (hypervisor) provides caching technology that could be utilized to cache the variations to the virtual hardware (virtual hard disk). This technology lets the user to abandon the changes being executed to the OS and allows it to boot from the pre-defined state [7].

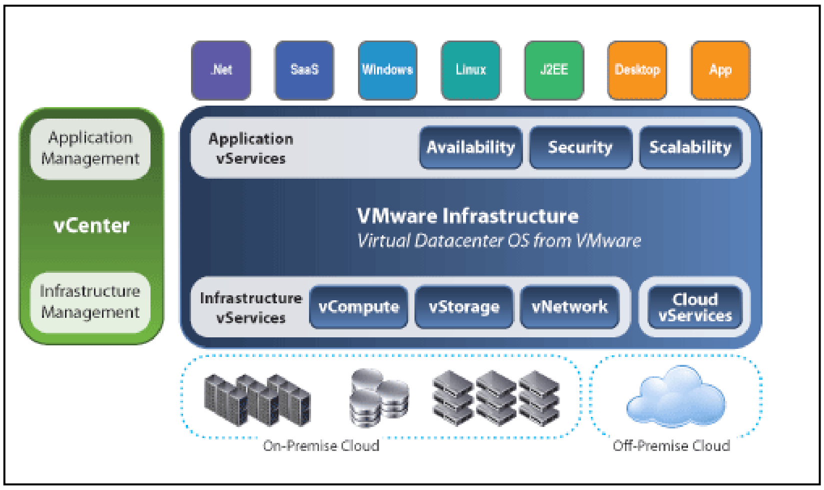

Figure 1: Virtualization

1.2 VM Migration

VM is referred as the instance of OS with more application executing in inaccessible partitioning in the machine. There would be number of machines that may be running on the top of lone PM. When one physical host become overloaded, it may be needed to dynamically send some amount of the load to other machine with less interruption to the user [8]. This procedure of transferring a VM from one physical host to other is known as Migration. Previously, for transferring a VM in two physical hosts, it was mandatory to close the VM and the allocation was required for sending the resources to novel physical host. VM consists of two types of techniques [9]:

i. Live migration

It can be describes as the changing of VM from one physical host to another being powered on. When the process is carrying out properly, this procedure can be executed without some conspicuous effect from the end user's point of view.

ii. Regular migration

It is the migration of the powered off VM. With this, the user has the option to transfer the linked disks from one data store to other. VMs are not required for being on shared storage.

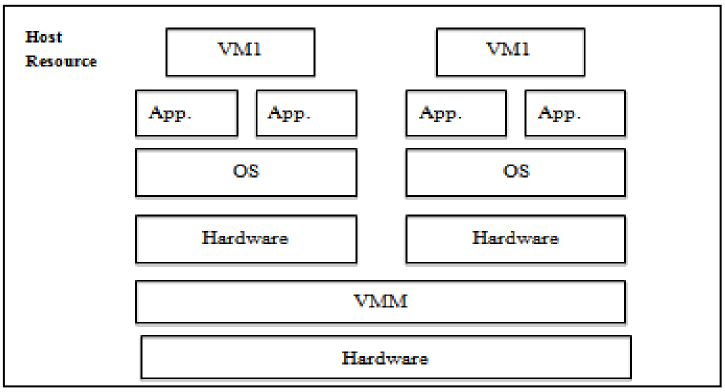

Figure 1.1: VM Migration of two operating systems

In the past, many researchers have been working on formulating energy-saving algorithms that reduce energy consumption. Many algorithms save data centre energy by shutting down or by placing idle servers in the server's sleep mode. Researchers have proposed a minimal migration (MM) virtual machine placement algorithm that takes into account the host CPU utilization of the list of virtual machines in descending order of CPU utilization [10].

The performance of the algorithms was better, but the SLA parameters are not considered when selecting a virtual machine for migration, which may be affected by live migration [11]. Most violations occur during live migration of virtual machines, migrating parameters (such as availability, response time, throughput, network bandwidth, etc.) that affect SLA (Service level agreement). Therefore, a new method for developing SLA-aware energy-saving algorithms needs to be allocated for data centre resources. The concept of virtual machine (VM) is related to the reduction of energy utilization because it essentially reduces the idle power of the general base [12].

2. Proposed Architecture

In the past few years, the layout and migration of VMs has always been a tough task. Whenever a physical machine cannot meet the full needs of a VM, there is a need for VMM. During this process, the VM will migrate without interfering with the jobs in the running state. In sharp contrast to this, many researchers have made efforts to minimize SLA violations and the number of migrations in various algorithms. The previously implemented algorithms are complex in nature and take a lot of time to find and allocate physical machines, as SLAs are also violated. Therefore, to improve SLA violations and minimize the number of migrations, ANN and GA has been used in this research to optimize VM migration.

2.1 ANN (Artificial Neural Network)

Neural network is a computational system inspired by the structure, processing method and learning ability of the brain. In this, there are very large numbers of neurons like processing elements and between those elements weights are there which connects the processing elements. Knowledge is acquired by the network through a learning process. Artificial neural network consists of simple computational units called neurons, which are connected to each other. They are highly used because of its highly complex problem solving nature. A main feature of these networks is their adaptive nature, where “learning by example” replaces “programming” in processing of problems. This feature makes it more appealing in the application domains as person can have little or no knowledge about the problem to be solved but training data is readily available. In the area of classification and prediction, ANN is highly used. ANN algorithm is defined below:

3. Artificial neural network algorithm

Assign ANN in the network

Describe input parameters viz. Neuron, training data with the VMs properties and group in the training data.

Develop ANN structure of ANN with initialization

Net = newff (Training data, Group, Neurons) Define the training metrics of ANN like number of iterations, parameters, transfer function, O/P goal and training method.

Train the ANN with the parameters by Net = train (Net, Training data, Group) Organize the VM migrations with network simulation Migrated_VM=sim(Net, Test VMs)

Develop the list of migrated VMs

3.1 GA (Genetic Algorithm)

GA (Genetic Algorithm) is basically used in the search space of large-scale applications. The advantage of the genetic algorithm is that the process is fully automated and local minima are avoided. The main components of a genetic algorithm are: crossover, mutation and fitness functions. Chromosome displays genetic algorithm solution. Crossover operations are used to generate new chromosomes from the parent set, and mutation operators add mutations. The fitness function performs chromosomes according to defined criteria. Improved chromosome fitness increases their chances of survival. The population is a collection of chromosomes. GA algorithm is defined below:

Genetic Algorithm

Create an arbitrary population of n chromosomes

Compute the fitness of each chromosome in the population

Build a new population with a reiteration of underneath steps till the new population is complete [Selection] Selection of two parent chromosome from the population according to fitness. **[Crossover]** Cross over the parents for the development of new offspring with crossover probability

[Mutation] Mutate the new offspring at each locus with mutation probability [Accepting] **Place** new offspring in a new population

Use newly generated population for the subsequent algorithm execution

If the end condition is fulfilled, halt and return the better solution in current population

As this research deals with the designing of an algorithm for analyzing the live migration behaviour in cloud data centres and for that ANN is used as a classification algorithm and GA as an Optimization algorithm. Therefore, the workflow of the work has been designed and is shown in below figure.

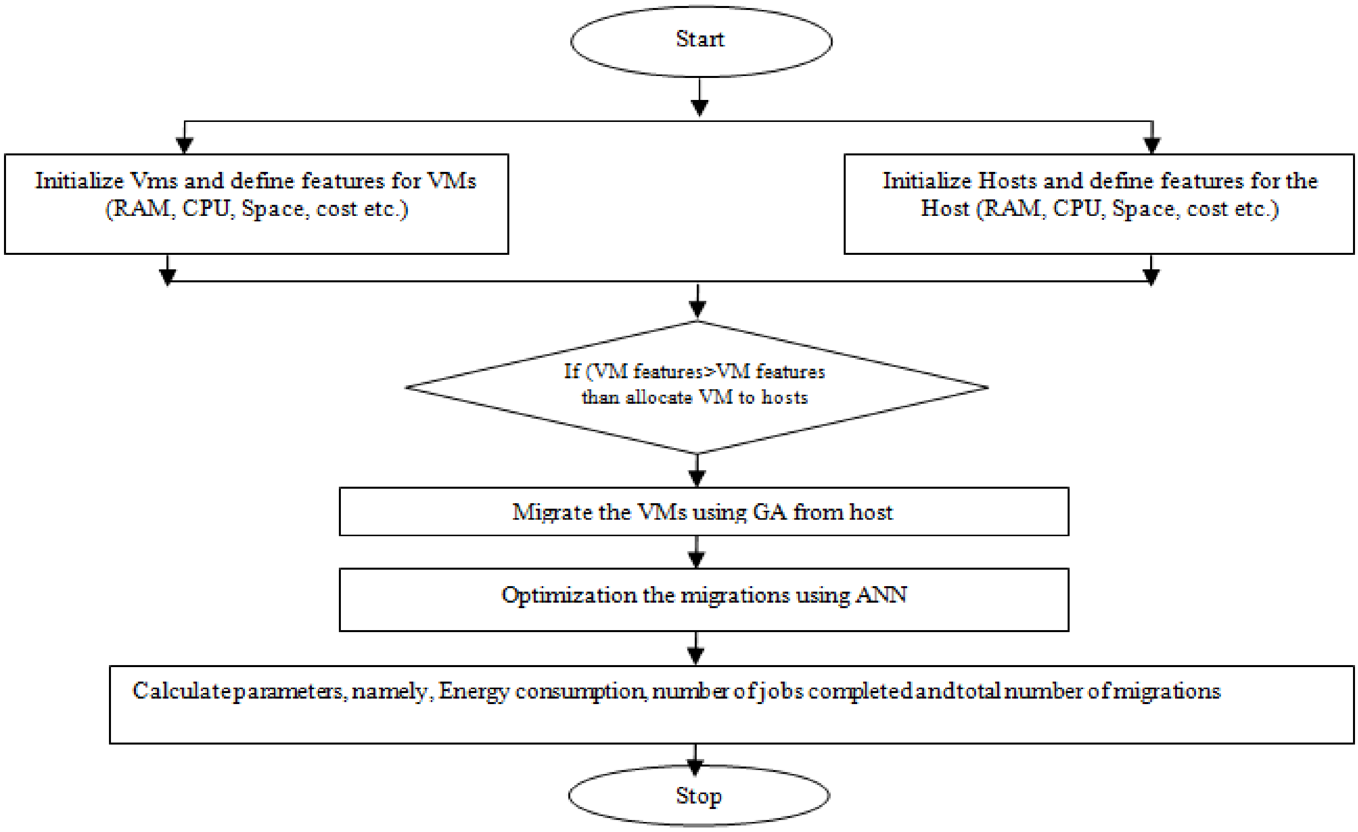

Figure 1.3: Proposed Workflow

4. Results and Discussion

In this section, the results obtained after the simulation of the work are defined. For the experimentation, parameters, namely, Energy consumption, number of jobs completed and total number of migrations are calculated.

Table 1: Energy consumption evaluation

Number of Iterations	Energy consumption (KWh)
1	0.0789
2	0.0438
3	0.0088
4	0.146
5	0.175

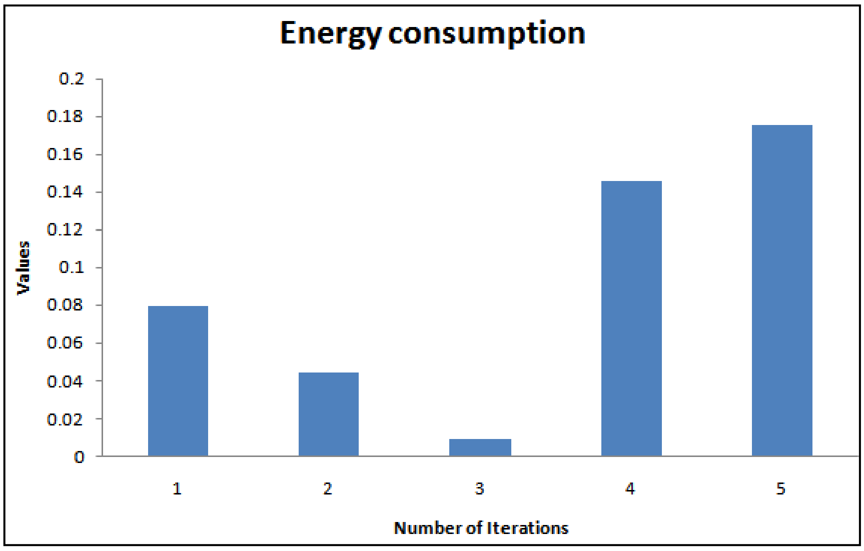

Figure 1.4: Energy consumption

Table 1 and figure 1.4 define the results obtained after the evaluation of simulation model. As depicted in figure 1.4, a graph has been drawn that shows the utilization of energy consumption by means of number of iterations. X-axis in the figure defines the number of iterations and Y-axis defines the values obtained after the evaluation. For an efficient system, utilization of energy should be less and the energy consumption in the proposed work is 0.0905 approximately.

Table 1.1: Number of migrations evaluation

Number of Iterations	Number of migrations
1	3
2	1
3	1
4	1
5	4

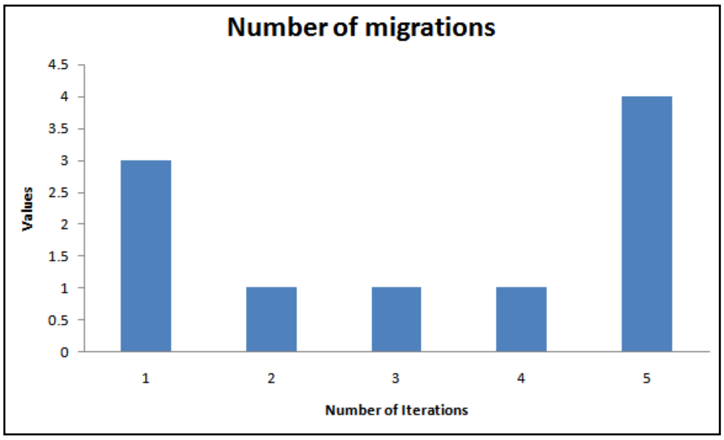

Figure 1.5: Number of migrations

Table 1.1 and figure 1.5 define the results obtained after the evaluation of simulation model. As depicted in figure 1.5, a graph has been drawn that shows the number of migrations by means of number of iterations by artificial neural network and genetic algorithm. X-axis in the figure defines the number of iterations and Y-axis defines the values obtained after the evaluation. The average value obtained for number of migration in the proposed system is 2.

Table 1.2: SLA Violation evaluation

Number of Iterations	SLA violation
1	0.286
2	0.624
3	1.681
4	0.881
5	0.959

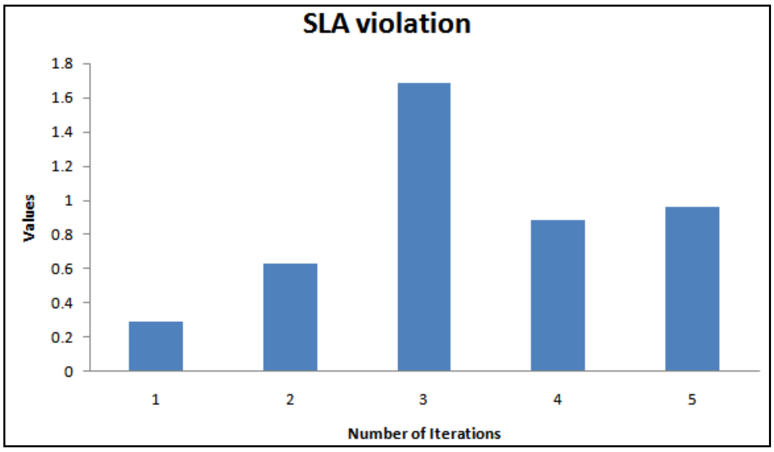

Figure 1.6: SLA violation

Table 1.2 and figure 1.6 defines the results obtained after the evaluation of simulation model. As depicted in figure 1.6, a graph has been drawn that shows the number of migrations by means of number of iterations by artificial neural network and genetic algorithm. X-axis in the figure defines the number of iterations and Y-axis defines the values obtained after the evaluation. The average value obtained for SLA violation in the proposed system is 0.8862.

5. Conclusion

VM migration and VM placement has always being a challenging task from a long. Number of researchers has executed their work for minimizing SLA violation and number of migration with energy consumption in number of ways. The existing algorithms are composite in nature and usually take a lot of time for allocating and finding a PM. For the effective utilization, GA (Genetic algorithm) as optimization algorithm and ANN (Artificial neural network) as classification algorithm has been used. The work has been executed by five number of iterations. For an efficient system, utilization of energy should be less and the energy consumption in the proposed work is 0.0905 approximately. The average value obtained for number of migration in the proposed system is 2. The average value obtained for SLA violation in the proposed system is 0.8862.

6. References

1. Zhang, F., Liu, G., Fu, X., & Yahyapour, R. (2018). A Survey on Virtual Machine Migration: Challenges, Techniques and Open Issues. IEEE Communications Surveys & Tutorials.

2. Beloglazov, A., Abawajy, J., & Buyya, R. (2012). Energy-aware resource allocation heuristics for efficient management of data centers for cloud computing. Future generation computer systems, 28(5), 755-768.

3. Bari, M. F., Boutaba, R., Esteves, R., Granville, L. Z., Podlesny, M., Rabbani, M. G., ... & Zhani, M. F. (2013). Data center network virtualization: A survey. IEEE Communications Surveys & Tutorials, 15(2), 909-928.

4. Buyya, R., Beloglazov, A., & Abawajy, J. (2010). Energy-efficient management of data center resources for cloud computing: a vision, architectural elements, and open challenges. arXiv preprint arXiv:1006.0308.

5. Kapil, D., Pilli, E. S., & Joshi, R. C. (2013, February). Live virtual machine migration techniques: Survey and research challenges. In Advance Computing Conference (IACC), 2013 IEEE 3rd International (pp. 963-969). IEEE.

6. Clark, C., Fraser, K., Hand, S., Hansen, J. G., Jul, E., Limpach, C., ... & Warfield, A. (2005, May). Live migration of virtual machines. In Proceedings of the 2nd Conference on Symposium on Networked Systems Design & Implementation-Volume 2 (pp. 273-286). USENIX Association.

7. Seth, S., & Singh, N. (2017, May). Dynamic Threshold-Based Dynamic Resource Allocation Using Multiple VM Migration for Cloud Computing Systems. In International Conference on Information, Communication and Computing Technology (pp. 106-116). Springer, Singapore.

8. Han, Y., Chan, J., Alpcan, T., & Leckie, C. (2017). Using virtual machine allocation policies to defend against co-resident attacks in cloud computing. IEEE Transactions on Dependable and Secure Computing, 14(1), 95-108.

9. Ahmad, R. W., Gani, A., Hamid, S. H. A., Shiraz, M., Yousafzai, A., & Xia, F. (2015). A survey on virtual machine migration and server consolidation frameworks for cloud data centers. Journal of Network and Computer Applications, 52, 11-25.

10. Hameed, A., Khoshkbarforoushha, A., Ranjan, R., Jayaraman, P. P., Kolodziej, J., Balaji, P. & Khan, S. U. (2016). A survey and taxonomy on energy efficient resource allocation techniques for cloud computing systems. Computing, 98(7), 751-774.

11. Xu, F., Liu, F., Jin, H., & Vasilakos, A. V. (2014). Managing performance overhead of virtual machines in cloud computing: A survey, state of the art, and future directions. Proceedings of the IEEE, 102(1), 11-31.

12. Radhakrishnan, A., & Kavitha, V. (2016). Energy conservation in cloud data centers by minimizing virtual machines migration through artificial neural network. Computing, 98(11), 1185-1202.