

Energy and SLA Efficient Virtual Machine Placement in Cloud Environment Using Non-Dominated Sorting Genetic Algorithm

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ABSTRACT

To increase the availability of the resources and simultaneously to reduce the energy consumption of data centers by providing a good level of the service are one of the major challenges in the cloud environment. With the increasing data centers and their size around the world, the focus of the current research is to save the consumption of energy inside data centers. Thus, this article presents an energy-efficient VM placement algorithm for the mapping of virtual machines over physical machines. The idea of the mapping of virtual machines over physical machines is to lessen the count of physical machines used inside the data center. In the proposed algorithm, the problem of VM placement is formulated using a non-dominated sorting genetic algorithm based multi-objective optimization. The objectives are: optimization of the energy consumption, reduction of the level of SLA violation and the minimization of the migration count.

KEYWORDS

Cloud Environment, Energy Efficiency, Genetic Algorithm, Multi-Objective Optimization, Virtual Machine Placement

INTRODUCTION

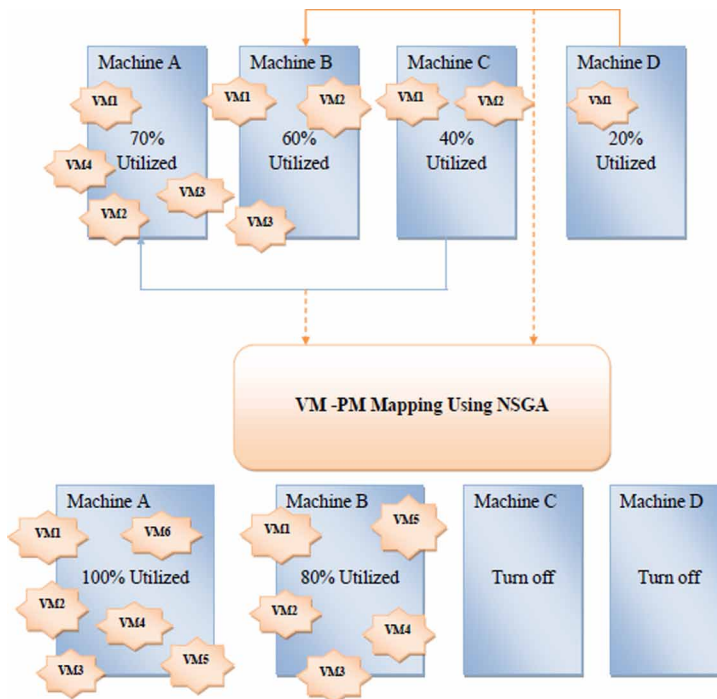
The current era of cloud computing is very harmful for environment sustainability and its main reason is huge amount of energy and power consumption where energy consumption is responsible for carbon dioxide emission and power consumption is responsible for overheating, heat dissipation, error proneness and performance of data centers. Therefore, it is necessary to minimize the energy consumption of data centers. The concept of virtualization either for server consolidation or VM consolidation has become so popular for the improvement of energy consumption of data centers. The virtual environment guarantees the delivery of services with minimum infrastructural requirements by the creation of multiple virtual machines (VMs) over the single physical machine (PM). Moreover, multiple operating systems can run simultaneously on the same hardware platform which makes effective use of overall hardware and thus, the reduced amount of hardware minimizes the need for power consumption for operations which further minimize the consumption of energy inside data

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centers. The basic clue of the consolidation process is the migration of the virtual machines to some new physical machines in order to reduce the count of physical machines and to switch off the idle physical machines. The basic problems of consolidation are VM placement and VM migration, and the main attention of this paper is VM placement, which will be discussed in next section. Figure 1 shows an example of VM placement or migration in which machine A and B are 70 and 60% utilized whereas machine C and D are 40 and 20% utilized and thus, considered as under-utilized machines. For the minimization of the power consumption of data center, it is beneficial to migrate the virtual machines from underutilized machines to other machines in order to reduce the count of used physical machines. As shown in the Fig.1, virtual machines are placed on physical machine A and B from C and D respectively. Moreover, machine C and D should be switch into hibernate mode or turn off to save the energy consumption.

In last few years, many different techniques have been proposed to solve the problem of VM placement like (Verma et al., 2008; Hermenier et al., 2009; Xu et al., 2010; Stillwell et al., 2010; Beloglazov et al., 2012) and genetic algorithms provide the best solution due to its speediness nature (Dong et al., 2014). In our previous work, Genetic algorithm (GA) has been used for the energy efficient VM placement. Experimental results depicted that GA performed well than traditional bin packing algorithms. Therefore, in this paper, we have framed the VM placement problem using a non-dominated sorting genetic algorithm (NSGA) to minimize the energy consumption and to improve the performance of data center. Rest of the paper is organized as follows: section 2 presents the most relevant work and section 3 formulates the VM placement problem. Detail description of NSGA and use of NSGA in VM placement is provided in section 4. In section 5 we evaluate the performance of NSGA and compares the experimental results with others. Section 6 presents the conclusion the paper with future work on energy efficient VM placement.

Figure 1. Schematic diagram for VM placement



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