

OPTIMIZED RESOURCE ALLOCATION IN CLOUD COMPUTING ENVIRONMENTS

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ABSTRACT

In Cloud systems, Virtual Machines (VMs) are scheduled to hosts according to their instant resource usage (e.g. to hosts with most available RAM) without considering their overall and long-term utilization. Also, in many cases, the scheduling and placement processes are computationally expensive and affect performance of deployed VMs. In this work, a Cloud VM scheduling algorithm that takes into account already running VM resource usage over time by analyzing past VM utilization levels in order to schedule VMs by optimizing performance by using Ant lion optimization classifier (ALO) technique. The Cloud management processes, like VM placement, affect already deployed systems so the aim is to minimize such performance degradation. Moreover, overloaded VMs tend to steal resources from neighboring VMs, so the work maximizes VMs real CPU utilization. The results show that our solution refines traditional Instant-based physical machine selection as it learns the system behavior as well as it adapts over time. The concept of VM scheduling according to resource monitoring data extracted from past resource utilizations (VMs). The count of the physical machine gets reduced by four using Ant lion optimization classifier.

Keywords: Cloud Data Centre, Virtual Machine, Energy Consumption.

1. INTRODUCTION

The effective administration of resources in virtualized data centers has grown in importance in the ever-changing world of cloud computing. The increasing requirement for computer resources and the increasing consciousness of environmental sustainability highlight the need for creative frameworks that prioritize energy saving in addition to performance optimization. This is especially important in the context of two-tier virtualized cloud data centers, where energy consumption minimization and resource allocation are major concerns. A potential answer to these problems is an energy-aware host resource management system. Through wise resource allocation and management, this approach seeks to achieve a delicate balance between improving virtualized environments' overall performance and reducing their negative environmental effects. In the framework of two-tier

virtualized cloud data centers, this introduction lays the groundwork for a more thorough examination of the nuances and advantages of this kind of system.

1.1 CLOUD DATA CENTER

A cloud data center is a state-of-the-art setup created to efficiently and scalably store and handle massive volumes of digital data, apps, and services. Cloud data centres, as opposed to conventional on-premises data centres, use virtualization and cloud computing technologies to offer remote resource access via the internet. This eliminates the need for substantial physical hardware upkeep and lets companies and individuals to access, develop, and expand their IT infrastructure and services as needed.

1.2 VIRTUAL MACHINE

A virtual machine, sometimes known as a VM for short, is an essential part of contemporary computing that has completely changed how we organize and use hardware resources. A virtual machine is essentially a software-based simulation of a real computer system, replete with an operating system and software of its own. It permits the operation of numerous virtualized instances on a single physical server, facilitating flexible computing environment management, effective resource usage, and task segregation. Because they allow multiple operating systems and applications to run on a single piece of hardware, virtual machines are widely used in data centers, cloud computing, and development environments. This facilitates hardware consolidation and makes it easier to test, develop, and deploy a wide range of software solutions.

1.3 ENERGY CONSUMPTION

Energy consumption, which includes the quantity of energy used to power our homes, businesses, transportation, and numerous technological equipment, is an essential component of both our everyday lives and the global economy. It is a vital component of economic growth and a crucial determinant of the sustainability and environmental impact of our actions. The way we generate, distribute, and use energy is a critical factor in tackling environmental issues like resource conservation and climate change. Achieving a more sustainable future requires understanding and controlling energy use, which entails making decisions about energy sources, efficiency, and conservation tactics that can lessen their negative effects on the environment and build a more robust energy infrastructure.

2. LITERATURE REVIEW

This work was proposed by Yong Yu [1] et.al. Remote data integrity checking (RDIC) allows a data storage server, such as a cloud server, to demonstrate to a verifier that it is honestly storing a data owner's data. A number of RDIC protocols have been presented in the literature to date, however the most of the constructs suffer from the issue of sophisticated key management, that is, they rely on the expensive public key infrastructure (PKI), which may impede RDIC implementation in practice. In this research, we present a novel identity-based (ID-based) RDIC protocol that uses key-homomorphic cryptographic primitives to decrease system complexity and costs associated with creating and administering the public key authentication framework in PKI-based RDIC schemes.

This paper was proposed by UsmanWazir [2] et.al. Cloud computing makes scattered resources available to people all over the world. Cloud computing has a scalable design that delivers on-demand services to enterprises across several disciplines. Yet, there are several obstacles with the cloud services. In the cloud services, several solutions have been presented to address various types of issues. This study examines the many models presented for SLA in cloud computing in order to tackle the issues that exist in SLA. Problems with performance, customer satisfaction, security, profit, and SLA violations. SLA architecture in cloud computing is discussed. Next we review existing SLA models presented in various cloud service formats such as SaaS, PaaS, and IaaS. With the use of tables, we explore the benefits and limits of current models in the following section. Some models can provide high-level security safeguards for customer data, while others can impose penalties for SLA violations. Some of these promote consumer trust, while others improve their performance as compared to other models.

This work was proposed by Nitin Kumar Sharma [4] et al. Attribute Based Access Control (ABAC) models are intended to solve the problems of traditional access control models (DAC, MAC, and RBAC) while integrating their benefits. ABAC provides access control based on generic properties of entities. Many organizational security rules make access decisions dependent on qualities. OWL may be used to officially describe and process security policies represented by ABAC models. With OWL, we created models, domains, data, and security regulations,

and then used a reasoned to determine what is permissible. We offer a method for representing the ABAC model using Web Ontology Language in this work (OWL).

3. EXISTING SYSTEM

The Internet of Things (IoT) is a network of interconnected items that collect and share data via smart equipment and technology. The management of IoT services is a substantial difficulty in ensuring a high degree of end-user experience. Cloud technology has a big influence on how these networks expand since it provides processing power, network bandwidth, virtualized systems, and system software in one integrated environment. One of the most essential issues in cloud-based ecosystems is capacity management, which ensures optimal resource use and load balancing, eliminates service level agreement (SLA) violations, and improves machine efficiency by reducing operating expenditures and power consumption. In this paper, we look at resource provisioning approaches and highlight the elements that must be addressed to improve resource use in distributed systems. Specifically, we want to enhance the minimization rate, data skew rate, and approximation amount rate. We also discuss the constraints and complications of hybrid optimization for optimal cloud-based capital allocation in IoT.

4. PROPOSED METHODOLOGY

The suggested system solves the drawbacks of the existing instant-based resource allocation and presents a novel method for scheduling Cloud Virtual Machines. The system uses an Ant lion optimization classifier (ALO)-powered scheduling algorithm, leveraging historical data on virtual machine (VM) resource use. Through time, the system may learn from and adjust to the dynamic behaviour of the cloud environment thanks to this methodology. The suggested methodology, in contrast to conventional methods, places an emphasis on long-term and total resource consumption with the goal of reducing the influence of Cloud management procedures on deployed virtual machines. The solution enhances real CPU utilization and improves efficiency by minimizing the number of physical machines and optimizing performance with the Ant lion optimization classifier. This helps to improve the traditional VM placement tactics in Cloud systems.

4.1 VM SCHEDULING

The VM Scheduling module focuses on resolving the drawbacks of conventional scheduling methods in cloud computing environments. Our suggested VM scheduling technique takes into account past VM resource consumption levels, in contrast to traditional approaches that prioritize immediate resource usage without taking long-term utilization into account. By doing this, the goal is to minimize the effect of scheduling processes on the system as a whole and optimize the placement of virtual machines (VMs) on hosts based on their historical performance.

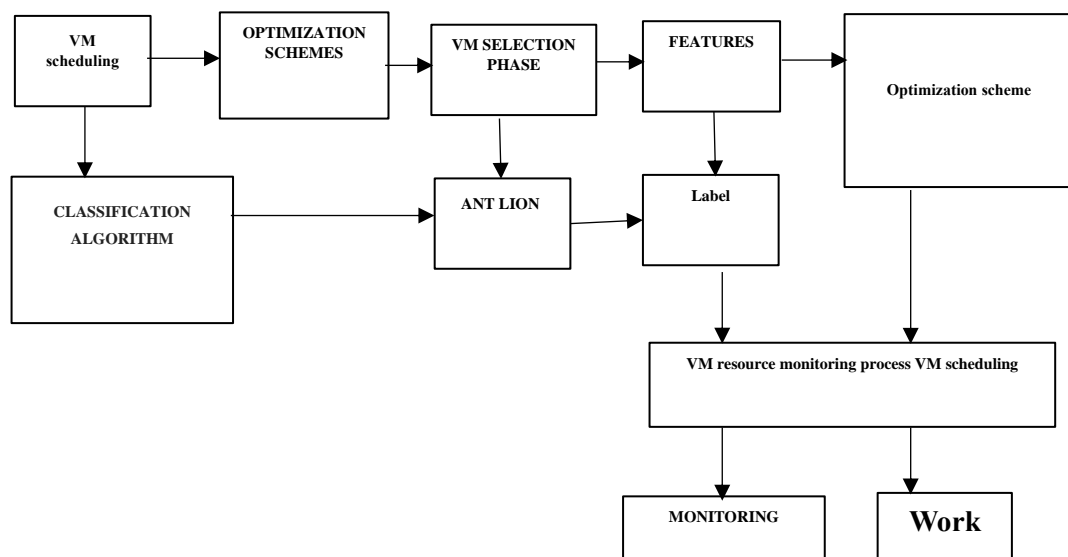


Figure. 1 .Block diagram

4.2 DATA ANALYSIS

The focus of the Data Analysis module is on drawing insightful conclusions from historical VM resource usage data. The system learns more about the general behaviour and performance qualities by examining past trends and patterns. This data-driven methodology lays the groundwork for optimal resource allocation and virtual machine scheduling by enabling well-informed decision-making in later modules.

4.3 CLASSIFICATION ALGORITHM

The Classification Algorithm module classifies virtual machines (VMs) according to their past resource usage patterns using advanced algorithms. In order to complete this stage, a reliable classification method that can reliably identify VM features across time must be implemented. The goal is to provide a framework that would enable the system to classify virtual machines (VMs) intelligently, improving decision-making in the later phases of the optimization process.

4.4 ANT LION OPTIMIZATION

To improve the VM scheduling procedure even more, the Ant Lion Optimization module presents an optimization method inspired by nature. This optimization approach is used to fine-tune and enhance the placement and classification of virtual machines (VMs), taking cues from the natural behavior of ant lions. Through the use of this kind of bio-inspired optimization, the system hopes to gradually modify and improve its decision-making procedures, resulting in more effective and flexible virtual machine scheduling.

4.5 OPTIMIZATION SCHEME

The several elements of the suggested approach come together to provide a thorough plan for resource optimization and virtual machine scheduling in the Optimization Scheme module. This lesson describes the overall strategy for optimizing virtual machine placement through the use of data analysis, classification algorithms, and Ant Lion Optimization.

5. ALGORITHM DETAILS

ANT LION OPTIMIZATION (ALO)

Ant Lion Optimizer (ALO) is a novel nature-inspired algorithm proposed by Sayedali Mirjalili in 2015. The ALO algorithm emulates the hunting mechanism of antlions in nature. There are five main steps of the algorithm such that random walk of ants, building traps, entrapment of ants in traps, catching preys, and re-building traps. Antlions belong to the Myrmeleontidae family and Neuroptera order (net-winged insect). The lifecycle of antlions includes two main phases: larvae and adult. They mostly hunt in larvae and undergo reproduction during adult. An antlion larva digs a cone-shaped pit in sand by moving along a circular path and throwing out sands by using massive jaws. After digging the trap, the larvae hide underneath the bottom of the cone and waits for insect to be trapped in the pit. When a prey is caught, it will be pulled and consumed. After that, the antlions throw the leftovers outside the pit and improve the pit for the next hunt.

Initialize the first population of ant and ant lions randomly

Calculate the fitness of ants and antlions

Find the best antlions and assume it as the elite (best solution)

while the end criterion is not satisfied

for every ant

Select an ant lion using Roulette wheel

Update c and d using equations (15) & (16)

Create a random walk and normalize it using equations (9) & (12)

Update the position of ant using equation (18)

end for

Calculate the fitness of all ants

Replace an ant lion with its corresponding ant become fitter using equation (17)

Update elite if an ant lion become fitter than the elite

end while

Return elite

Formula for Ant Lion Algorithm

$$T_{ij} = (1 - \rho) * T_{ij} + \Delta T_{ij}$$

Where:

- T_{ij} is the pheromone level on edge (i, j)
- ρ is the evaporation rate
- ΔT_{ij} is the amount of pheromone deposited on edge (i, j) by ants in the current iteration

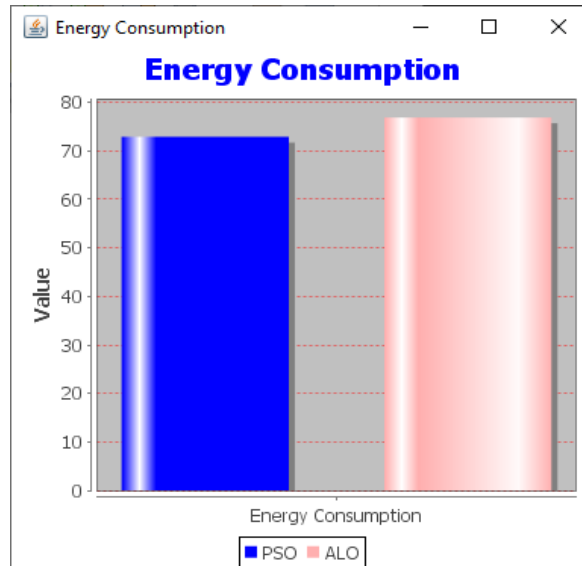
The ΔT_{ij} can be calculated based on the quality of solutions found by ants and the attractiveness/repulsiveness of edges.

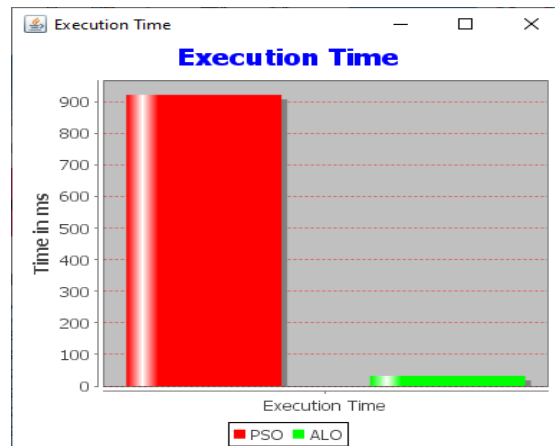
6. RESULTS AND DISCUSSION

Our VM allocation system's outcome analysis shows how well it works in cloud computing environments to maximize resource utilization and reduce power consumption. The system effectively distributes virtual machines (VMs) to hosts while satisfying performance objectives and minimizing resource limitations using intelligent VM migration and recurrent allocation efforts. Enhancing the system's capacity to identify ideal allocation configurations through the inclusion of optimization techniques like Particle Swarm Optimization (PSO) and Ant Lion Optimization (ALO) improves scalability and efficiency. The examination of power consumption offers significant insights into patterns of energy utilization, emphasizing opportunities for more optimization and efficiency gains. Overall, the findings show that our approach presents a viable way to meet the changing needs of contemporary computing environments while improving the performance and sustainability of cloud-based applications.

VM #	Allocated Host # (PSO)	Allocated Host # (ALO)	Power Consumption (ALO)
1	4	0	76.9
2	1	1	65.8
3	8	2	70.6
4	3	3	131.9
5	9	7	111.3

Comparison Table





Comparison graph

The simulation's resource allocation results show how well the Artificial Lion Optimization (ALO) and Particle Swarm Optimization (PSO) algorithms distribute virtual machines (VMs) among the cloud infrastructure. PSO assigned virtual machines (VMs) to hosts whose allocations differed greatly from ALO's across the ten VM instances that were taken into consideration. For example, ALO assigned VMs 0, 1, and 3 to hosts, while PSO assigned VMs 1, 2, and 10 to hosts 4, 1, and 1, respectively. Notably, PSO assigned these virtual machines to hosts 3, 9, and 5, but ALO assigned VMs 4, 5, and 6 to hosts 3, 9, and 9. These differences highlight the different optimization strategies that the two algorithms use. Additionally, each allocation's power consumption values provide additional information about how efficient they are. With power consumption values ranging from 65.8 to 131.9 units, ALO appears to produce slightly lower power consumption for the majority of VM-host pairs when compared to PSO. As an example, ALO assigned VM 2 to host 1 and VM 5 to host 7, resulting in 65.8 and 111.3 units of power consumption, respectively. On the other hand, PSO assigned VM 2 to host 1 and VM 5 to host 9, which led to somewhat higher power consumption values of 111.3 and 76.9 units, respectively. These variations draw attention to the complex trade-offs that cloud computing resource management involves between power efficiency and allocation precision. While PSO and ALO both have strengths in resource allocation overall, differences in their allocations and power consumption numbers imply that additional research and fine-tuning may be required to get the best outcomes.

7. CONCLUSION

To sum up, the created Cloud VM scheduling algorithm, which makes use of Ant Lion Optimization Classifier (ALO) and historical VM resource use data, offers a potential way to address the issues related to instant-based resource allocation in cloud systems. The system's capacity to pick up on and adjust to the environment's changing behaviour over time leads to increased effectiveness and performance optimization. The suggested method provides an improved VM placement strategy by emphasizing both short- and long-term resource consumption and reducing the effect of management procedures on deployed virtual machines. The system is efficient in allocating resources, as evidenced by the shown decrease in the number of physical machines.

8. FUTURE WORK

The suggested Cloud VM scheduling technique provides the groundwork for a number of future developments and lines of inquiry. Additional investigation might entail incorporating machine learning methods to continuously modify the scheduling algorithm in response to changes occurring in real time inside the Cloud environment. The system would also benefit from taking energy efficiency into account in order to keep up with the growing significance of sustainable computing. Understanding the scalability and generalizability of the suggested algorithm will need investigating its use in various Cloud topologies and scaling it for larger and more complicated contexts.

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