International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

An Efficient Approach of Task Scheduling in Fog Computing

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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 accessible RAM) without considering their overall and long-term utilization. Also, in many circumstances, the scheduling and placement processes are computationally intensive and impair performance of deployed VMs. In this work, a Cloud VM scheduling algorithm that takes into consideration already existing VM resource usage over time by assessing historical VM utilization levels in order to plan VMs by optimizing performance by utilizing KNN with NB approach. The Cloud management activities, such VM deployment, affect existing deployed systems hence the aim is to avoid such performance degradation. Moreover, overloaded VMs prefer to take resources from neighboring VMs, thus the work maximizes VMs real CPU consumption. The results reveal that our method refines traditional Instant-based physical machine selection as it learns the system behavior as well as it adjusts over time. The notion of VM scheduling according to resource monitoring data taken from prior resource utilizations (VMs). The count of the physical machine gets lowered by four utilizing KNN with NB classifier.

Keywords: Cloud Data Center, Virtual Machine, Energy Consumption, Fog Computing, Task Scheduling

1. INTRODUCTION

Fog computing has surfaced as a potential framework that extends cloud computing capabilities closer to the network edge in the quickly changing environment of computing paradigms. In fog computing, task scheduling is essential for maximizing resource use, reducing response times, and improving system performance as a whole. Effectively assigning tasks to fog nodes is essential for satisfying a variety of application needs while taking the fog environment's dynamic nature into account. To fully realize the promise of this distributed computing paradigm, this introduction examines novel strategies and techniques that tackle the difficulties associated with task scheduling in fog computing. The ultimate goal is to achieve a balance between computational efficiency and responsiveness. The creation of reliable work scheduling algorithms is becoming more and more important as fog computing spreads throughout many industries in order to fully reap the rewards of this revolutionary technology.

1.1 CLOUD DATA CENTER

Cloud data centers have become the backbone of contemporary computer infrastructure in the age of rapid

digital transformation, completely changing how consumers and organizations access and manage data. These centers mark a significant transition from conventional on-premises data processing and storage to remotely hosted, scalable, and adaptable computing environments. Cloud data centers offer a wide range of services, from networking and analytics to storage and processing, allowing businesses to dynamically scale their resources in response to demand. The built-in benefits of cost-effectiveness, scalability, and accessibility have rendered cloud data centers essential in today's globalized society. Knowing the nuances of these data centers is crucial for both businesses and tech enthusiasts as the demand for cloud services keeps rising.

1.2 VIRTUAL MACHINE

Several operating systems (OS) can run on a single physical machine thanks to the virtual machine (VM), a software-based simulation of a real computer. With the use of this technology, separated environments that function independently of the underlying hardware also referred to as virtualized instances, or VMs can be created for operating systems and applications. A hypervisor, also known as a Virtual Machine Monitor (VMM), is a crucial part of virtual machines since it controls and distributes the host machine's physical resources to the virtual machines. Two varieties of hypervisors exist: Type 2 (hosted) hypervisors operate on top of an already-installed operating system, whereas Type 1 (bare-metal) hypervisors operate directly on the hardware. Virtual machines (VMs) find extensive application in several computer contexts, including cloud computing, testing and development environments, and server consolidation.

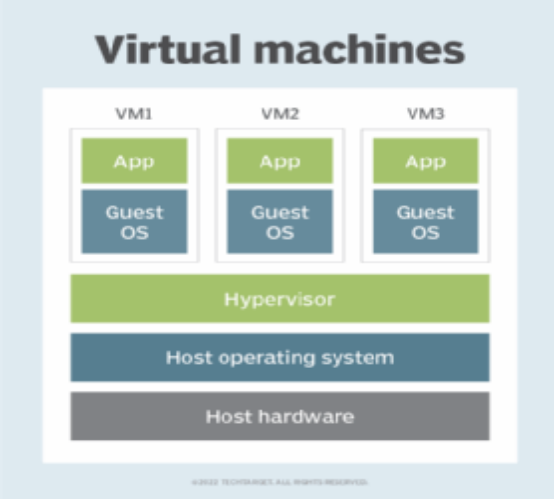

Figure 1. Virtual Machine

1.3 ENERGY CONSUMPTION

Energy consumption is one of the most important worldwide factors in the modern technological and industrial landscape. The need for energy is growing as societies depend more and more on cutting-edge technologies to run their daily lives. The difficulty is not only supplying the energy required to power homes, businesses, and the extensive network of data centers that supports our digital infrastructure, but also doing so in a sustainable manner. Energy use's effects on the environment have come to be of great concern, especially when it comes to computing and data processing. The energy consequences of these breakthroughs must be understood and addressed as the world moves toward increasingly digital and networked systems. This introduction lays the groundwork for a discussion of the intricacies surrounding

energy use, highlighting the urgent need for creative frameworks and solutions that support sustainability and efficiency across a range of industries.

1.4 FOG COMPUTING

Fog computing offers a decentralized design that moves computational resources closer to the network's edge, hence bringing distributed computing closer to its core. Fog computing, in contrast to standard cloud computing, processes data and delivers services with lower latency and more efficiency by utilizing a network of heterogeneous devices and edge servers. Fog computing solves the problems caused by latency-sensitive and bandwidth-intensive applications by reducing the load on centralized cloud data centers. By highlighting its role in promoting a more responsive and flexible computing environment at the network's edge, this introduction lays the groundwork for understanding the significance of fog computing in the changing landscape of computing architectures.

1.5 TASK SCHEDULING

A key component of computer systems is task scheduling, which includes the planned arrangement and carrying out of different operations to maximize output and efficient use of resources. Effective task scheduling guarantees that computational workloads are assigned to available resources in a way that maximizes throughput, reduces delay, and improves overall system efficiency, whether in conventional computing environments or contemporary distributed systems. Decisions on when and where to complete activities are made during this process, keeping in mind resource constraints, dependencies, and priority. Effective task scheduling is crucial for achieving scalability, responsiveness, and cost-effectiveness in computing systems, from operating systems managing local tasks on a single machine to complex cloud computing scenarios where tasks may be distributed across a network of interconnected nodes.

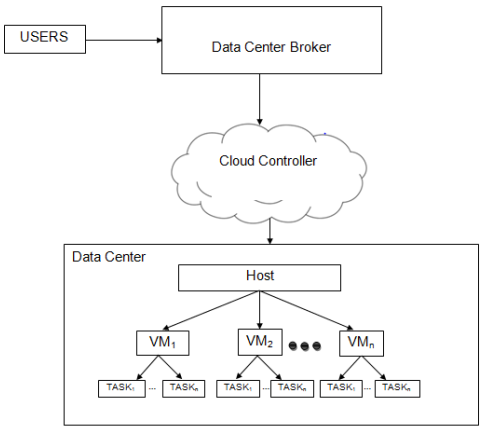

Figure 2. Task Scheduling

2. LITERATURE REVIEW

A novel approach to remote data integrity checking (RDIC) is proposed in this paper by Yong Yu [1] et.al. The proposed identity-based (ID-based) RDIC protocol utilizes key-homomorphic cryptographic primitive to reduce the complexity of the system and the cost of establishing and managing the public key authentication framework in PKI-based RDIC schemes. The security model of the proposed ID-based RDIC protocol is formalized, including security against a malicious cloud server and zero knowledge privacy against a third party verifier. The protocol is proven to be secure against the malicious server in

the generic group model and achieves zero knowledge privacy against a verifier. Extensive security analysis and implementation results demonstrate that the proposed protocol is both provably secure and practical for real-world applications**.**

This paper explores the challenges and models proposed for SLA [2] in cloud computing. Cloud computing offers distributed resources and on-demand services to organizations globally, but there are various challenges that exist in cloud services. To overcome these challenges, different techniques have been proposed, including models for SLA in cloud computing. We review the different models proposed for SLA in different cloud service models like SaaS, PaaS, and IaaS, and discuss their advantages and limitations. Additionally, we examine the role of the cloud service provider in establishing SLA and the parameters that consumers must consider before signing SLA in the cloud platform. Overall, this survey provides inights into the challenges and solutions for SLA in cloud computing**.**

PritiNarwal [3] et.al has proposed a paper on the topic of Cloud Computing, which is a dynamic platform that utilizes virtualization technology. In a Cloud computing environment, virtualization abstracts the hardware system resources in software, enabling each application to run in an isolated environment known as the virtual machine. The allocation of virtual machines to different users on the same server is done by the hypervisor. While Cloud computing offers numerous benefits such as resource-sharing, cost-efficiency, high-performance computability, and reduced hardware costs, it also poses several security threats. These threats can directly impact Virtual Machines (VMs) or indirectly affect the hypervisor through the virtual machines hosted on it. This paper provides a comprehensive review of all potential security threats and proposes countermeasures using Game Theoretic approaches. Game Theory is employed as a defensive measure due to the independent and strategic decision-making nature of cloud users, where each player competes for the best possible secure solution. In addition to security and privacy concerns, it is crucial to address other issues like efficiency and optimization, considering that different users have varying resource requirements in a cloud environment.

Nitin Kumar Sharma [4]et.al has proposed a paper that introduces Attribute Based Access Control (ABAC) models as a solution to the limitations of classical access control models (DAC, MAC, and RBAC) while incorporating their advantages. ABAC provides access control based on generic attributes of entities, aligning with many organizational security policies that rely on attributes for access decisions. The paper utilizes the Web Ontology Language (OWL) to formally define and process security policies, enabling the use of a reasoned to determine access permissions. The ABACα model, represented in OWL, is presented as a means to enforce policies using the EYE reasoned, which infers logical relationships and grants access for requested actions. This paper serves as an initial step towards specifying and enforcing machine understandable policies within the ABAC model, which is recognized as one of the most comprehensive access control models available today. Additionally, the paper acknowledges the need for further analysis on the performance of the reasoning process and highlights the limitations of the basic ABACα model, such as the absence of static/dynamic separation of duties and the lack of additional attributes for contextual information.

In this study, Ziad Ismail [5]et.al proposed a paper that addresses the security challenges introduced by new developments in cloud computing. The focus is on ensuring the confidentiality, integrity, and availability of outsourced data. To achieve this, a Service Level Agreement (SLA) is typically signed between the cloud provider and the customer. One important aspect of the SLA is verifying the cloud provider's compliance with data backup requirements for redundancy purposes. There are various security mechanisms available to check the integrity and availability of outsourced data. This task can be performed

by the customer or delegated to an independent entity referred to as the verifier. However, frequent data verification can lead to additional costs, which may discourage customers from performing it regularly. To address this, we propose using game theory to capture the interaction between the verifier and the cloud provider and determine an optimal data verification strategy.

3. EXISTING SYSTEM

Without a cord Through the internet, cloud computing provides data and computer resources on a pay-per-use basis. This allows us to update our software automatically. Our carbon impact is decreased because we can just use the space needed for the server. The primary issue in cloud computing that lowers system performance is task scheduling. An effective task-scheduling method is required to increase system performance. Current task-scheduling algorithms prioritize considerations such as CPU memory, task resource requirements, execution time, and execution cost. They do not, however, take network bandwidth into account. In this paper, we provide an effective task scheduling technique that takes network capacity into account to provide divisible task scheduling. This allows us to distribute the workflow according to the amount of network bandwidth that is available. Our suggested task-scheduling approach allocates the appropriate number of tasks to each virtual machine using a nonlinear programming model for divisible task scheduling. We create a divisible load scheduling technique based on the allocation, taking network bandwidth into account.

4. PROPOSED SYSTEM

The suggested system solves the drawbacks of the existing instant-based resource allocation and presents a novel method for scheduling Cloud Virtual Machines. Utilizing past information on virtual machine resource usage, the system uses a scheduling method driven by KNN with NB classifier. Based on past performance data, KNN is a well-liked machine learning method for regression and classification tasks. It is also used to forecast the processing capacity of the server. Conversely, NB is a straightforward and effective text classification technique that makes the assumption that each feature is independent. Through time, the system may learn from and adjust to the dynamic behavior 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 system provides improved efficiency and increases real CPU utilization by optimizing performance and minimizing the number of physical machines through the KNN with NB classifier. This helps to improve the traditional VM placement tactics in Cloud systems.

4.1 VM SCHEDULING

The main element in charge of coordinating the distribution of virtual machines in the cloud environment is the VM Scheduling module. To decide where to deploy virtual machines (VMs), it interfaces with system parameters, user demands, and historical data. This module employs the KNN with NB classifier to forecast server processing capability and improve virtual machine placement, drawing on insights from the Data Analysis module. It seeks to increase the effectiveness of Cloud system administration, lessen the requirement for instantaneous resource allocation, and improve overall resource consumption.

4.2 DATA ANALYSIS

The system as a whole is built upon the Data Analysis module. It gathers, organizes, and examines past

information about virtual machine resource usage. The system is able to recognize patterns and trends in resource demands over time because to this data-driven methodology. The module provides input to the VM Scheduling module by using statistical and machine learning techniques to derive relevant insights. The system becomes adaptive to the dynamic nature of the Cloud environment by continuously learning from prior performance, which helps with more precise decision-making.

4.3 KNN WITH NB CLASSIFIER

K-Nearest Neighbors (KNN) and Naive Bayes (NB), two potent machine learning techniques, are combined in the KNN with NB Classifier module. Based on past performance data, KNN is used to forecast server processing capacity. In order to forecast future events, it finds commonalities between historical and present patterns of resource consumption. However, NB, a text classification algorithm, makes the assumption that each feature is independent and adds to the overall classification scheme. The system's capacity to allocate resources and locate virtual machines (VMs) more intelligently is improved by the combination of these techniques.

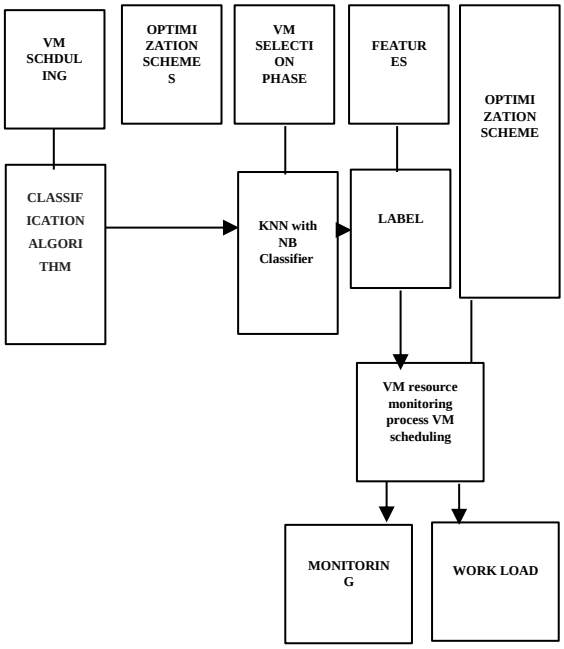

Figure 3. Block diagram

4.4 OPTIMIZATION SCHEME

The Optimization Scheme module works to improve the traditional methods for placing virtual machines (VMs) in cloud systems. Through the utilization of KNN with NB Classifier module insights, this component seeks to minimize the number of physical computers while optimizing performance. The goal of the optimization method is to reduce the effect of cloud management procedures on deployed virtual machines (VMs) while optimizing real CPU consumption. By applying smart and data-driven decision-making techniques, this module is essential to achieving increased efficiency in Cloud systems.

5. RESULT ANALYSIS

algorithm	accuracy
Non Linear Programming Model	75
KNN with NB	81

Table 1. Comparison table

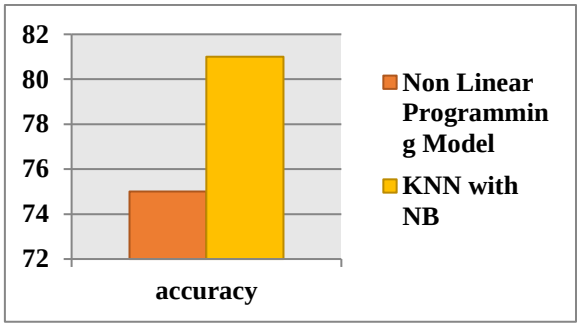

Figure 4. Comparison graph

As part of the system evaluation, various methods are evaluated for correctness in relation to virtual machine scheduling. The Non-Linear Programming Model's performance in forecasting and optimizing virtual machine resource allocation was demonstrated by its 75% accuracy rate. On the other hand, the suggested KNN with NB algorithm fared better, with 81% accuracy. This indicates that the machine learning-driven method, which makes use of historical data and the KNN with NB classifier, greatly enhances the accuracy of VM scheduling choices. The increased precision suggests that the KNN with NB system is better able to forecast server processing capability from past performance data, which improves overall resource use and virtual machine placement. These accuracy metrics demonstrate the potential for increased efficiency and better decision-making in Cloud VM scheduling by highlighting the efficacy of the suggested method in contrast to a conventional Non-Linear Programming Model.

6. CONCLUSION

Finally, by combining historical data analysis and machine learning algorithms specifically, KNN with NB Classifier the suggested VM scheduling system exemplifies a progressive approach to Cloud resource management. This optimizes VM placement and boosts overall efficiency. The approach differs from conventional instant-based allocation techniques in that it places a greater emphasis on long-term resource usage, adaptation to dynamic Cloud settings, and the reduction of management process consequences. The system attempts to offer users a dependable and intelligent way to make sense of virtual machine allocation through thorough testing and careful implementation. Through the use of past performance data and pattern recognition, the system can help increase CPU usage, decrease the number of physical machines in Cloud systems, and improve scalability. It is anticipated that the successful deployment and operation of this novel virtual machine scheduling system will greatly improve the efficiency and long-term viability of cloud resource allocation techniques.

7. FUTURE WORK

The suggested VM scheduling mechanism could be improved and expanded in a number of ways for

future development. To further improve the precision of resource usage forecasts, it may be possible to investigate the incorporation of more machine learning techniques or sophisticated predictive models. Other potential areas for enhancement include investigating the possibilities of reinforcement learning techniques and integrating real-time adaption mechanisms to abrupt changes in workload. Furthermore, given the dynamic nature of cloud technologies, the system might be expanded to facilitate multi-cloud setups, allowing for the smooth distribution of resources among several cloud service providers.

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