International Multidisciplinary Research Journal Reviews (IMRJR)

International Multidisciplinary Research Journal Reviews (IMRJR)
A Peer-reviewed journal
Volume 1, Issue 1, September 2024
DOI 10.17148/IMRJR.2024.010104

Integration of Cloud Computing and Deep Learning for Cybersecurity

Dr. Santosh Kumar Singh[1], Dr. V.R. Vadi[2], Dr. Asjad Usmani[3], Dr. P. K. Nayak[4]

Associate Professor, Department of CS & IT, GGSIPU Affiliated College, New Delhi, India[1]

Professor, Director, DBIT, GGSIPU, New Delhi, India[2]

Associate Professor (HoD), Department of Management Studies, DBIT, GGSIPU, New Delhi, India[3]

Associate Professor (HoD), Department of Commerce, DBIT, GGSIPU, New Delhi, India[4]

Abstract: Integrating cloud computing and deep learning for cybersecurity is a promising area of research and application, given the increasing complexity and volume of cyber threats. This article examines the current state of play and emerging trends in combining deep learning and cloud computing, as well as how these two technologies interact. The global public cloud services market is growing at a rapid pace, which makes data management more vulnerable to cyberattacks and breaches. To increase intrusion detection's efficacy in cloud computing environments, various intrusion detection systems employ various deep learning techniques. The security of cloud data is further enhanced by the application of encryption technology and the related deep learning retrieval technology. Furthermore, by effectively allocating resources and resolving the issue of slow cloud service speed, the paper thoroughly examines how the deep reinforcement learning scheduling mechanism can optimize cloud service performance. To solve the issues with energy consumption in cloud computing data centers, it also determines the best energy plan using deep neural networks. In addition, the five new cloud computing architectures are reviewed, and the function of deep learning in these frameworks is examined. Lastly, it examines some of the issues that cloud computing and deep learning may face in the future, such as low latency and high throughput optimization in deep learning and cloud computing security and confidentiality. In conclusion, this article sheds light on the patterns, obstacles, and possibilities for the future development of deep learning and cloud computing integration.

Keywords: Security, Deep learning, Cloud computing, Cybersecurity.

I. INTRODUCTION

The market has been paying more attention to both cloud computing and deep learning over the past ten years, which has increased the value of these technologies on the market. These technological landscapes are evolving, and with them come new applications, challenges, and opportunities. Examining the current state and interconnection of both environments holds great value and promise, given their inherent similarities and shared characteristics. This paper significantly advances the field by providing a comprehensive analysis of the current status and emerging trends in deep learning and cloud computing. The integration of deep learning into developing cloud computing architectures is the main area of emphasis, with special attention paid to highlighting the similarities and synergies between these two fields. The purpose of this paper is to address cybersecurity challenges, the paper investigates how cloud computing and deep learning intersect. The rest of this paper is organized as follows. In Section 2 We will describe the current state of deep learning and cloud computing, Section 3 gives the intersection of deep learning and cloud computing, Section 4 explores emerging cloud computing, Section 5 provides future challenges and development directions, and finally, Section 6 concludes the study.

II. CURRENT STATE OF DEEP LEARNING AND CLOUD COMPUTING

Deep learning is a subset of machine learning that developed from conventional neural networks. Deep learning uses automated collective learning techniques, as opposed to traditional machine learning, which completes classification tasks by a sequence of steps that include preprocessing, feature extraction, careful feature selection, and then learning and classification. This paradigm offers a more integrated and automated method for tasks of this kind because the system can simultaneously learn and classify data. Currently, specialized hardware like GPUs has been developed for deep learning, specifically for the model training phase. This breakthrough improves network connectivity and reduces hardware costs, enabling deep models to process large datasets and analyze complex problems with ease. Given its substantial development potential, deep learning is an important technique for data processing and modeling in the big data era. It is consequently becoming more and more well-liked in society [1].

International Multidisciplinary Research Journal Reviews (IMRJR)
A Peer-reviewed journal
Volume 1, Issue 1, September 2024
DOI 10.17148/IMRJR.2024.010104

The first iteration of cloud computing was proposed by Google CEO Eric Schmidt in August 2006 (Fig. 1) [2]. At the time, Eric Schmidt saw cloud computing as a way to access stored files, such as computer software, over a network as opposed to the more conventional method of accessing software through hardware.

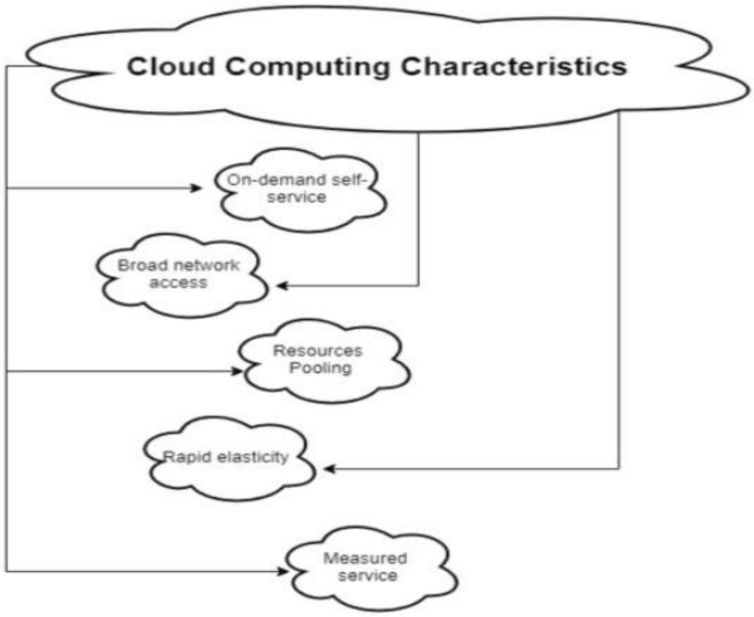

Fig 1. The concept of cloud computing [2].

Three main models are used by cloud providers to distribute their services. Software as a service (SaaS) is the first model that gives users access to software via a web browser on a range of client devices. Platform as a service (PaaS) is the second model in which providers provide the basic infrastructure so that users can concentrate on developing applications. The third model, known as infrastructure as a service (IaaS), gives users access to a variety of resources that are provided by the service provider, such as servers, networks, storage space, and more. Together, these three models serve as the cornerstone of cloud computing services, meeting various user needs and preferences. Deep learning can be implemented within these service frameworks because of the robust capabilities of cloud computing services. Significant processing power is available through cloud computing services, which enable users to take advantage of specialized hardware and machine images for deep learning infrastructure. Infrastructure as a service (IaaS) allows for the effective use of these resources. The smooth assimilation of deep learning into cloud computing not only provides users with significant computational capacity but also creates a coherent bond between the domains of deep learning and cloud computing. The potential to use advanced machine learning methods within a scalable and adaptable cloud infrastructure is increased by this [3].

III. INTERSECTION OF DEEP LEARNING AND CLOUD COMPUTING

A. Deep Learning Applied to Cloud Computing Security

With the continued rapid development of cloud computing, there will inevitably be an increase in cyber-attacks targeting cloud data, which will raise the associated risks of managing and storing such data. Anil Kumar et al. presented a cloud-centric intrusion prevention strategy based on deep learning concepts to address this changing problem. Deep learning technology is the main tool used in this novel approach to categorize and gauge the efficacy of network intrusions. The Fig. 2 model, which is an example of a deep learning model, is the Fuzzy min-max neural network (FMMNN-IDS) model, which effectively predicts intrusion detection in the context of cloud computing services. This strategy has a lot of potential to improve cloud environments' security posture against changing cyberthreats [4].

International Multidisciplinary Research Journal Reviews (IMRJR)
A Peer-reviewed journal
Volume 1, Issue 1, September 2024
DOI 10.17148/IMRJR.2024.010104

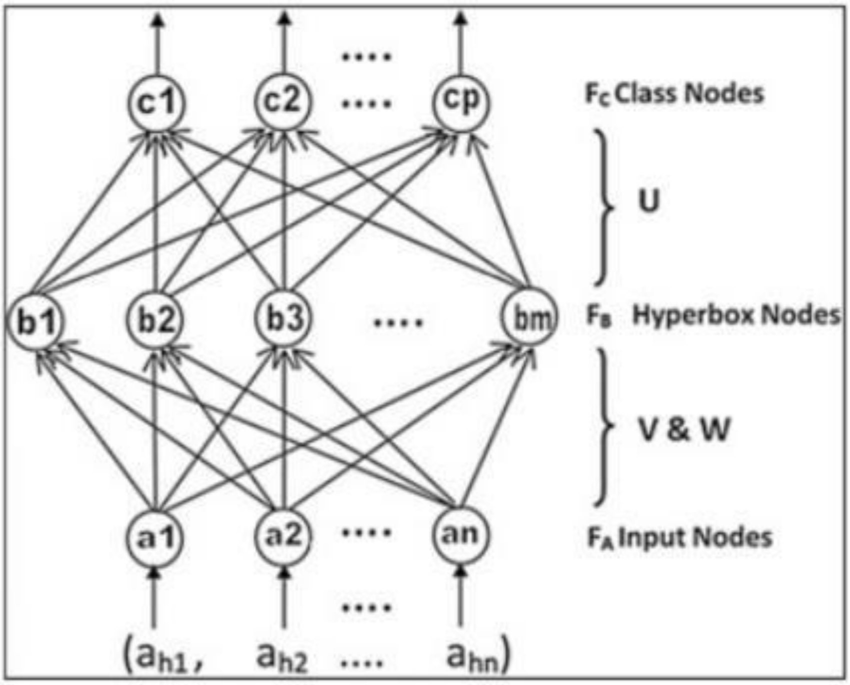

Fig 2. Fuzzy min-max neural network architecture [4].

At a different level, Ma Wentao et al. suggested advanced measures mainly centered around cloud data encoding, particularly images. They encrypted the pictures using a brand-new encryption method. Then, the optimized feature extractors and encrypted photos are uploaded to a cloud server. To improve data security, secure services are run concurrently on the cloud server. The encrypted images are then retrieved using a private image retrieval technique that makes use of deep convolutional neural network features. At last, the cloud server's matching process is finished. Their method proved to be more effective than current ones through experimental validation, resulting in both cost savings and enhanced security for cloud data transmission [5].

B. Deep Learning to Improve Cloud Computing Performance

Utilizing deep neural networks' innate ability to process data and analyze complex problems, cloud computing can make better use of deep neural networks. The efficiency of data center infrastructure is low in the current cloud environment, and when an operation goes wrong, the throughput of data center facilities will be drastically reduced to maintain the stability and quality of cloud connectivity, which will lower the quality of cloud computing services. To address the issue of slow cloud service speed, a deep reinforcement learning scheduling mechanism is therefore put forth in the literature [6]. This mechanism optimizes cloud node mapping after performing deep reinforcement learning for service requests. The benefits of deep learning and reinforcement learning are combined in this mechanism to optimize time, cost, energy consumption, and other aspects of cloud computing services while efficiently allocating resources.

IV. EMERGING CLOUD COMPUTING

New developments in cloud computing are focused on creating a middleman between the user and the cloud in order to increase proximity and, as a result, boost the speed and caliber of cloud computing services. There are five main categories into which this developing cloud computing architecture can be divided [1]. These developing clouds also have uses for deep learning. Edge computing is the first type of cloud computing to emerge. Edge computing is pre-processing data sent by users at a device that is closer to the user segment than the cloud server, then sending the processed data to the cloud. In Ma Wentao et al.'sstudy,which is discussed in Section 2, the encrypted image is optimized on an edge computing platform in order to construct a feature extractor. This has to do with how deep learning is incorporated into edge cloud computing [5]. Fog computing is the second cloud computing trend to emerge. A cloud computing architecture known as fog computing makes use of routers as processing and data filtering environments. Chilamkurti et al. presented a novel distributed parallel attack detection technique for IoT in the field of applying deep learning to fog computing. The technique leverages a fully connected (FC) deep neural network (DNN). The experimental setup applies deep learning to the nodes. Multiple node-distributed models will identify an attack as soon as it starts. The purpose of this specialized DNN is to identify possible attacks against distributed fog nodes. The results of experiments demonstrate that this specialized DNN is more effective at detecting attacks than the softmax algorithm [7].

Serverless computing is the third emerging cloud. Using a cloud service architecture, serverless computing breaks down large applications into functional blocks, with independent modules running as needed. Rich computational resources and outstanding performance are features of serverless cloud computing, which can also leverage deep learning to improve efficiency. Hang Zhang and colleagues proposed using deep learning methods to allocate computer power. By limiting the scheduling of cloud computing in the serverless architecture, this deep learning technique enables it to make cost-saving decisions between constrained operations [8]. Volunteer computing is the fourth aspect of emerging cloud computing. It is a paradigm that makes use of resources that people all over the world contribute to the Internet. While volunteer computing is acknowledged for its broad range of services, there are currently few examples of deep learning's integration and limited applications within this field. In terms of incorporating deep learning methodologies and examples, this field is still largely unexplored and underdeveloped. A fascinating and promising direction for further research and development is the potential intersection of deep learning and volunteer computing [9]. The final aspect of the emerging cloud computing landscape is software-defined computing, which consists of a cloud architecture in which a control platform centrally manages a multitude of devices. Zhongyu Wang et al.'sstudyfinds that deep learning plays a crucial role in the resource allocation process. Making use of a multitude of deep neural networks improves the process of making the best decisions and allocating resources. By ensuring that various devices in the SD-MEC network can methodically allocate tasks to appropriate edge servers, this sophisticated method enhances the effectiveness and efficiency of resource utilization in the software-defined computing paradigm [10]. In conclusion, the wise distribution of resources is the main use of deep learning in the developing field of cloud computing.

V. FUTURE CHALLENGES AND DEVELOPMENT DIRECTION

Both cloud computing and deep learning present many opportunities as well as challenges in their future development paths. Although deep learning models can be used to defend against cyberattacks in cloud environments, security and confidentiality issues continue to be raised. Concerns regarding the energy requirements of data centers are also raised by the surge in users, which presents issues with energy consumption. Therefore, deep learning approaches must continue to be developed in order to select and improve upon optimal policy functions. To handle the changing security, energy efficiency, and functionality landscape at the nexus of deep learning and cloud computing, this ongoing development is essential [3]. Deep learning necessitates a large amount of memory and processing power, both of which take a long time. Thus, its computational capacity is limited. As a result, optimization for low latency and high throughput will be the primary focus of future research in this field. To advance deep learning and make it more responsive and efficient to meet the demands of a wide range of applications and use cases, it is imperative that these optimization issues be resolved [9].

VI. CONCLUSION

The integration of cloud computing and deep learning in cybersecurity provides a robust framework for tackling modern cyber threats. The combination of scalable cloud resources and advanced AI techniques enables effective, real-time threat detection, and response, enhancing the overall security posture of organizations. In summary, it is clear that the combination of deep learning and cloud computing holds great promise for solving complex problems and opening up new avenues for innovation in the digital space. Neural network models that are woven throughout deep learning are powerful tools for addressing and mitigating cloud computing challenges. They contribute to an overall improvement in cloud computing capabilities by strengthening security protocols and improving performance metrics. Deep learning's remarkable adaptability and versatility are evident in a wide range of applications and are crucial for the wise distribution of computational resources in the intricate field of developing cloud computing.

In addition to increasing efficiency, this thoughtful resource allocation creates the framework for cloud services that are responsive and scalable. In the future, cloud computing will face obstacles related to improving security and the never-ending search for more service capacity. These difficulties call for creative fixes and technological breakthroughs to strengthen cloud infrastructures against changing threats and meet users' increasing demands. The main hurdles in the field of deep learning are achieving strict quality criteria and optimizing operating speeds. This highlights the continuous need for research and development to improve deep learning algorithms' computational accuracy and efficiency. The future of information technology will be shaped by the revolutionary discoveries that can only be obtained via continued collaboration between these two fields.

REFERENCES

[1]. F. Jauro, H. Chiroma, A. Y. Gital, M. Almutairi, S. M. Abdulhamid, J. H. Abawajy, "Deep learning architectures in emerging cloud computing architectures: Recent development, challenges and next research trend," Applied Soft Computing, vol. 96, 2020, pp. 106582, ISSN 1568-4946.

[2]. P. Mell and T. Grance, "Sp 800-145, the NIST Definition of Cloud Computing Csrc NIST," [Online]. Available: [21 Dec 2018], consulted on 21 Dec 2018.

International Multidisciplinary Research Journal Reviews (IMRJR)
A Peer-reviewed journal
Volume 1, Issue 1, September 2024
DOI 10.17148/IMRJR.2024.010104

[3]. S. Ahmad, I. Shakeel, S. Mehfuz, J. Ahmad, "Deep learning models for cloud, edge, fog, and IoT computing paradigms: Survey, recent advances, and future directions," Computer Science Review, vol. 49, 2023, pp. 100568, ISSN 1574-0137.
[4]. A. Kumar, R. S. Umurzoqovich, N. D. Duong, P. Kanani, A. Kuppusamy, M. Praneesh, M. N. Hieu, "An intrusion identification and prevention for cloud computing: From the perspective of deep learning," Optik, vol. 270, 2022, pp. 170044, ISSN 0030-4026.
[5]. W. Ma, T. Zhou, J. Qin, X. Xiang, Y. Tan, Z. Cai, "A privacy-preserving content-based image retrieval method based on deep learning in cloud computing," Expert Systems with Applications, vol. 203, 2022, pp. 117508, ISSN 0957-4174.
[6]. C. Li, J. Tang, T. Ma, X. Yang, Y. Luo, "Load balance based workflow job scheduling algorithm in distributed cloud," Netw. Comput. Appl., vol. 152, 2020, Article 102518.
[7]. A. A. Diro, N. Chilamkurti, "Distributed attack detection scheme using deep learning approach for the internet of things," Future Gener. Comput. Syst., 2017.
[8]. H. Zhang, J. Wang, H. Zhang, C. Bu, "Security computing resource allocation based on deep reinforcement learning in serverless multi-cloud edge computing," Future Generation Computer Systems, vol. 151, 2024, pp. 152-161, ISSN 0167-739X.
[9]. F. Costa, L. Silva, M. Dahlin, "Volunteer cloud computing: MapReduce over the internet," in 2011 IEEE International Symposium on Parallel and Distributed Processing Workshops and Phd Forum, IEEE, 2008, pp. 1855-1862.
[10]. Z. Wang, T. Lv, Z. Chang, "Computation offloading and resource allocation based on distributed deep learning and software-defined mobile edge computing," Computer Networks, vol. 205, 2022, pp. 108732, ISSN 1389-1286.