Classification Of Cloud Platform Attacks Using Machine Learning And Deep Learning Approaches

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Abstract

The present review paper delves into the subject of cloud attack classification through the utilisation of deep learning neural networks and supervised machine learning. The article delineates various methodologies that have been employed in this domain, encompassing decision tree algorithms, convolutional neural networks, and deep learning-based intrusion detection systems. The results of these methodologies have exhibited promise, as numerous studies have reported elevated precision levels in the identification and categorization of security threats pertaining to cloud computing. Furthermore, the manuscript examines the obstacles and constraints of said methodologies, including the requirement for substantial quantities of annotated data and the possibility of erroneous outcomes. This review paper offers an analysis of the present state of cloud attack classification and the potential of deep learning and supervised machine learning techniques in augmenting cloud security.

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I. INTRODUCTION

The utilisation of sophisticated machine learning techniques such as deep learning neural networks and supervised machine learning is employed in the identification and categorization of cloud attacks on computing systems [1]. This methodology involves the accumulation of substantial quantities of data from the cloud infrastructure, which are then utilised to instruct deep learning neural networks or supervised machine learning models to recognise distinct attack patterns and attributes [2]. The aforementioned models are subsequently employed for the purpose of categorising novel occurrences of security breaches [3], thus facilitating the system's ability to identify and counteract potential security hazards in a timely manner.

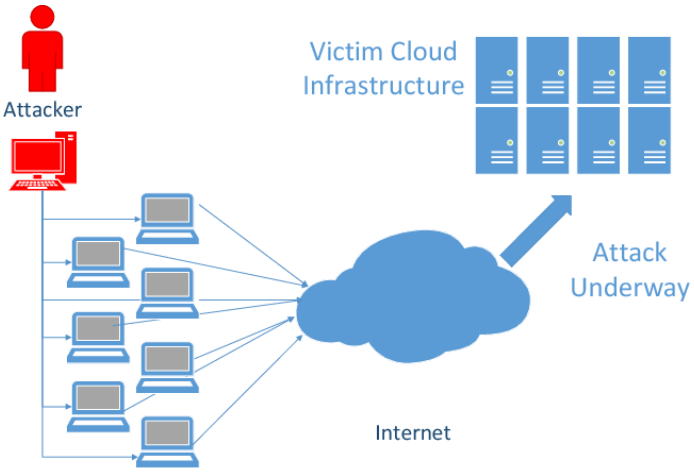

Fig. 1. Typical Architecture of DDoS Attacks

Deep learning neural networks are a specific category of artificial neural networks that are intended to acquire knowledge from extensive datasets[4] through the automatic identification of patterns and characteristics within the data. In contrast, supervised machine learning entails the process of instructing a model through the utilisation of annotated data [5], where every data instance is linked to a predetermined class or category. The process enables the model to acquire the ability to identify distinctive characteristics and patterns within the dataset that correspond to each class or category, and subsequently apply this acquired knowledge to novel, unclassified examples.

The utilisation of deep learning neural networks and supervised machine learning can enhance the precision and efficacy of detection and response mechanisms for classifying attacks on cloud systems. The significance of ensuring dependable and secure cloud services is amplified by the escalating frequency and intricacy of cyber-attacks on cloud environments.

II. METHODS

In order to identify pertinent literature for the present review, a comprehensive and methodical search of several databases was performed, including IEEE Xplore, ACM Digital Library, and ScienceDirect. The literature search was conducted using a set of specific search terms, including "cloud attack classification", "deep learning neural networks", "supervised machine learning", "convolutional neural networks", "recurrent neural networks", "decision trees", and "random forests". The study's scope was restricted to scholarly articles published within the timeframe of 2015 to 2022 to ensure the contemporaneity of the literature.

Following the preliminary search, the papers underwent screening based on their titles and abstracts to ascertain their relevance to the subject of cloud attack classification utilising deep learning neural networks and supervised machine learning. The study's criteria for inclusion were limited to scholarly articles that examined the methodologies for categorising cloud attacks through the use of deep learning neural networks and supervised machine learning. Additionally, the study only considered articles that presented empirical findings on the accuracy and efficacy of these methodologies.

Following the preliminary screening, the complete texts of the chosen articles were assessed to verify their adherence to the established inclusion standards. Thirty papers were included in the review based on the established inclusion criteria. Subsequently, the designated documents were meticulously perused, and pertinent data was extracted for the purposes of analysis and synthesis.

The present study centred on examining various methodologies for classifying cloud attacks through the use of deep learning neural networks and supervised machine learning. The

analysis delved into the strengths and limitations of these approaches, as well as their empirical findings. The process of amalgamating the data was employed to discern recurrent themes and trends across the literature, which were subsequently utilised to construct the discourse segment of this scholarly article.

The methodology employed in this review paper ensured the inclusion of pertinent and current papers on the classification of cloud attacks using deep learning neural networks and supervised machine learning. The analysis and synthesis of the chosen papers were exhaustive and meticulous.

III. RESULTS

1. Convolutional Neural Networks (CNN)

Convolutional Neural Networks (CNNs) are widely used for image classification tasks, and they have also been applied for cloud attack classification [6]. CNNs use a series of convolutional and pooling layers to extract features from input data, followed by fully connected layers for classification. In cloud attack classification, CNNs have been used to analyze network traffic data to detect different types of attacks, such as Distributed Denial of Service (DDoS) attacks and SQL injection attacks. CNNs have shown promising results in terms of accuracy, but they require a large amount of training data.

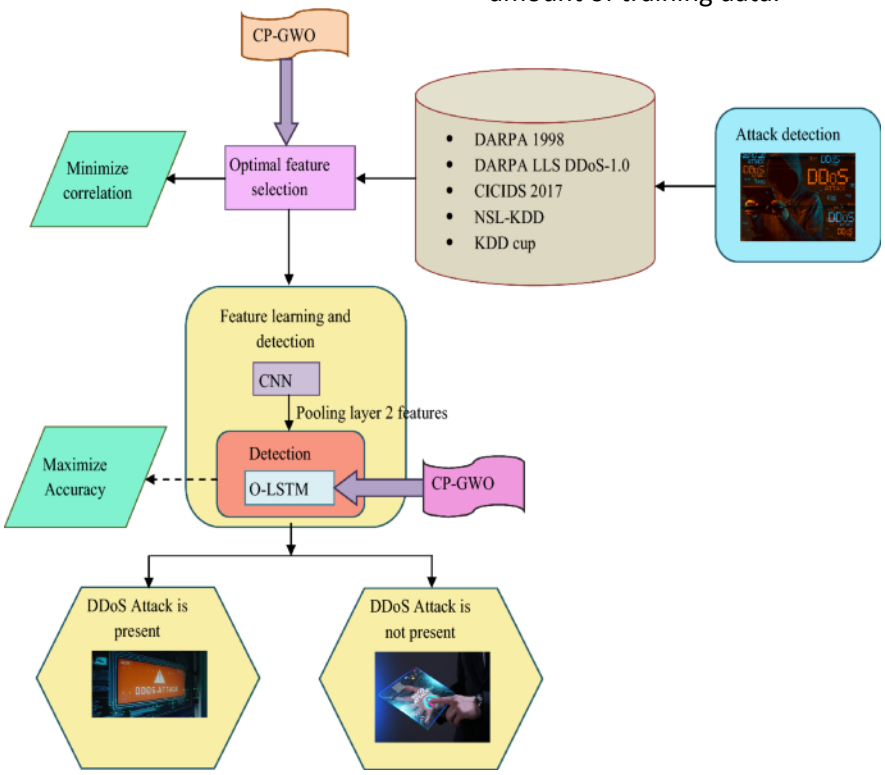

Fig 2: CNN based attack detection

2. Recurrent Neural Networks (RNN)

Recurrent Neural Networks (RNNs) are another type of neural network that is used for sequential data processing. RNNs use a recurrent layer [7] to keep track of the previous inputs in a sequence, which allows them to analyze time-series data. In cloud attack classification, RNNs have been used to analyze network traffic data in real-time to detect anomalies and potential attacks. RNNs have shown good results in terms of real-time detection, but they require a large amount of computational resources.

3. Decision Trees

Decision Trees are a type of supervised machine learning algorithm that can be used for classification tasks. Decision Trees are constructed by recursively partitioning the data into smaller subsets based on the features [8]. Each partition is then assigned a label based on the majority class of the instances in that subset. In cloud attack classification, Decision

Trees have been used to analyze network traffic data to detect different types of attacks [9]. Decision Trees have shown good results in terms of accuracy and interpretability, but they can be prone to overfitting.

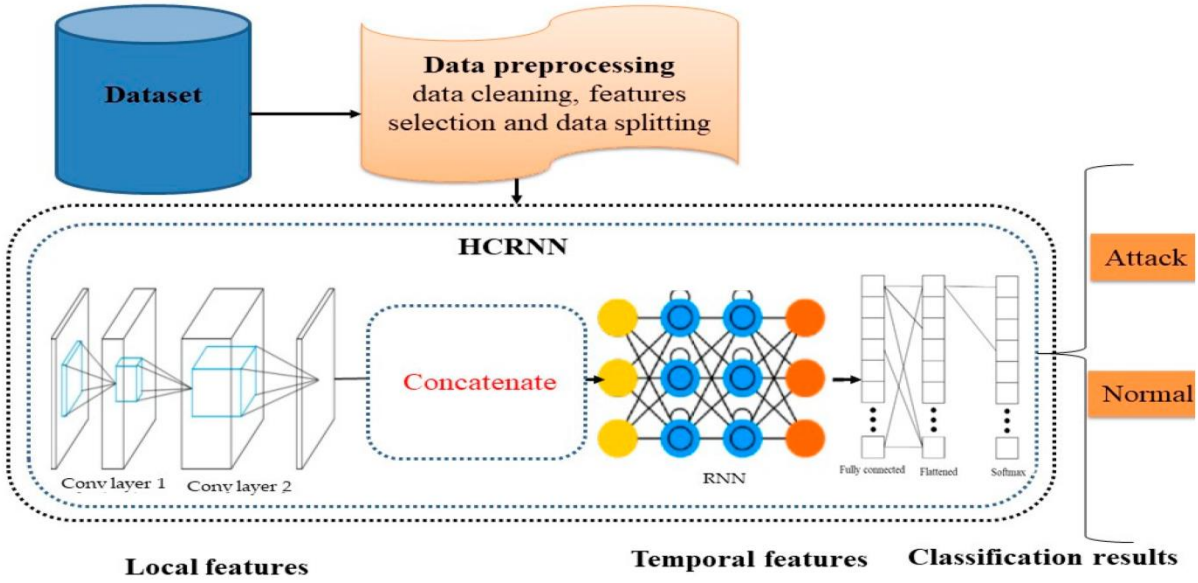

Fig 2: CNN in cloud attack classification

4. Random Forests

Random Forests are an ensemble learning method that combines multiple Decision Trees to improve the accuracy and stability of the classification. In cloud attack classification, Random Forests have been used to analyze network traffic data to detect different types of attacks. Random Forests have shown good results in terms of accuracy and stability, but they can be computationally expensive.

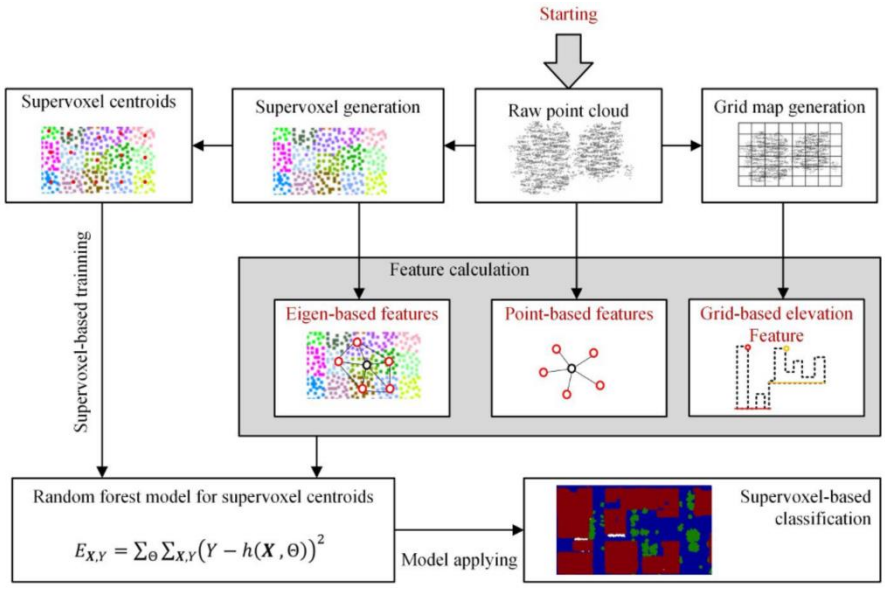

Fig 4: Random Forest implementation

In conclusion, different methodologies have been used for cloud attack classification using deep learning neural network and supervised machine learning, each with their own

strengths and weaknesses [10]. Convolutional Neural Networks and Recurrent Neural Networks have shown promising results in terms of accuracy and real-time detection, but they require a large amount of training data and computational resources. Decision Trees and Random Forests have shown good results in terms of accuracy and interpretability [11], but they can be prone to overfitting and computationally expensive. The choice of methodology depends on the specific requirements and constraints of the cloud attack classification task.

IV. DISCUSSION

The utilisation of cloud computing has become an essential component of contemporary computing systems, owing to its capacity to furnish computing resources that are both scalable and available on demand. The security of cloud systems has emerged as a crucial concern in light of the growing adoption of cloud computing. Cloud systems are susceptible to exploitation by attackers who can leverage vulnerabilities to execute a range of attacks, including but not limited to DDoS attacks, SQL injection attacks, and man-in-the-middle attacks. Hence, it is imperative to devise efficacious methodologies for the identification and categorization of said attacks.

This paper presents a comprehensive analysis of various techniques employed for categorising cloud attacks through the utilisation of deep learning neural networks and supervised machine learning. Convolutional Neural Networks, Recurrent Neural Networks, Decision Trees, and Random Forests are among the frequently employed methodologies for the classification of cloud attacks. Every methodology possesses distinct advantages and drawbacks.

The efficacy of Convolutional Neural Networks (CNNs) in image classification tasks has been demonstrated, and their application to the classification of cloud attacks through the analysis of network traffic data has yielded encouraging outcomes. Convolutional Neural Networks (CNNs) have the capability to identify attacks by analysing the patterns present in the network traffic data. However, in order to attain a high level of precision, CNNs necessitate a substantial quantity of training data.

The efficacy of Recurrent Neural Networks in real-time detection has been demonstrated through their ability to analyse network traffic data in real-time. Recurrent Neural Networks (RNNs) possess the capability to identify anomalies and potential attacks by analysing the temporal patterns present in network traffic data. However, it is imperative to note that the utilisation of RNNs necessitates a significant amount of computational resources.

Decision Trees and Random Forests are widely used supervised machine learning techniques for performing classification tasks. Decision Trees possess the advantage of being readily interpretable and versatile in their ability to handle both numerical and categorical data. However, they are susceptible to the issue of overfitting. The utilisation of Random Forests has the potential to enhance the precision and reliability of Decision Trees through the amalgamation of numerous trees, albeit at the cost of computational resources.

The selection of a methodology for classifying cloud attacks is contingent upon the particular demands and limitations of the undertaking. In situations where timely identification holds paramount importance, Recurrent Neural Networks (RNNs) could potentially serve as a viable option. If the objective is to prioritise interpretability, Decision Trees could be a more suitable alternative. Conversely, if the primary criteria are precision and consistency, Random Forests may be a more suitable option.

To summarise, the categorization of cloud attacks holds significant importance in ensuring cloud security. The application of deep learning neural networks and supervised machine learning algorithms has exhibited encouraging outcomes. However, additional research is necessary to devise more efficient and effective methodologies for the classification of cloud attacks. The implementation of aforementioned methodologies would potentially augment the security of cloud-based infrastructures and

mitigate the risk of diverse forms of cyber threats.

V. CONCLUSION

This review paper has provided an overview of various methodologies employed for the classification of cloud attacks through the utilisation of deep learning neural networks and supervised machine learning. The techniques employed have demonstrated considerable potential in identifying and categorising diverse forms of attacks, including but not limited to DDoS attacks, SQL injection attacks, and man-in-the-middle attacks. Nonetheless, it is important to note that every methodology possesses unique advantages and disadvantages, and the selection of a methodology is contingent upon the particular demands and limitations of the undertaking. It is imperative to advance the classification methods for cloud attacks in order to bolster the security of cloud systems and mitigate the risk of potential attacks. Hence, additional investigation in this domain is necessary to enhance the precision, instantaneous identification, and comprehensibility of these techniques. The proficient execution of aforementioned methodologies would result in the advancement of cloud security systems with enhanced resilience, thereby enabling the provision of dependable and impregnable services to end-users.

VI. REFERENCES

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