CYBER THREAT ANALYSIS BASED ON ARTIFICIAL NEURAL NETWORKS USING EVENT PROFILES

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ABSTRACT

One of the major challenges in cybersecurity is the provision of an automated and effective cyber-threats detection technique. In this paper, we present an AI technique for cyber-threats detection, based on artificial neural networks. The proposed technique converts multitude of collected security events to individual event profiles and use a deep learning-based detection method for enhanced cyber-threat detection. For this work, we developed an AI-SIEM system based on a combination of event profiling for data preprocessing and different artificial neural network methods, including CNN, LSTM, and SVM with PSO. If the object is based on accuracy we can select the SVM with PSO but there will data loss during the analysis then if you go with CNN and LSTM the accuracy is low compare to SVM with PSO but there is no data loss. The system focuses on discriminating between true positive and false positive alerts, thus helping security analysts to rapidly respond to cyber threats. All experiments in this study are performed by authors using two benchmark datasets (NSLKDD and CICIDS2017) and two datasets collected in the real world. To evaluate the performance comparison with existing methods, we conducted experiments using the five conventional machine-learning methods (SVM, k-NN, RF, NB, and DT). Consequently, the experimental results of this study ensure that our proposed methods are capable of being employed as learning-based models for network intrusion-detection, and show that although it is employed in the real world, the performance outperforms the conventional machine-learning methods.

1. INTRODUCTION

With the emergence of artificial intelligence (AI) techniques, learning-based approaches for detecting cyber attacks, have become further improved, and they have achieved significant results in many studies. However, owing to constantly evolving cyber attacks , it is still highly challenging to protect IT systems against threats and malicious behaviors in networks. Because of various network intrusions and malicious activities, effective defenses and security considerations were given high priority for finding reliable solutions [1], [2], [3], [4].

Traditionally, there are two primary systems for detecting cyber-threats and network intrusions. An intrusion prevention system (IPS) is installed in the enterprise network, and can examine the network protocols and flows with signature-based methods primarily. It generates appropriate intrusion alerts, called the security events, and reports the generating alerts to another system, such as SIEM. The security information and event management (SIEM) has been focusing on collecting and managing the alerts of IPSs. The SIEM is the most common and dependable solution among various security operations solutions to analyze the collected security events and logs [5]. Moreover, security analysts make an effort to investigate suspicious alerts by policies and threshold, and to discover malicious behavior by analyzing correlations among events, using knowledge related to attacks.

Nevertheless, it is still difficult to recognize and detect intrusions against intelligent network attacks owing to their high false alerts and the huge amount of security data [6], [7]. Hence, the most recent studies in the field of intrusion detection have given increased focus to machine learning and artificial intelligence techniques for detecting attacks. Advancement in AI fields can facilitate the investigation of network intrusions by security analysts in a timely and automated manner. These learning-based approaches require to learn the attack model from historical threat data and use the trained models to detect intrusions for unknown cyber threats [8], [9].

A learning-based method geared toward determining whether an attack occurred in a large amount of data can be useful to analysts who need to instantly analyze numerous events. According to [10], information security solutions generally fall into two categories: analyst- driven and machine learning-driven solutions. Analyst-driven solutions rely on rules determined by security experts called analysts. Meanwhile, machine learning-driven solutions used to detect rare or anomalous patterns can improve detection of new cyber threats [10]. Nevertheless, while learning-based approaches are useful in detecting cyber attacks in systems and networks, we observed that existing learning-based approaches have four main limitations.

First, learning-based detection methods require labeled data, which enable the training of the model and evaluation of generated learning models. Furthermore, it is not straightforward to obtain such labeled data at a scale that allow accurate training of a model. Despite the need for labeled data, many commercial SIEM solutions do not maintain labeled data that can be applied to supervised learning models [10].

2. LITERATURE SURVEY

TITLE: Enhanced Network Anomaly Detection Based on Deep Neural Networks

Abstract: Due to the monumental growth of Internet applications in the last decade, the need for security of information network has increased manifolds. As a primary defense of network infrastructure, an intrusion detection system is expected to adapt to dynamically changing threat landscape. Many supervised and unsupervised techniques have been devised by researchers from the discipline of machine learning and data mining to achieve reliable detection of anomalies. Deep learning is an area of machine learning which applies neuron- like structure for learning tasks. Deep learning has profoundly changed the way we approach learning tasks by delivering monumental progress in different disciplines like speech processing, computer vision, and natural language processing to name a few. It is only relevant that this new technology must be investigated for information security applications.

The aim of this paper is to investigate the suitability of deep learning approaches for anomaly-based intrusion detection system. For this research, we developed anomaly detection models based on different deep neural network structures, including convolutional neural networks, autoencoders, and recurrent neural networks. These deep models were trained on NSLKDD training data set and evaluated on both test data sets provided by NSLKDD, namely NSLKDDTest+ and NSLKDDTest21. All experiments in this paper are performed by authors on a GPU-based test bed. Conventional machine learning-based intrusion detection models were implemented using well-known classification techniques, including extreme learning machine, nearest neighbor, decision-tree, random-forest, support vector machine, naive-bays, and quadratic discriminant analysis. Both deep and conventional machine learning models were evaluated using well-known classification metrics, including receiver operating characteristics, area under curve, precision-recall curve, mean average precision and accuracy of classification. Experimental results of deep IDS models showed promising results for real-world application in anomaly detection systems.

TITLE: Network Intrusion Detection Based on Directed Acyclic Graph and Belief Rule Base

Abstract: Intrusion detection is very important for network situation awareness. While a few methods have been proposed to detect network intrusion, they cannot directly and effectively utilize semi-quantitative information consisting of expert knowledge and quantitative data. Hence, this paper proposes a new detection model based on a directed acyclic graph (DAG) and a belief rule base (BRB). In the proposed model, called DAG-BRB, the DAG is employed to construct a multi- layered BRB model that can avoid explosion of combinations of rule number because of a large number of types of intrusion. To obtain the optimal parameters of the DAG-BRB model, an improved constraint covariance matrix adaption evolution strategy (CMA-ES) is developed that can effectively solve the constraint problem in the BRB. A case study was used to test the efficiency of the proposed DAG-BRB. The results showed that compared with other detection models, the DAG-BRB model has a higher detection rate and can be used in real networks.

TITLE: HAST-IDS: Learning hierarchical spatial-temporal features using deep neural networks to improve intrusion detection

Abstract: The development of an anomaly-based intrusion detection system (IDS) is a primary research direction in the field of intrusion detection. An IDS learns normal and anomalous behavior by analyzing network traffic and can detect unknown and new attacks. However, the performance of an IDS is highly dependent on feature design, and designing a feature set that can accurately characterize network traffic is still an ongoing research issue. Anomaly-based IDSs also have the problem of a high false alarm rate (FAR), which seriously restricts their practical applications. In this paper, we propose a novel IDS called the hierarchical spatial-temporal features-based intrusion detection system (HAST-IDS), which first learns the low-level spatial features of network traffic using deep convolutional neural networks (CNNs) and then learns high-level temporal features using long short-term memory networks. The entire process of feature learning is completed by the deep neural networks automatically; no feature engineering techniques are required. The automatically learned traffic features effectively reduce the FAR. The standard DARPA1998 and ISCX2012 data sets are used to evaluate the performance of the proposed system. The experimental results show that the HAST-IDS outperforms other published approaches in terms of accuracy, detection rate, and FAR, which successfully demonstrates its effectiveness in both feature learning and FAR reduction.

TITLE: Data security analysis for DDoS defense of cloud based networks

Abstract: Distributed computing has become an effective approach to enhance capabilities of an institution or organization and minimize requirements for additional resource. In this regard, the distributed computing helps in broadening institutes IT capabilities. One needs to note that distributed computing is now integral part of most expanding IT business sector. It is considered novel and efficient means for expanding business. As more organizations and individuals start to use the cloud to store their data and applications, significant concerns have developed to protect sensitive data from external and internal attacks over internet. Due to security concern many clients hesitate in relocating their sensitive data on the clouds, despite significant interest in cloud-based computing. Security is a significant issue, since data much of an organizations data provides a tempting target for hackers and those concerns will continue to diminish the development of distributed computing if not addressed. Therefore, this study presents a new test and insight into a honeypot. It is a device that can be classified into two types: handling and research honeypots.

Handling honeypots are used to mitigate real life dangers. A research honeypot is utilized as an exploration instrument to study and distinguish the dangers on the internet. Therefore, the primary aim of this research project is to do an intensive network security analysis through a virtualized honeypot for cloud servers to tempt an attacker and provide a new means of monitoring their behavior

3. EXISTING SYSTEM

Traditionally, there are two primary systems for detecting cyber-threats and network intrusions. An intrusion prevention system (IPS) is installed in the enterprise network, and can examine the network protocols and flows with signature-based methods primarily. It generates appropriate intrusion alerts, called the security events, and reports the generating alerts to another system, such as SIEM. The security information and event management (SIEM) has been focusing on collecting and managing the alerts of IPSs. The SIEM is the most common and dependable solution among various security operations solutions to analyze the collected security events and logs[5]. Moreover, security analysts make an effort to investigate suspicious alerts by policies and threshold, and to discover malicious behaviour by analyzing correlations among events, using knowledge related to attacks.

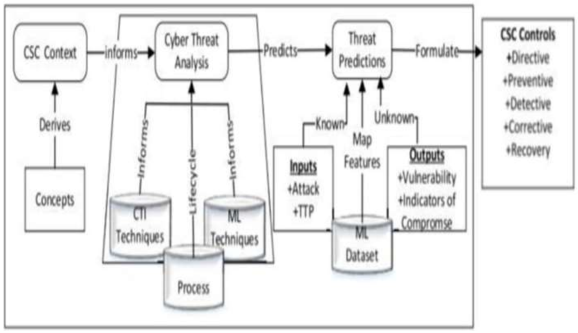
Proposed System:

In this proposed application we are going to analyze cyber fraud analysis with the help of different neural network algorithm like LSTM,CNN and SVM with PSO and with the help of these algorithm we can get more accuracy compare with machine learning algorithms.

In this proposed approach we implemented event profile based cybersecurity analysis for cyber threat detection for this analysis we are using NSLKDD dataset. The dataset is having of different type of cyber threat.

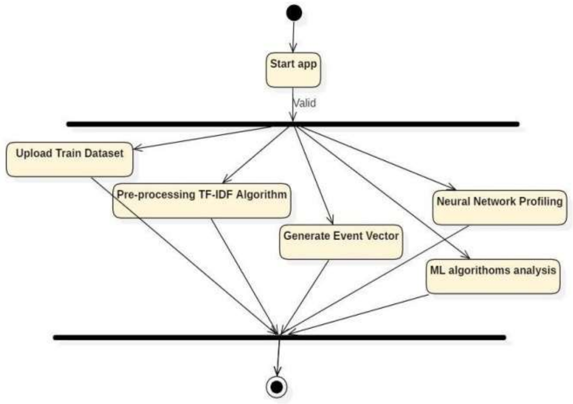
With the help of our proposed approach we will be achieving high performance with less data loss.

4.SYSTEM ARCHITECTURE .



Activity Diagram

A graphical representation of the work process of stepwise exercises and activities with support for decision, emphasis and simultaneousness, used to depict the business and operational well-ordered stream of parts in a framework furthermore demonstrates the general stream of control.



5. SYSTEM IMPLEMENTATION

Data Parsing: This module take input dataset and parse that dataset to create a raw data event model
TF-IDF: using this module we will convert raw data into event vector which will contains normal and attack signatures
Event Profiling Stage: Processed data will be splitted into train and test model based on profiling events.
Deep Learning Neural Network Model: This module runs CNN and LSTM algorithms on train and test data and then generate a training model.
Generated trained model will be applied on test data to calculate prediction score, Recall, Precision and FMeasure. Algorithm will learn perfectly will yield better accuracy result and that model will be selected to deploy on real system for attack detection.

6.1 TYPES OF TESTING

■Unit testing
Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

■Integration testing
Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

■Functional test
Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.
Functional testing is centered on the following items:

7.RESULTS

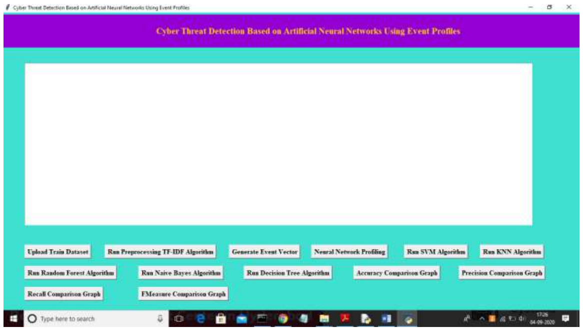

Cyber Threat Detection Based on Artificial Neural Networks Using Event Profiles
Cyber Threat Detection Based on Artificial Neural Networks Using Event Profiles
Upload Train Dataset
Run Preprocessing TF-IDF Algorithm
Generate Event Vector
Neural Network Profiling
Run SVM Algorithm
Run KNN Algorithm
Run Random Forest Algorithm
Run Naive Bayes Algorithm
Run Decision Tree Algorithm
Accuracy Comparison Graph
Precision Comparison Graph
Recall Comparison Graph
FMeasure Comparison Graph
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fig.7. 1 uploading of dataset

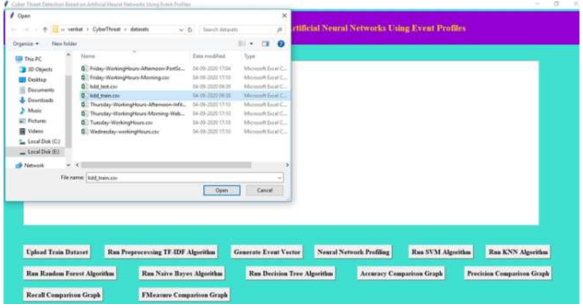
Cyber Threat Detection Based on Artificial Neural Networks Using Event Profiles
Open
venkat › CyberThreat › datasets
Search datasets
Organize ▾
New folder
This PC
3D Objects
Desktop
Documents
Downloads
Music
Pictures
Videos
Local Disk (C:)
Local Disk (E:)
Network
Name
Date modified
Type
Friday-WorkingHours-Afternoon-PortSc...
Friday-WorkingHours-Morning.csv
kdd_test.csv
kdd_train.csv
Thursday-WorkingHours-Afternoon-Infil...
Thursday-WorkingHours-Morning-Web...
Tuesday-WorkingHours.csv
Wednesday-workingHours.csv
File name: kdd_train.csv
Open
Cancel
rtificial Neural Networks Using Event Profiles
Upload Train Dataset
Run Preprocessing TF-IDF Algorithm
Generate Event Vector
Neural Network Profiling
Run SVM Algorithm
Run KNN Algorithm
Run Random Forest Algorithm
Run Naive Bayes Algorithm
Run Decision Tree Algorithm
Accuracy Comparison Graph
Precision Comparison Graph
Recall Comparison Graph
FMeasure Comparison Graph

fig.7.2 dataset loaded

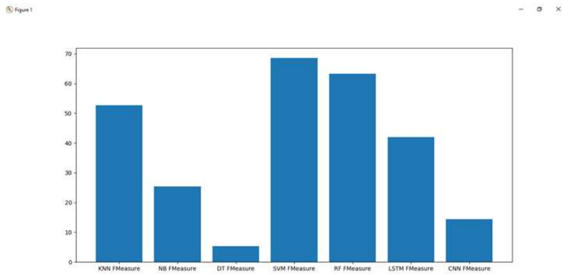

fig.7.3 comparasion Graph

8. CONCLUSION & FUTURE WORK

In this paper, we have proposed the AI-SIEM system using event profiles and artificial neural networks. The novelty of our work lies in condensing very large-scale data into event profiles and using the deep learning-based detection methods for enhanced cyber-threat detection ability. The AI-SIEM system enables the security analysts to deal with significant security alerts promptly and efficiently by comparing longterm security data. By reducing false positive alerts, it can also help the security analysts to rapidly respond to cyber threats dispersed across a large number of security events.

For the evaluation of performance, we performed a performance comparison using two benchmark datasets (NSLKDD, CICIDS2017) and two datasets collected in the real world. First, based on the comparison experiment with other methods, using widely known benchmark datasets, we showed that our mechanisms can be applied as one of the learning-based models for network intrusion detection. Second, through the evaluation using two real datasets, we presented promising results that our technology also outperformed conventional machine learning methods in terms of accurate classifications.

In the future, to address the evolving problem of cyber attacks, we will focus on enhancing earlier threat predictions through the multiple deep learning approach to discovering the long-term patterns in history data. In addition, to improve the precision of labeled dataset for supervised- learning and construct good learning datasets, many SOC analysts will make efforts directly to record labels of raw security events one by one over several months.

REFERENCES

[1] S. Naseer, Y. Saleem, S. Khalid, M. K. Bashir, J. Han, M. M. Iqbal, K. Han, "Enhanced Network Anomaly Detection Based on Deep Neural Networks," IEEE Access, vol. 6, pp. 48231-48246, 2018.

[2] B. Zhang, G. Hu, Z. Zhou, Y. Zhang, P. Qiao, L. Chang, "Network Intrusion Detection Based on Directed Acyclic Graph and Belief Rule Base", ETRI Journal, vol. 39, no. 4, pp. 592-604, Aug. 2017

[3] W. Wang, Y. Sheng and J. Wang, "HAST-IDS: Learning hierarchical spatial-temporal features using deep neural networks to improve intrusion detection," IEEE Access, vol. 6, no. 99, pp. 1792-1806, 2018.

[4] M. K. Hussein, N. Bin Zainal and A. N. Jaber, "Data security analysis for DDoS defense of cloud based networks," 2015 IEEE Student Conference on Research and Development (SCOReD), Kuala Lumpur, 2015, pp. 305-310.

[5] S. Sandeep Sekharan, K. Kandasamy, "Profiling SIEM tools and correlation engines for security analytics," In Proc. Int. Conf. Wireless Com., Signal Proce. and Net.(WiSPNET), 2017, pp. 717-721.

[6] N.Hubballiand V.Suryanarayanan,‘‘False alarm minimization techniques in signature- based intrusion detection systems: A survey,’’ Comput. Commun., vol. 49, pp. 1-17, Aug. 2014.

[7] A. Naser, M. A. Majid, M. F. Zolkipli and S. Anwar, "Trusting cloud computing for personal files," 2014 International Conference on Information and Communication Technology Convergence (ICTC), Busan, 2014, pp. 488-489.

[8] Y. Shen, E. Mariconti, P. Vervier, and Gianluca Stringhini, "Tiresias: Predicting Security Events Through Deep Learning," In Proc. ACM CCS 18, Toronto, Canada, 2018, pp. 592- 605.