

Hybrid classification model to detect advanced intrusions using data mining techniques

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Abstract

Traditional signature based approach fails in detecting advanced malwares like stuxnet, flame, duqu etc. Signature based comparison and correlation are not up to the mark in detecting such attacks. Hence, there is crucial to detect these kinds of attacks as early as possible. In this research, a novel data mining based approach were applied to detect such attacks. The main innovation lies on Misuse signature detection systems based on supervised learning algorithm. In learning phase, labeled examples of network packets systems calls are (gave) provided, on or after which algorithm can learn about the attack which is fast and reliable to known. In order to detect advanced attacks, unsupervised learning methodologies were employed to detect the presence of zero day/ new attacks. The main objective is to review, different intruder detection methods. To study the role of Data Mining techniques used in intruder detection system. Hybrid – classification model is utilized to detect advanced attacks.

Keywords: Data Mining; Hybrid; Stuxnet; Flame; Duqu; Unsupervised Learning.

1. Introduction

Intrusion is defined as an action set done to accommodate goals relating security, like reliability, privacy, or accessibility. The resource of networking and computing are checked for the intrusion. Detection of intrusion is the process of diagnosing and acknowledging to intrusion activities. IDS were first introduced by James Anderson in the year 1980[1]. Detection of intrusion methods is followed for several years to ensure security in the system. Using intrusion detection methods, one can gather and use facts from known types of attacks and discover if someone wants to attack your network or a particular host. The information gathered are being used in improving network safety, as well as for authorized functions. Both economic and open source products are made available for this cause. Many susceptibility estimation tools are also made available in the market which is used in fixing various kinds of security holes available in a network. Hybrid categorization model is used to detect advanced intrusions using data mining techniques. The technique is calculated with a captured real-time flow and a dataset of packets, a scattered disapproval of service dataset, and the intrusion of benchmark dataset called the discovery of knowledge and mining of data.

2. Literature review

Detection of network anomaly by Cascading K-Means Clustering and C4.5 Decision Tree algorithm [7] was used by many researchers in the past years. It was useful to detect intruder in High accuracy rate, Drawback of this approach is cannot processing large dataset. Efficient accession toward Intrusion Detection System using the technique of data mining [2] used Hybrid PSO with

C4.5, SNORT with ALADLERAD, SVM and HOPERAA approaches to detect Intruders. Advantage of this approach is the detection of the intruder in high accuracy rate. Drawback of this approach it cannot be applied to real traffic. A design of hybrid intrusion detection system for computer network safety [8] mentioned in this paper focus on the hybrid IDS is achieved by consolidating anomaly detection of packet header and network traffic. The advantage of this approach is Detect more attacks than SNORT, Draw back cannot detect behavioral attacks. Hybrid access for Anomaly Network Traffic Detection using the technique of Data Mining[9]mentioned in this paper focus on hybrid IDS is the combing the method Entropy and SVM classifier .Advantage of this approach is network properties is clearly defined , Disadvantage is it cannot process large data.

3. Components of intrusion detection system

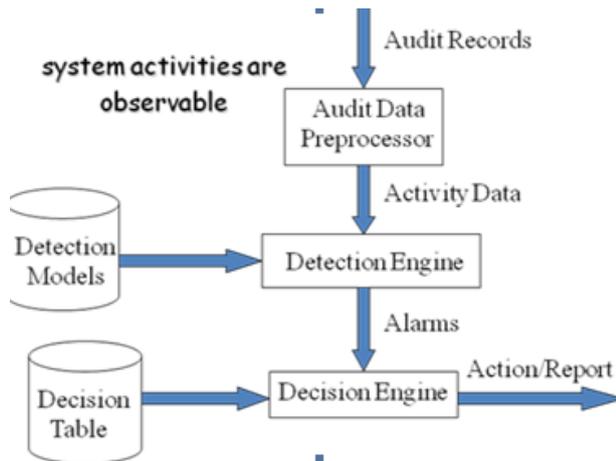


Fig. 1: Components of Intruder Detection System.

Audit records means by which the current level of act of an network security of an organization can be checked and it permits for the analysis and diagnosing of selected trends and particular safety circumstances. It gets its way into Audit data processor. After observing and acting upon this corresponding data it gets allowed into detection engine. This engine has some limited amount of detection models in which they allow the process to be detected for any intrusion. If detected then it would cause an alarm to occur. A decision table thus summarizes the overall intrusion occurred in the system and finally produces the report. Fig 1 shows Components of Intruder detection system

3.1. Combining multiple classifiers

The classifiers described in this section each models a single aspect of the system behavior. They are what we call the base (single level) classifiers. Combining evidence from multiple base classifiers is proposed to improve the effectiveness in detecting intrusions. For example, in addition to the classifier for network traffic (using tcpdump data), we can include the classifiers on the commands issued during the (connection) sessions of well-known services, e.g. ftp, telnet etc. The combined evidence of anomalous traffic patterns and session behavior leads to a more accurate assertion that the network is under attack. A priority in our research plan is to study and experiment with (inductively learned) classification models that combine evidence from multiple (base) detection models. The general approach in learning such a meta-detection model can be summarized as follows:

- Base classifiers can be built that specifies various forms of the target system.
- Meta learning task can be formulated: A collection of evidence is the each record in the training data (created at the equivalent term of time) from the base classifiers; Either 1 Or 0 is the each attribute value in the record, the prognosis (evidence) from a base classifier that the designed behavior is "normal" or "abnormal" (i.e., whether it fits the model or not).
- Meta classifier can be produced by applying learning algorithm.

4. Detection classification

4.1. Misuse detection systems

Analyze of intrusions regarding known pattern (signatures) for the malignant action is a way of discovering the computer attacks. In the approach of misuse detection, unusual system behavior is characterized first, and then the remaining behavior is characterized as normal.

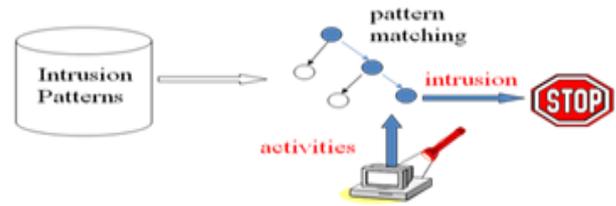
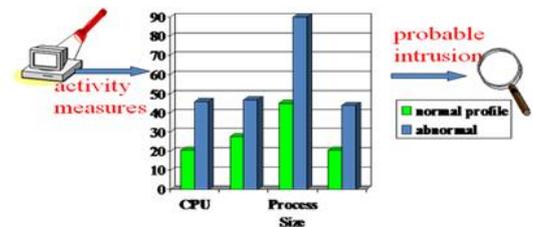


Fig. 2: Misuse Detection.

Misuse detection records this specific pattern of intrusion as well as monitors present audit trails and matching patterns. When the matched event occurs then it returns them to be the event as intrusion. Some of the illustration models are expert rules, colored petri net and state transition diagram.

4.2. Anomaly detection systems

Malicious traffic is diagnosed regarding divergence from traditional regular network. Anomaly detection (also outlier detection) is the process of identification of items, events or observations which do not co ordinate to a familiar template or other items in a dataset.



Relatively high false positive rate - anomalies can just be new normal activities.

Fig. 3: Anomaly Detection.

First use anomaly detection to discover what to look for. Then use this information as a target variable for classification. Then use anomaly detection again to find the undiscovered events that the classifier doesn't know about.

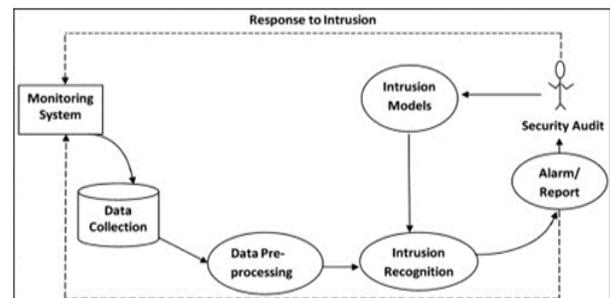


Fig. 4: Over All Structure of Intruder Detection Process.

Fig 5 shows over all structure of intruder detection system. The monitoring system captures all the entering packets and broadcasted through the network. The collected information send for pre-processing. In preprocessing the noise can be removed then the information are investigated and categorized according to their measure. The alarm are raised based on the state of the data [2]

5. Data mining: A KDD process

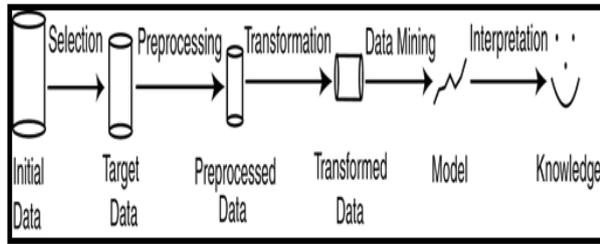


Fig. 5: Data Mining Process.

- Selection: In this process we can obtain data from various sources.
- Preprocessing: Here the data cleaning process is done.
- Transformation: Convert various formats in to common format. Transform it in to new format.
- Data Mining: Obtain the desired results.
- Interpretation/Evaluation: Present results to user in expressive manner

DM and KDD are often used interchangeably. Actually, it is only the part of KDD. It follows the process of learning the application domain and gathering and integrating data followed by cleaning and preprocessing of data. Reducing and projecting data in order to find useful features, dimensionality and variable reduction. This is followed by choosing of data mining for performing its tasks. Finally evaluating and interpreting the discovered knowledge. Fig5 shows Data Mining Process.

5.1. Attacks can be described as

- DoS attack – A kind of attack where the attacker generates processing time of the resources and memory busy so as to avoid legitimate user from accessing those resources.
- U2R attack – Here the attacker sniffs the password or makes some kind of attack to access the particular host in a network as a legitimate user. They can even promote some susceptibility to acquire the fundamental access of the system.
- R2L attack – Here the attacker sends a message to the host in a network over remote system and makes some susceptibility.
- Probe attack – Attacker will scan the network to gather information and would make some violation in the future.
- The data set of KDD Cup 99 contains 23 attack types as well as its features are grouped as,
- Basic features - It encompasses all the attributes of TCP/IP connection and leads to delay in detection.
- Traffic features - It is evaluated in accordance with window interval & two features as same host and same service.

5.2. O same host feature

It examines the number of connections for the past 2 s that too from the same destination host. In other words, the probability of connections will be done in a specific time interval.

2.3. O same service feature

It examines the number of connections in a particular time interval that too posses same service.

2.4. Data mining in intrusion detection system

A wide and variety of mining techniques have been used to detect intruders.

k-Means: Data mining learning process Clustering play an important role. K-Means clustering is used to partitioning the training data into k clusters. It is an efficient method for grouping the

abnormal and normal data. The main drawback of this K-means algorithm is it can't able to handle noisy data [3].

CART (Classifications Regression Tree): CART methodology is technically called as binary recursive partitioning [4]. Classification and Regression Tree (CART) analysis is used to find the class to which the data belongs and incessant and calculate its value. The advantage of CART is does not depend on data to a particular type of distribution [3].

Neural Networks: A Neural Networks (NN) is also called as Artificial Neural Network (ANN), it is a mathematical model or computational model which is generally based on role of human brain. ANN contains of numerous nodes which bear a resemblance to biological neurons of human brain. There are two different types of artificial neural network one is feed forward and another one is feedback. [5].

Genetic Algorithms: A GA provide a broad search method for machine learning methods and optimization. GA is started with a set of results selected population from one result are used to form a new population. The new result is selected compared to the old one [5].

Support Vector Machine: SVM used in the supervised machine learning algorithm. SVM can be used for both regression analysis and Classification. SVM plots data item as a n-dimensional space (n is number of feature available) with the value of each feature being the value of a particular coordinate. Advantage of SVM is the independent of feature space and classification precision is too high [6].

6. Proposed IDS

- Adaptive approach that is capable to detect new intrusions.
- Multi feature data fusion is the model cost factors associated to intrusion detection and to dynamically configure Intruder Detection components for better protection and cost performance.

Hybrid classifiers with auto correlation and multi feature set fusion that correlates (various sources of) review data and attack information

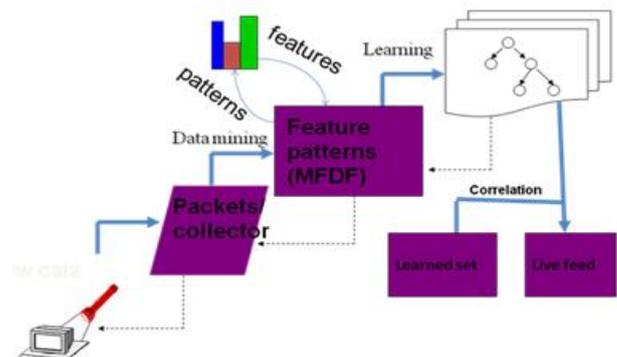


Fig. 6: Proposed Intruder Detection System.

The challenge for Proposed IDS is data fusion. It is to combine heterogeneous data from the acoustic system, electro mechanical system and others. Features extraction refers to data obtained from the various sensors subjected to feature extraction process. Auditor models have feature sets were all the aspects available in the system in the used. Data obtained from various resources is subjected to feature extraction process. It is the process of removing the redundant data and extracting informative data from large data sets. Learned sets and live feeds are correlated into the learning process.

7. Conclusion

We proposed a hybrid intruder detection technique, which is the combination of two different data mining methods. In this method,

detection of intruder is performed using more efficient techniques. The proposed approach provides better results compared to the other mining techniques considered for detection of attacks.

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