Using Support Vector Machine and Naive Bayes Classification for Intrusion Detection

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Abstract

For identifying the various attacks involved in a particular network, Intrusion Detection System is used. The role of Intrusion Detection System (IDS) is identified and prevent the malicious or un-authorized user to access the system. The data present on web or other data on the system or the data on a network of systems have many complicated and structural relations. To uniquely and properly identify the intrusion in a network it is necessary to understand the structural relationship between the data types and many algorithms based for clustering data neglect the relation among the individual data types. A defensive layer, or in other words the preventive layer is made between the data and data types by Intrusion Detection System; this ensures the unauthorized and unauthenticated users to have access for the system. These unauthorized users can be easily detected by sensing and sending a Alert Message, Operator to the Administrator. The Support Vector Machine and Naïve Bayes Classification are defined as the two techniques which can be used to create a valuable Intrusion Detection System. The proposed System accepts Fuzzy K-Means clustering algorithm which accepts either Support Vector Machine or Naïve Bayes Classifier to detect the malicious Users. The administrator would have the complete data set which will help out to detect the malicious users after complete scanning and authorization of user. If any type of user with different data sets trying to access system, then can be considered as a Intrusion Detection. In this paper we combine two of the efficient data mining algorithms and make a hybrid technique for the detection of intrusion called fuzzy k-means, Naïve Bayes Classification and Support vector machine.

Keywords: Intrusion Detection, Fuzzy K-Mean, SVM, Naïve Bayes Classification

I. INTRODUCTION

The intrusion or attack in the computer network is one of the most important issues creating problems for the network managers. However many countermeasures are taken for the security of the network but continuous growth of hackers requires to maintain the defending system up to data. This paper presents a K-means and support vector machine based intrusion detection system. The support vector machine is optimal partitioning based linear classifier and at least theoretically better other classifier also because only small numbers of classes required during classification SVM with one against one technique can be the best option and the K-means clustering filters the un-useful similar data points hence reduces the training time also hence provides an overall enhanced performance by reducing the training time while maintaining the accuracy. The proposed algorithm is tested using KDD99 dataset and results show the effectiveness of the algorithm. The paper also analysed the effect of different input parameters on classification accuracy.

II. INTRUSION DETECTION SYSTEM

INSTRUSION detection System monitors the violation of management and security policy and malicious activities in the computerized network [1]. The intrusion can be caused by inside (legal users), or outside (illegal users) in the system [2]. Nowadays recognition and prevention of intrusion is one of the most important mechanisms that provides security in networks and computer systems, and generally is used as a complemented security for firewalls [3]. IDS systems created as a software and hardware system that each one has its specific properties [1]. Hardware systems have been preferred to software system because of their speed and accuracy. But software systems are more common because of high compatibility with several operating systems [4]. James P. Anderson is known as a first person who propounded the investigation about registered events in the system in the field of security. Anderson demonstrated a report in 1980 which was the first activity about the recognition of intrusion [5, 6]. IDS generally have three main functions: monitoring and evaluation, detection and response [7].

Intrusion detection techniques are usually classified into misuse detection and anomaly detection. Anomaly detection focuses on detecting unusual activity patterns in the observed data. Misuse detection methods are intended to recognize known attack patterns.

III. INTRUSION DETECTION TECHNIQUES

Intrusion detection techniques are divided into two groups and there are several algorithms which are described for supervised and unsupervised learning

A. Supervised Learning Algorithms:

1) *k-Nearest Neighbour:*

The k-Nearest neighbour is a classical algorithm [8] that finds k examples in training data that are closest to the test example and assigns the most frequent label among these examples to the new example. The only free parameter is the size k of the neighbourhood.

2) *Multi-Layer Perceptron:*

Training of a multi-layer perceptron involves optimizing the weights for the activation function of neurons organized in network architecture. The global objective function is minimized using the RPROP algorithm [9]. The free parameter is the number of hidden neurons.

3) *Regularized Discriminant Analysis:*

Assuming both classes of examples are normally distributed, a Bayes-optimal separating surface is a hyperplane (LDA), if covariance matrices are the same, or a quadratic surface otherwise (QDA). A gradual morph between the two cases can be implemented by using a regularization parameter [10]. Another free parameter ¸ controls the addition of identity matrix to covariance matrices.

4) *Fisher Linear Discriminate:*

Fisher Linear Discriminate constructs a separating hyper plane using a direction that maximizes inter-class variance and minimized the intra-class variance for the projection of the training points on this direction [8]. The free parameter is the trade-off between the norm of the direction and the "strictness" of projection.

5) *Linear Programming Machine and Support Vector Machine:*

Linear Programming Machine (LPM) and Support Vector Machine (SVM) construct a hyper plane of the minimal norm which separates the two classes of training examples [11]. LPM uses the 1-norm, SVM uses the 2-norm. Furthermore, SVM apply a non-linear mapping to construct a hyper plane in a feature space. In our experiments, radial basis functions are used, their complexity controlled by the width parameter w. Another parameter C controls the trade-off between the norm of a hyper plane and the separation accuracy.

B. Unsupervised Learning Algorithms:

1) *k-Means Clustering:*

k-Means clustering is a classical clustering algorithm [8]. After an initial random assignment of example to k clusters, the centres of clusters are computed and the examples are assigned to the clusters with the closest centres. The process is repeated until the cluster centres do not significantly change. Once the cluster assignment is fixed, the mean distance of an example to cluster centres is used as the score. The free parameter is k.

2) *Single Linkage Clustering:*

Single linkage clustering [12] is similar to k-Means clustering except that the number of clusters is controlled by the distance parameter W: if the distance from an example to the nearest cluster center exceeds W a new cluster is set.

3) *Quarter-Sphere Support Vector Machine:*

The quarter-sphere SVM [13] is an anomaly detection method based on the idea of fitting a sphere onto the center of mass of data. An anomaly score is defined by the distance of a data point from the center of the sphere. Choosing a threshold for the attack scores determines the radius of the sphere enclosing normal data points.

IV. RELATED WORK

A. Evaluation of Fuzzy K-Means and K-Means Clustering Algorithms In Intrusion Detection Systems [14]:

According to the growth of the Internet technology, there is a need to develop strategies in order to maintain security of system. One of the most effective techniques is Intrusion Detection System (IDS). This system is created to make a complete security in a computerized system, in order to pass the Intrusion system through the firewall, antivirus and other security devices detect and deal with it. The Intrusion detection techniques are divided into two groups which includes supervised learning and unsupervised learning. Clustering which is commonly used to detect possible attacks is one of the branches of unsupervised learning. Fuzzy sets play an important role to reduce spurious alarms and Intrusion detection, which have uncertain quality. This paper investigates k-means fuzzy and k-means algorithm in order to recognize Intrusion detection in system which both of the algorithms use clustering method.

B. An Improved Techniques Based on Naive Bayesian for Attack Detection [15]:

With the enormous growth of computer networks and the huge increase in the number of applications that rely on it, network security is gaining increasing importance. Moreover, almost all computer systems suffer from security vulnerabilities which are both technically difficult and economically costly to be solved by the manufacturers. Therefore, the role of Intrusion Detection Systems (IDSs), as special-purpose devices to detect anomalies and attacks in a network, is becoming more important. The naive Bayesian Classification is use for intrusion detection system. One of the most important deficiencies in the KDD99 data set is the huge number of redundant records, which causes the learning algorithms to be biased towards the frequent records, and thus prevent them from learning infrequent records, which are usually more harmful to networks such as U2R and R2L attacks. NSL KDD data set have less redundant record .

C. Data Mining for Network Intrusion Detection [16]:

This paper gives an overview of our research in building rare class prediction models for identifying known intrusions and their variations and anomaly/outlier detection schemes for detecting novel attacks whose nature is unknown. Experimental results on the KDDCup'99 data set have demonstrated that our rare class predictive models are much more efficient in the detection of intrusive behavior than standard classification techniques. Experimental results on the DARPA 1998 data set, as well as on live network traffic at the University of Minnesota, show that the new techniques show great promise in detecting novel intrusions. In particular, during the past few months our techniques have been successful in automatically identifying several novel intrusions that could not be detected using state-of-the-art tools such as SNORT. In fact, many of these have been on the CERT/CC list of recent advisories and incident notes.

D. Intrusion Detection based on Boosting and Naïve Bayesian Classifier [17]:

In this paper, we introduce a new learning algorithm for adaptive intrusion detection using boosting and naïve Bayesian classifier, which considers a series of classifiers and combines the votes of each individual classifier for classifying an unknown or known example. The proposed algorithm generates the probability set for each round using naïve Bayesian classifier and updates the weights of training examples based on the misclassification error rate that produced by the training examples in each round.

E. Network Intrusion Detection using Tree Augmented Naive-Bayes [18]:

Computer networks are nowadays subject to an increasing number of attacks. Intrusion Detection Systems (IDS) are designed to protect them by identifying malicious behaviours or improper uses. Since the scope is different in each case (register already-known menaces to later recognize them or model legitimate uses to trigger when a variation is detected), IDS have failed so far to respond against both kind of attacks. In this paper, we apply two of the ancient data mining algorithms called Naive Bayes and tree augmented Naive Bayes for network intrusion detection and compares them with decision tree and support vector machine. We present experimental results on NSL-KDD data set and then observe that our intrusion detection system has higher detection rate and lower false positive rate.

F. Hybrid Approach using Fuzzy K means, Naïve Bayes Classification and Support vector machine:

Combining two data mining technique called Fuzzy K-means and Support vector machine or Fuzzy K means and Naïve Bayes Classification makes a new technology which can be used to detect and classify the intruders in a particular network. This form hybrid technique. We are combining this technique because the existing rules are the knowledge from experts knowledge or other system. The different methods will measure different aspects of intrusions.

G. Support Vector Machine:

For the purpose of Binary Classification a new learning methodology was introduced known as Support Vector Machine. SVM belongs to the group of supervised learning methodology. SVM's can be used to create a hyper-plane which can easily classify the two data classify belong to each other group.

V. CONCLUSION

In this thesis we reviewed a method for classification of intruder in system Intrusion detection is the major task in networking. There are so many solution provided by the researchers for detection of intruder in the network. Like Pattern Matching, Measure Based method, Data Mining method and Machine Learning Method.

Here we detected intrusion through data mining method by combining two data mining technique fuzzy K means and Support Vector machine classification or fuzzy k means and Naïve bayes classification and formed a hybrid technique.

These different methods can be combined together to find the different set of classes across the system and any intrusion and can help to detect any intrusion or error in a network. Combined these rules find the intruder attack more quickly from the exiting one.

VI. FUTURE ASPECT

In future, an association rule based approach or IF-THEN rules could be effective in classified the traffic in different classes. However accuracy of the algorithms plays an important role to correctly cluster the datasets. Standalone algorithms may not be able to provide efficient results. An another hybrid approach to data clustering can also be applied for analysis and to obtain low inter-cluster similarity.

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