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Fraud Detection using Supervised Learning Algorithms

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Abstract: Now a days due to de-monetization everyone had started using credit cards for different types of transactions. So there will be a more chances for occurring fraud. Banks have many and enormous databases. Important business information can be extracted from these data stores. Fraud is an issue with far reaching consequences in the backing industry, government, corporate sectors and for ordinary consumers. Increasing dependence on new technologies such as cloud and mobile computing in recent years has encountered the problem. Physical detections are not only time consuming they are costly and they don't give accurate results. Not surprisingly economic institutions have turned to automated process using numerical and computational methods. Traditional approaches relied on manual techniques such as auditing, which are inefficient and unreliable due to the difficulty of the problem. Data mining-based approaches have been shown to be useful because of their ability to identify small anomalies in large data sets. So we have used some of the supervised algorithms to detect the fraud which gives accurate results. There are many different types of fraud, as well as a variety of data mining methods, and research is continually being undertaken to find the best approach for each case. Financial fraud is a term with various potential meanings, but for our purposes it can be defined as the on purpose use of illegal methods or practices for the purpose of obtaining financial gain . Fraud has a large negative impact on business and society credit card fraud alone accounts for billions of dollars of lost revenue each year.

Keywords: Fraud detection, Financial fraud, Decision tree.

I. INTRODUCTION

Fraud refers to the abuse of a profit organization's system without necessarily leading to direct legal concerns. Fraud is an universal act in order to deceive another person or organization for financial benefits. Credit card fraud detection is the process of identify those transactions that are false into two classes of lawful and fake transactions. These kind of frauds can be broadly classified into three categories that is traditional card related frauds and internet frauds .The fraud which is committed by individuals exterior to the organization is called as customer fraud or external fraud where when a fraud is committed by top-level management is known as management fraud or internal fraud. Fraud detection being part of all the overall fraud control, automates and helps reduce the manual parts of a screening process. Credit card fraud is an unauthorized account activity by a person for which the account is not proposed. It is also defined as when an individual uses another individual credit card for personal reasons while the owner of the card and the card issuer are not aware of the fact that the card being used. And the persons using the card has not at all having the piecing together with the card holder or the issuer has no objective of making the repayments for the purchase they done. It involves identifying fraud as quickly as possible once it has been performed. Fraud detection methods are continuously developed to define offenders in familiarizing their strategies. Data mining refers to extract or mining knowledge from large amount of data. Data mining is associated with (a)supervised learning based on training data of known fraud and genuine cases and (b)unsupervised learning with data that are not labeled to be fraud or rightful. Data mining is a process that uses a variety of data analysis tools to discover patterns and relationships in data that may be used to make a valid forecast. The six basic steps of data mining process are defining the problem, preparing data, Exploring data, Building models, explore and validate models, deploying and update models. The improvement of new fraud detection methods is made more difficult due to the severe limitation of the exchange of ideas in fraud detection. The best cost effective option is to tease out possible suggestions of fraud from the available data using mathematical scientific algorithms. Fraud not only causes unbelievable financial losses but also purchases the organization by many steps backwards in this cut-throat competitive world. Commercial fraud is an systematized crime. It encompasses various types of crimes and unlawful activities such as identity theft, asset misappropriation and many more. In present consequence, implementing effective fraud prevention methods at first place and detection technique in case of failure of preventive measures is no more a competitive advantage but a reason that ensures the survival of the fittest and the chances of fraud may be reduced to a level by trying the accuracy of intention and acceptability of financial transactions which is impossible. Data mining is a process of extracting knowledge by learning patterns from the available data has been widely used for developing fraud detection systems. Data mining is defined as identifying the exciting patterns from the data stored in large databases in such a way that the statistics are reliable and actionable. It is

also defined as a process that uses mathematical, statistical, artificial intelligence and machine learning techniques to extract and identify useful information and gain knowledge from large databases. Choosing a task relevant attribute from large datasets is one of the difficult task for designing fraud detection systems.

II. LITERATURE SURVEY

[**Jarrod West, Maumita Bhattacharya]"Intelligent Financial fraud detection"**
This author explains about different intelligent approaches to fraud detection which are both statistical and computational though the performance was differed each technique was shown to be reasonably capable at detecting various forms of financial fraud. The ability of the computational methods such as neural networks and support vector machines to learn and adapt to many new techniques is highly effective to the evolving of tactic fraudsters. Initial fraud detection studies focused heavily on statistical models such as logistic regression, as well as neural networks. Neural networks are used for financial applications such as forecasting. Neural network are well established history with fraud detection. But they require high computational power for training and operation, making it unsuitable for real-time function. Potential for over fitting if training set is not a good representation of the problem domain, so requires constant retraining to adapt to new methods of fraud. In this paper the author says about the different kinds of frauds i.e., insurance fraud , mortgage fraud , health insurance fraud , telecommunication fraud , credit card fraud. Different techniques have been defined for different kinds of frauds defining the parameters like entropy, sensitivity and comparing the efficiency of the different kinds of algorithms and representing them in a graphical representation.

[Rasa kanapickiene, Zivile Grundiene] "The model of fraud detection by means of financial ratios"
This author explains about how financial ratios are analysed in order to determine the most fraud-sensitive ratios of financial statements with regard to company managers' and employees' motivation to commit fraud. It was found out that in most cases fraud is committed to show that the company keeps growing and to fulfill obligation conditions. Literary sources offer a wide range of such ratios. Theoretical analysis showed that profitability, liquidity, activity and structure ratios are analyzed most often. Theoretical survey revealed that, in scientific literature, financial ratios are analyzed in order to designate which ratios of the financial statements are the most sensitive in relation with the motifs of executive managers and employees of companies to commit frauds. The logistic regression model of fraud detection in financial statements has been developed.

[Fletcher H. Glancy, Surya B. Yadav] "A computational model for financial reporting fraud detection"
This author explains that the computational fraud detection model is possible to detect financial exposure fraud from the text of annual filings with the Security and Exchange Commission. The model is generalizable because it specifies automatable steps that can be adapted to other domains and genres. A potential application for CFDM is to screen companies for investigation of potential fraud by the SEC (Security and exchange commission). Additional potential applications include financier analysis, e-mail spam detection, and business intelligence validation. A computational fraud detection model (CFDM) was proposed for detecting fraud in financial reporting. CFDM uses a quantitative approach on textual data. It incorporates techniques that use essentially all of information contained in the textual data for fraud detection. Extant work provides a foundation for detecting deception in high and low synchronicity computer-mediated communication (CMC). CFDM provides an analytical method that has the potential for automation. It was tested on the Management's Discussion and Analysis from 10-K filings and was able to distinguish fraudulent filings from non-fraudulent ones. CFDM can serve as a screening tool where deception is suspected.

Siddhartha Battacharya, Sanjeev jha , Kurian Thanakunnel, J Christopher Westland: Data Mining for credit card fraud:
This author says that with the growth in credit card transactions, as a share of the payment system ,there has also been increase in the credit card fraud and most of the U.S consumers are noted to be significantly concerned about identity fraud. While predictive models for credit card fraud detection are in active in use practice, reported studies on the use of web data mining approaches for credit card fraud detection are relatively few, possibly due to the lack of available data for research. In this paper the author evaluates two advanced data mining approaches , support vector machines and random forests. Together with well known logistic regression as part of an attempt to better detect credit card fraud. In this paper the Statistical fraud detection methods have been divided in to two broad categories: supervised and unsupervised. In supervised fraud detection methods , models are estimated based on the samples of fraudulent and legitimate transactions to classify new transactions as fraudulent or legitimate. In unsupervised fraud detection, outliers or unusual transactions are identified as potential cases of fraudulent transactions. Both thee fraud detection methods predict the probability of fraud in any given transaction. Predictive models for credit card fraud detection are in active use. Other techniques reported for credit card fraud detection include case based reasoning and hidden Markov models. Support vector machines and random forests are sophisticated data mining techniques which have been noted in recent years to show superior performance across different applications. The choice of these two

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techniques together with the logistic regression is based on their accessibility for practitioners and noted performance advantages.

III. RELATED WORK

Financial fraud detection is an evolving field in which it is desirable to stay ahead of the perpetrators. Additionally, it is evident that there are still facets of intelligent fraud detection that have not been investigated. Survey of fraud detection says that there are different types of frauds and there are different computational methods for detecting the financial frauds done by the fraudsters. Different computational methods have been stated for detecting the fraud by computing various parameters for each kind of algorithm and the computing time representing with graphical view. They had taken the different datasets german credit card dataset and from different countries like china also from the available datasets they had developed computational methods for detecting the fraud and stating which algorithm is accurate. In existing system fraud detection is done using ID3 and support vector machine algorithms and a survey stating the percent of fraud happened and defining different parameters and comparing different parameters for the algorithms. Fraud detection is an important part of the modern finance industry. The system which i had proposed is fraud detection using supervised learning algorithms that is decision tree learning algorithm and Navie bayes classifier and comparing these two algorithms with the building time acquired by these two learning algorithms. Though their performance differed, each technique was shown to be reasonably capable at detecting various forms of financial fraud. In particular, the ability of the computational methods such as Decision trees and Bayesian classifier to learn and adapt to new techniques is highly effective to the evolving tactics of fraudsters. With the available dataset we can classify whether the user is good or bad that mean whether he will be able to repay the loan or not if he is a good user it is represented with the positive count and if the user is bad the value is represented as negative count and from these values we can calculate the sensitivity and efficiency and represent them in a graphical representation.

IV.TYPES OF FRAUDS

There are different types of frauds they are: credit card fraud, financial fraud, mortgage fraud, insurance fraud , telecommunication fraud.

Credit card fraud:
This fraud is defined as the method of purchasing and marketing goods without having money. It is a small plastic card to provide the credit service to the customer. Now a days credit card plays a important role in automated business and online money transaction area which is increasing every year. With the growth of usage of the credit card, fraudsters are finding more opportunities to commit the fraud which causes huge loss to cardholders and banks. Credit card fraud is classified in to two two types:

- **Offline credit card fraud:**

This kind of fraud is done physically which means the plastic card is stolen by fraudsters and using the card in stocks or supplies or stores or for different purposes as an actual owner. It is an unusual type of fraud because financial organizations will immediately block the card immediately when the card holders report about the theft.

- **Online credit card fraud:**

This kind of fraud is popular and it is very dangerous, the credit card's information is stolen by the fraudsters to be used in future online transactions by internet or by phone. This kind of fraud is also called as "cardholder not existing" fraud. The card holders can be obtained by the fraudsters through the skimming, phishing or credit card generators.
There is another classification for credit card fraud they are application fraud and behavioral fraud. This classification is based on fraudster's strategy on compelling the fraud. Application fraud occurs when the user enters any wrong evidence and wrong details in to the presentation for opening a new credit card. Fraudsters may use other persons information to obtain credit cards or get their new credit cards by using false information with the intention of the never repaying the purchases. Behavioral fraud occurs when fraudsters obtain credit card holder details to use them later for sales which are made on a cardholder present basis.

V.SUPERVISED LEARNING ALGORITHMS

Supervised learning algorithms are defined as the desired output is known for the input provided in these kind of algorithms we have an input and the desired output is known and we need to map a function for these values . In these supervised learning algorithms predictions are made on the known training dataset and it will be accurate. These learning algorithms are further grouped into regression and classification problems. The Supervised learning algorithms uses a supervised training data where it contains supervised examples. The supervised learning algorithm analyzes the training dataset and produces an classifier. For this initially we need to collect the accurate training dataset and we need to find the accuracy of the function. It is the machine learning task of inferring a function from supervised training

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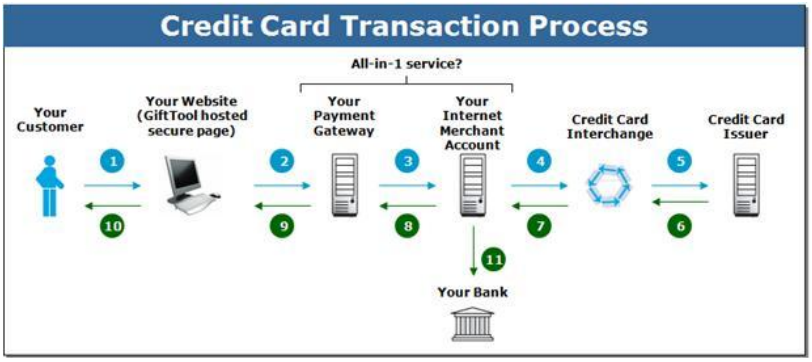
data. The training data consists of training examples. In supervised learning , each example is a pair consisting of an input object and a desired output value.. a supervised learning algorithm.



Introduction to decision tree algorithm:
To find an optimal way to classify the learning set initially we need to minimize the depth of the tree. To minimize the tree we need some function information gain. In order to define information gain precisely we need to calculate entropy first.

Entropy:
Without loss of generality, that the resulting decision tree classifies instances into two categories, we'll call them P(positive)and N(negative).
Given a set S, containing these positive and negative targets, the entropy of S related to this boolean classification is:
Entropy(S)=
- P(positive)log2P(positive) - P(negative)log2P(negative)
P(positive): proportion of positive examples in S
P(negative): proportion of negative examples in S
Information gain:
To minimize the decision tree depth, when we traverse the tree path, we need to select the optimal attribute for splitting the tree node, which we can easily imply that the attribute with the most entropy reduction is the best choice. We define information gain as the expected reduction of entropy related to specified attribute when splitting a decision tree node.
The information gain, Gain(S,A) of an attribute A,
Gain(S,A)= Entropy(S) - Sum for v from 1 to n of (|Sv|/|S|) * Entropy(Sv)
The intention of this ordering is:
1. To create small decision trees so that records can be identified after only a few decision tree splitting.
2. To match a hoped for minimalism of the process of decision making

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Maximum(Gain(S,A)). Create child nodes of this rootNode and add to
rootNode in the decision tree.
For each child of the rootNode, apply ID3(S,A,V) recursively until reach node that has entropy=0 or reach leaf node.
End ID3.

Naïve bayes classifier:
Introduction to Bayesian Classification The Bayesian Classification represents a supervised learning method as well as a statistical method for classification. Assumes an underlying probabilistic model and it allows us to capture uncertainty about the model in a principled way by determining probabilities of the outcomes. It can solve diagnostic and predictive problems. This Classification is named after Thomas Bayes (1702-1761), who proposed the Bayes Theorem. Bayesian classification provides practical learning algorithms and prior knowledge and observed data can be combined. Bayesian

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Classification provides a useful perspective for understanding and evaluating many learning algorithms. It calculates explicit probabilities for hypothesis and it is robust to noise in input data.

Uses of Naive Bayes classification:
1. Naive Bayes text classification The Bayesian classification is used as a probabilistic learning method (Naive Bayes text classification). Naive Bayes classifiers are among the most successful known algorithms for learning to classify text documents.
2. **Spam filtering**: Spam filtering is the best known use of Naive Bayesian text classification. It makes use of a naive Bayes classifier to identify spam e-mail. Bayesian spam filtering has become a popular mechanism to distinguish illegitimate spam email from legitimate email (sometimes called "ham" or "bacn").[4] Many modern mail clients implement Bayesian spam filtering. Users can also install separate email filtering programs. Server-side email filters, such as DSPAM, Spam Assassin, Spam Bayes, Bogofilter and ASSP, make use of Bayesian spam filtering techniques, and the functionality is sometimes embedded within mail server software itself. 3. Hybrid Recommender System Using Naive Bayes Classifier and Collaborative Filtering (http://eprints.ecs.soton.ac.uk/18483/) Recommender Systems apply machine learning and data mining techniques for filtering unseen information and can predict whether a user would like a given resource. It is proposed a unique switching hybrid recommendation approach by combining a Naive Bayes classification approach with the collaborative filtering. Experimental results on two different data sets, show that the proposed algorithm is scalable and provide better performance–in terms of accuracy and coverage–than other algorithms while at the same time eliminates some recorded problems with the recommender systems.

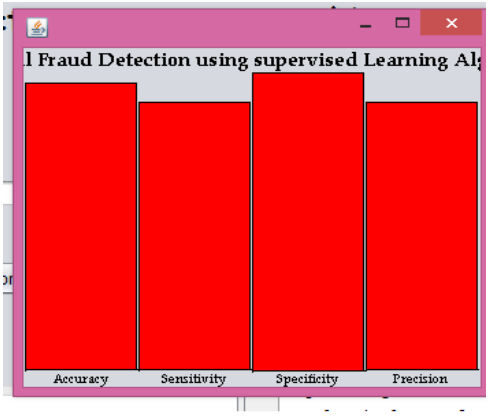

Fig 1.Bar Chart for accuracy measures

VI. CONCLUSION

Credit card fraud has become more and more rampant in recent years. To improve merchants' risk management level in an automatic and effective way, building an accurate and easy handling credit card risk monitoring system is one of the key tasks for the merchant banks. One aim of this study is to identify the user model that best identifies fraud cases. There are many ways of detection of credit card fraud. If one of these or combination of algorithm is applied into bank credit card fraud detection system, the probability of fraud transactions can be predicted soon after credit card transactions by the banks. And a series of anti-fraud strategies can be adopted to prevent banks from great losses before and reduce risks. This paper gives contribution towards the credit card fraud detection using the supervised learning algorithms.

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