

Survey on Q-learning algorithm for credit card fraud detection.

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Abstract:

Financial fraud is an ever growing threat with way consequences within the economic business. Now-a-days the uses of electronic transactions are increasing because they are easy and time saving for customers. Individual cards have its unique identification information which give services to the user and will be paid according to their use. German Credit Data is one of the most famous datasets in the realm of fraud detection and it is available in two formats that is categorical attribute and numerical attribute. Increased in number of credit card transactions opens the door for thieves to steal credit card details and commit fraud. Thieves steal the account of users which includes the card account number or other information that would be necessarily available to a merchant during legitimate transactions. To overcome this situation we are using Q- learning algorithm which is an off policy reinforcement learning algorithm. It's considered off-policy because the Q- learning function learns from actions that are outside the current policy like taking random actions and therefore a policy isn't needed. The 'Q' in Q-learning algorithm stands for the quality that is applied on the raw and pre- processed knowledge of data. This paper describes the existing application related to credit card fraud detection.

Keywords: *Fraudulent transaction, Reinforcement learning algorithm, Q learning, Fraud detection, Fraud prevention.*

I. Introduction:

In today's world, online shopping has become an integral part of our life. Now a days the use of electronic transaction are increasing because they are easy and time saving for customers. As card payment becomes the most prevailing mode of payment for both online as well as regular purchase, frauds related with it are also accelerating. A credit card is payment card issued to users to enable the cardholder to pay a merchant for goods and services based on the cardholder's promise to the card issuer to pay them for the amounts and another agreed charges. Individual cards has its unique identification information which give services to the user and will be paid according to use[6].

As increased in number of credit card transactions open the door for thieves to steal credit card details and commit fraud. Credit card begins with the theft of the physical card or with the compromise of data associated with the account including the card account number or other information that would necessarily be available to a merchants during legitimate transactions. There are many techniques which are used for detecting the frauds during credit card transactions such as Decision Tree, Genetic Algorithm, Neural Network, Outlier Analysis and logistic regression. In this techniques work detection is done based on time analysis and pattern analysis, which had a lot of drawbacks. The time analysis is sequence of well-defined data points measured at the consistent time interval over the period of time. The pattern analysis is used to transform the given data set into particular pattern.[12]The various existing applications related to credit card fraud detection has been discussed in section II.

II. Literature Survey:

[1]Domingos Bruno, et.al Describes Decision Tree technique that sorts the information into branch-like fragments that manufacture an altered tree with a root hub, inward hubs, and leaf hubs. Decision tree is easy to understand and implemented. Decision tree is a calculation that uses a tree like diagram or model of choices what's more, their potential results to foresee a ultimate conclusion this calculation employments restrictive Explanation. Decision tree is also called as choice tree which uses the graph or model to predict the final output. For inductive Decision learning these sorts of calculations are well-known and have been effectively connected to abroad scope of assignments. The general rule used in decision tree is ' If condition 1 and condition 2 but not condition 3 then outcome' .The main disadvantage of decision tree is that they are unstable, meaning that a small change in the data can leads to large change in the structure of optimal decision tree.

Navanshu Khare et al.[2] describes Logistic Regression which is a directed characterization technique that profits the likelihood of double ward variable that is anticipated from the free variable of dataset that is strategic relapse anticipate the likelihood of an result which has two qualities either zero or one, yes or no and false or genuine. The function of logistic regression works as a Stepwise selections of the variables and the corresponding coefficients are accordingly computed. The advantage of Logistic regression over the decision tree is that it is intrinsically simple, it has low variance and so is less prone to over-fitting. There are numerous kinds of calculated regression model such as double strategic model, different strategic model, binomial calculated models. Paired Logistic Regression model is used to gauge the likelihood of a double reaction dependent on at least one indicators. The logistic regression is not a useful tool unless you have already identified all the important independent variables.

Carneiro E.M., et al. describes Neural system[3] based representation identification depends absolutely on the human mind working head. Neural system innovation has made a computer fit for the think. As human mind learn through past involvement and utilize its information or involvement in settling on the choice in day by day life issue the same procedure is connected with the credit card misrepresentation recognition innovation called as neural network. The Neural Network technique can work for organized, unstructured, and envisioned datasets.. The greater computational burden, proneness to over fitting, and the empirical nature of model development is the main drawbacks of neural network. Its concealed layers do fitting component changes of envisioned datasets. Thus, the Neural Network method has a distinct advantage over the Linear Regression method in cases of pictured datasets.

Daniel Garner,et al.[4]describes Genetic Algorithm which is an enhancement strategy that attempt to recreate common development forms. genetic algorithm is also called as Hereditary Algorithm. The Genetic pool of a particular population for a given issue possibly contains the arrangement, or a superior arrangement that means it will give a solution or a better solution to a given problem. This is the essential thought behind the genetic calculation. The main goal of Artificial Genetic Algorithm is to improved the solution to a problem.. This improvement is completed by keeping the best mix of information factors. It streamlines the issue definition and furthermore creates a goal work that is the method for figuring out which person produces the best result. There are Three Different operations which are carried out by the genetic algorithm which are as follow:

- A. Selection: It is the survival of the fittest and the inclination is constantly given to better results.
- B. Mutation: It depends on attempting arbitrary mixes what's more, assessing the outcome (achievement or disappointment) of the result.

C. Crossover: It is finished by joining parts of good results in the desire for making a surprisingly better result.

Aishwarya Kaneri, et al.[5] describes Outlier analysis systems which are connected to recognize false Master card utilization. Distinguishing fake charge card utilization is like recognize an anomaly. The information comprises of a few measurements, for example, client id, sum spent, and time between continuous card utilizations, etc. whenever we are dealing with large data set the outlier analysis is efficiently used. The fraud are reflected in value-based records and relate to high installment, buy of things that was never acquired by client, high rate of procurement and so on.

Xueton Xuetong Niu, et al.[6] describes the dataset and preprocessing approach which is used the dataset contains numerical input variables which are from a PCA transformation due to confidentiality issue. For the non-numerical features of “Time” and “Amount”, we normalize them by using Robust Scalar which scales the data according to the quantile range. Specifically for the supervised learning models, to tackle the heavily unbalanced problem, random down sampling is used to avoid the bias results toward the non-fraudulent class.

Kaithekuzhical Leena Kurien¹ and et al. describes the two techniques Logistic Regression and Random Forest classifier[7] are used. Logistic Regression classifier was selected as it is used for predictive analysis and it is used to describe data independent variables. Random Forest classifier is an ensemble of random decision trees. Random Forest achieved better results than decision trees. Its default hyper parameter settings produces good prediction results. The main trees in forest the algorithm is slow.

Nator junior carvahlllo da costa and et al. describes A naïve bayes classifier[8] which is basic probabilistic classifier dependent on the bayes hypothesis. Bayesian system can process the restrictive likelihood of a hub dependent on given qualities allotted to different hubs. There are a few points of interest of Bayesian Network, for example, the capacity to deal with fragmented information sources, the learning of causal relationship, etc. The explanations for the making of such model is the capacity of kid hubs to work autonomously without hindering other kid hubs and especially impact the likelihood of root hub.

Hamzath Ali Shukur, et al. describes two techniques Information mining and machine learning[9] which are famous techniques to study and battle the Visa misrepresentation cases. There is countless investigations that misused the quality of information mining and AI to avert the Visa false exercises. In view of Self-Organizing Map and Neural Network, the investigation of got Receiver Operating Curve (ROC) over 95.00% of extortion cases without false cautions rate. There are Different modern procedures dependent on Machine learning, Artificial Intelligence, and this has been developed is as yet advancing to recognize fraudulent in credit card.

Summary Table of Algorithm:

<i>Algorithm</i>	<i>Accuracy</i>	<i>Advantages</i>	<i>Disadvantages</i>	<i>Related to Database</i>
Dataset preprocessing [6](April 2019)	68%	- It works on time and amount analysis. - It uses down sampling due to this same amount of fraud transaction reduced.	- Large amount of dataset required. - Trained classifier is required.	It works on all types of data.
Supervised& Unsupervised [9] (April 2019)	80%	Utilize the suspicion that fake examples can be gained from an investigation of past exchanges.	- Supervised method can be complex compared to unsupervised. - Unsupervised gives the less accuracy.	Easily work on assorted database
Random Forest [7] (March 2019)	75%	- It assembles random decision trees. - Hyper parameter settings produces good prediction results.	Due to multiple trees in forest the algorithm is slow.	Easily work on large databases.
Decision tree[1] (December 2018)	52%	- This algorithm is useful for inductive learning. - This method follows the scoring process.	- They are unstable - a small change in data can leads to large change in the data can leads to large change in structure.	Can deal with huge informational collections.
Naïve Bayes [8](December 2018)	70%	High processing and detection speed/high accuracy.	Excessive training need / expensive.	It is good if dataset has plenty of input but small number of records.
Outlier analysis[5] (March 2018)	78%	- Using less memory. - Computation is required. - Works fast and well on online large datasets.	It can handle thousands of input variables without variable deletion.	Good in large datasets.
Logistic Regression[2] (November 2018)	54.86%	- This algorithm gives simple formula for classification. - Work better on linear dataset.	- Not preferable on non-linear data - It is not capable of handling fraud detection at the time of transaction	- This algorithm wants dependent and independent attributes. - This algorithm return values between 0 & 1.
Neural Network [3](March 2018)	65%	Pictured datasets.	- Greater computational burden. - Appropriate feature conversions of pictured datasets	Work for structured, unstructured, and pictured datasets.

Genetic algorithm[4] (May 2017)	60%	• It streamlines the issue definition. • Creates the goal work.	• Does not find the most optimal solution. • Hard to choose parameters.	• Easily work on complex database.
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This table describes that the accuracy advantages and disadvantages of above algorithm. There are two types of accuracy the initial one is training accuracy in which the number of entries trained and tested come from the same source. The another one is testing accuracy.

In testing accuracy, the number of entries trained and tested come from the different sources (which reduces accuracy, and is the actual accuracy of the system).

The existing algorithm like Naive Bayes shows 97% accuracy, but that is only for training, and it has a testing accuracy of 70%. These algorithms have large processing delays. To reduce delay Q learning algorithm which is machine learning algorithm is proposed. formally shows a result in the form of 0 and 1 classes. The 0 class shows the normal transactions and the another class which is 1 shows fraud transactions. By using these two classes of dataset we can easily identify a fraud in credit card transaction.

For detecting fraud which occurs during credit card transaction we require a technique. So we are implementing a Q learning algorithm for detection of fraud and also for prevention of fraud by improving its accuracy and by reducing time delay.

Discussion:

Q-learning is an off policy reinforcement learning algorithm that seeks to find the best action to take given the current state. It's considered off-policy because the Q-learning function learns from actions that are outside the current policy, like taking random actions, and therefore a policy isn't needed. More specifically, Q-learning seeks to be told a policy that maximizes the entire reward.[11]

Data set is an accumulation of related arrangements of data that is made out of independent components however can be controlled as a unit by a computer. An informational collection is sorted out into some kind of information structure. Factor example ,In a database, for instance, an informational index may contain a gathering of business information (names, pay rates, contact data, marketing projections, etc). The database itself can be viewed as an informational collection, as can assemblages of information inside it identified with a specific sort of data, for example, deals information for a specific corporate division[1]. The dataset contains formally 2 factors in credit card fraud detection which are time and amount of transactions. The dataset formally shows a result in the form of 0 and 1 classes. The 0 class shows the normal transactions and the another class which is 1 shows fraud transactions. By using these two classes of dataset we can easily identify a fraud in credit card transaction. For detecting fraud which occurs during credit card transaction we require a technique. So we are implementing a Q learning algorithm for detection of fraud and also for prevention of fraud by improving its accuracy and by reducing time delay.

Conclusion:

Financial Fraud is one of the major factor that must be taken care. In this paper, the various existing application and algorithm needed to detect credit card frauds has been discussed.

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