University of Science and Technology of Hanoi

Bachelor's Thesis in Information and Communication Technology

Application of Machine Learning in Credit Card Fraud Detection

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Abstract

Credit card fraud is an [sth] problem in the financial world. The number of fraudulent transactions is expected to increase due to the recent trend of using non-cash payments. However, using machines to detect credit card fraud is not an easy task since the available datasets for this problem are highly imbalance i.e. the number of genuine cases greatly outnumber the fraudulent cases, which makes process of training a classification models harder and create inaccurate models.

In order to tackle this problem, our project suggests different techniques to resample the dataset, such as, undersampling, oversampling and hybrid strategy, which is a combination of both undersampling and oversampling. These techniques are implemented with different predictive models like Logistic Regression, Random Forest and XGBoost. Each combination between a resampling method and model is evaluated based on precision, recall, f1-score, precision-recall (PR) curve and receiver operating characteristics (ROC) curve.

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1 Introduction

1.1 Credit Card Fraud Detection

1.2 Aim of the project

In this project, our main objective is to explore different techniques to deal with an imbalanced dataset and evaluate them to see which method performs better than the others. More specifically, this project focuses on handling a credit card transaction dataset to build model to detect fraudulent transaction by using different sampling methods along with various models. After that we chose the most well-performed model based on a range of evaluation metrics.

1.3 Overview

This section provides an overall overview of the content entailed in each section. In section 2, we discuss relevant literature in the current field of research, focusing on the methods to build a credit card fraud detection model. Section 3 presents the methodology including the data processing steps, tools and libraries used, as well as the training of the model. In Seciton 4, we describe model's evaluation metrics - precision, recall, f1-score, PR curve, ROC curve and provide a detailed discussion on the results of our project. The final section 5 presents a brief conclusion of our project.

2 Literature Review

3 Methodology

3.1 Dataset Description

For this project, we used a dataset consists of transactions made by credit cards in two days in September 2013 by European cardholders which was collected by the Machine Learning Group of Université Libre de Bruxelles (ULB) and was published on Kaggle*. The dataset is contains a total of 284,807 transactions in total, in which only 492 are fraudulent. The dataset is considered to be highly skewed as the positive class (frauds) only accounts for 0.172% of the dataset. Figure 1 visualizes the class distribution of the dataset.

The dataset only contains numerical values as a result of Principal Components Analysis (PCA) transformation. Due to confidentiality issue, most of original attributes was not revealed. There are total 30 features, 28 of which was generated by PCA. The only features that was not transformed are '*Time*' and '*Amount*' Feature 'Class' is the target attribute and it takes value 1 in case of fraud and 0 otherwise. Table 1 gives a detailed description about the dataset's attributes.

Attribute	**Type**	**Description**
Time	Integer	Time elapsed between each transaction and the first transaction
V1	Double	First PCA component
V2	Double	Second PCA component
...	...	...
V28	Double	Last PCA component
Amount	Double	Transaction amount
Class	Integer	Target class (0 = Genuine and 1 = Fraud)

Table 1: Dataset Attribute Description

*https://www.kaggle.com/mlg-ulb/creditcardfraud

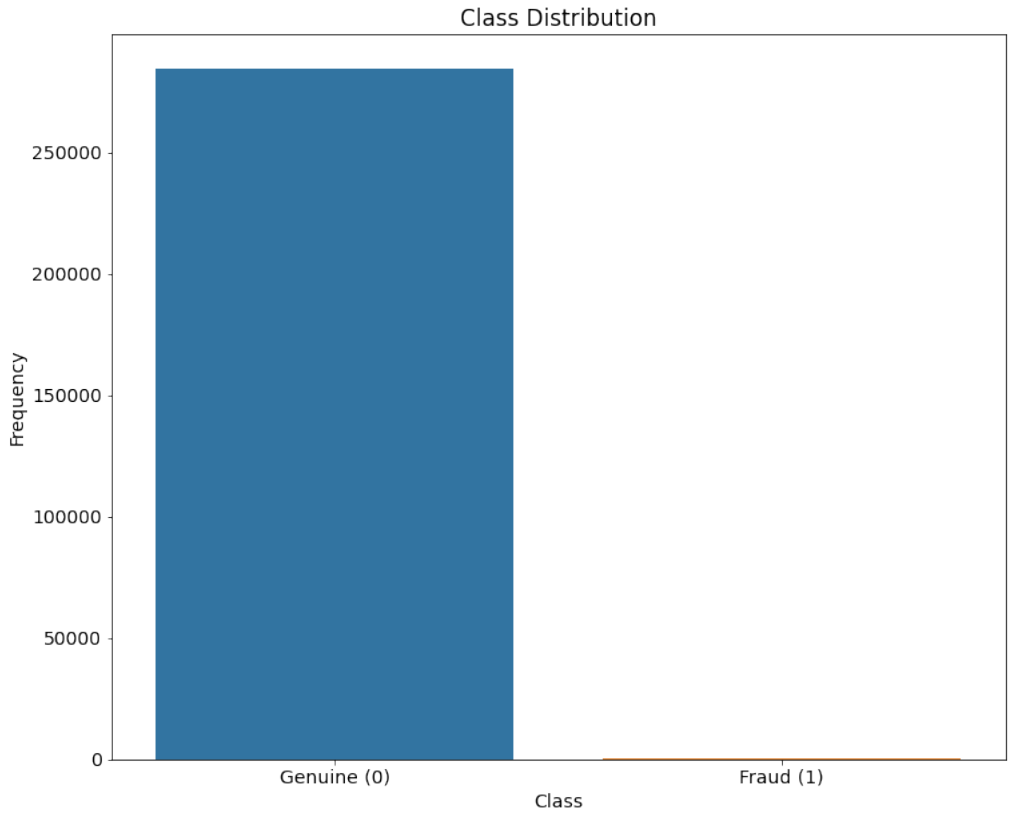

Figure 1: Dataset Class Distribution

4 Results

4.1 Evaluation Metric

4.2 Performance

4.3 Discussion

Overall, the models we chose achieved our main criteria, real time detection and high accuracy. Both YOLOv4 and YOLOv5 perform similarly, with the average precision on unknown test data achieving 0.75. This result means the system should perform accurately and reliably.

4.3.1 Difficulties

5 Conclusion

6 References