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Leveraging Change Point Detection for Enhanced Credit Card Fraud Detection

A dissertation by

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April 2025

Submitted in partial fulfillment of requirements for the

BEng (Hons) Software Engineering degree at the University of Westminster

ABSTRACT

Credit card fraud represents a trend within the financial sector that creates tremendous monetary loss and lost consumer confidence. Traditional fraud detection methods, founded on static models and predefined rules, have difficulty keeping pace with the ever-changing fraudsters' strategies and therefore generate excessive numbers of false positives and let through fraudulent transactions. This project mitigates these limitations by applying Change Point Detection (CPD) techniques to identify sudden changes in behavioral patterns of transactions that define fraudulent activities. By integrating CPD with machine learning algorithms such as Isolation Forest, Local Outlier Factor (LOF), and One-Class SVM, the system enhances the accuracy and timeliness of detecting fraud and lowering false alarms.

The work draws on a mixed methodology that combines CPD with anomaly detection models to dynamically monitor streams of transactions. CPD identifies abrupt changes in transactional patterns, for instance, unusual spikes in the value or volume of transactions, whereas the machine learning classifiers mark such anomalies as possibly fraudulent. The system is evaluated using a publicly accessible 284,807 credit card transaction dataset and has an accuracy of 99.02% when employing One Class SVM and operates well against false positives compared to the with CPD applied and without CPD applied. Key performance indicators such as precision, recall, and F1-score are quantified to validate the effectiveness of the proposed solution.

This research unveils the unrevealed capabilities of CPD as a credit card fraud detection method through its findings of an effective solution that suits financial institutions. The system operates through a modular design structure allowing simple integration of standard fraud detection software frameworks implemented Python Frameworks. Future development should center on time-sensitive processing as well as better feature engineering with cloud deployment to enhance both performance and scalability dimensions. This research completes an essential void in fraud identification through its data-oriented adaptive system that updates its detection of new fraud methods in real-time.

Keywords: credit card fraud detection, anomaly detection, change point detection, Isolation Forest, One-class SVM, Autoencoder, Real-Time Fraud Detection, Sudden Behavioral Shifts.

Subject Descriptions:

- Information systems -> Information retrieval -> Anomaly Detection -> Fraud Detection
- Computing methodologies -> Machine learning -> Machine learning approaches -> Anomaly Detection Techniques
- Computing methodologies -> Machine learning -> Machine learning techniques -> Change Point Detection (CPD)