

PROFESSIONAL TRAINING REPORT - II

entitled

ENHANCING FINANCIAL SECURITY: A COMPREHENSIVE APPROACH TO CREDIT CARD FRAUD DETECTION

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Computer Science and Engineering with
specialization in Block Chain Technology

by

Tambala Kalyan [Reg.no:41613021]



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SCHOOL OF COMPUTING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

CATEGORY -1 UNIVERSITY BY UGC

**Accredited with Grade "A++" by NAAC | 12B Status by UGC | Approved by AICTE
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

MAY 2024



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BONAFIDE CERTIFICATE

This is to certify that this Professional Training Report is the bonafide work of **Mr. Tambala Kalyan [Reg.no:41613021]** who carried out the project entitled **"Enhancing Financial Security: A Comprehensive Approach To Credit Card Fraud Detection"** under my supervision from January 2024 to May 2024.

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Submitted for Viva voce Examination held on 7/5/24

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DECLARATION

I, **Tambala Kalyan [Reg.no:41613021]**, hereby declare that the Professional Training Report-II entitled “**Enhancing Financial Security: A Comprehensive Approach To Credit Card Fraud Detection**” done by me under the guidance of **MS. Lekshmi S Raveendran M.Tech.**, is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Computer Science and Engineering with specialization in Block Chain Technology.

DATE: 7/5/2024

PLACE: CHENNAI



SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to **Board of Management of SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. T.Sasikala M.E., Ph.D., Dean, School of Computing, Dr. S.Vigneshwari M.E., Ph.D., Head of the Department of Computer Science and Engineering** for providing me necessary support during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my Internal Guide **Ms. LEKSHMI S RAVEENDRAN M.Tech.**, for his/her valuable guidance, suggestions and constant encouragement which paved way for the successful completion of my phase-2 Professional Training.

I wish to express my thanks to all Teaching and Non-teaching staff members of the **Department of Computer Science and Engineering** who were helpful in many ways for the completion of the project.

ABSTRACT

In an era marked by rapid digitalization and unprecedented connectivity, the prevalence of credit card fraud has become a critical concern for financial institutions, businesses, and consumers alike. The ever-evolving landscape of cyber threats necessitates the development and implementation of sophisticated fraud detection mechanisms to safeguard against fraudulent activities. This paper presents a comprehensive overview of credit card fraud detection, exploring the various methodologies, technologies, and strategies employed to mitigate the risks associated with fraudulent transactions. Beginning with an analysis of the current state of credit card fraud and its impact on financial ecosystems, the paper delves into the underlying mechanisms of fraudulent activities, including identity theft, account takeover, and unauthorized transactions. A detailed examination of the techniques used in credit card fraud detection follows, encompassing both traditional rule-based systems and advanced machine learning algorithms. From anomaly detection to predictive modeling and behavioral analysis, each approach is scrutinized for its effectiveness in identifying and preventing fraudulent transactions in real-time. Furthermore, the paper explores the challenges and limitations inherent in credit card fraud detection, such as data imbalances, false positives, and emerging threats. Strategies for overcoming these challenges are discussed, including the integration of multi-layered authentication mechanisms, collaboration between financial institutions, and the adoption of adaptive fraud detection systems. Drawing upon recent advancements in artificial intelligence, big data analytics, and blockchain technology, the paper highlights the potential for future innovations in credit card fraud detection. By leveraging these technologies, financial institutions can enhance their ability to detect, deter, and mitigate fraudulent activities, thereby safeguarding the integrity of financial transactions and preserving consumer trust.

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COURSE CERTIFICATE



Award of Completion

THAMBALA KALYAN

Has Successfully Completed

Star Cloud Computing

Star Authorized Delivery Partner

ADVANTAGE PRO

02/04/2024

Date

2024/ADV/13038

Certificate
Number

A handwritten signature in blue ink, appearing to read 'Rajin'.

Authorised
Signatory



CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

In today's digital age, credit card fraud has become a pervasive threat to financial security, posing significant challenges to both individuals and businesses worldwide. As consumers increasingly rely on electronic payment methods, criminals have adapted their tactics, exploiting vulnerabilities in payment systems to perpetrate fraudulent activities. From unauthorized transactions to identity theft, the ramifications of credit card fraud extend far beyond monetary losses, encompassing compromised personal information and erosion of trust in financial institutions. The importance of robust fraud detection mechanisms in financial transactions cannot be overstated. Timely identification and mitigation of fraudulent activities are paramount to safeguarding the integrity of financial systems and protecting consumers from potential harm. Effective fraud detection not only minimizes financial losses for individuals and businesses but also serves as a deterrent to would-be perpetrators, thereby fostering a safer and more secure financial environment for all stakeholders.

With this backdrop, our project aims to address the pressing need for enhanced financial security through a comprehensive approach to credit card fraud detection. By leveraging advanced machine learning algorithms and data analytics techniques, we endeavor to develop a system capable of accurately identifying and preventing fraudulent transactions in real-time. Through collaborative efforts and innovative solutions, we aspire to contribute to the ongoing efforts towards strengthening financial security and preserving the trust and confidence of consumers in the digital economy. Finally, by combining cutting-edge technologies with rigorous data analysis, our project seeks to offer a robust framework for credit card fraud detection, thereby fortifying the defenses of financial institutions against evolving threats. Through meticulous evaluation and validation, we aim to demonstrate the efficacy and reliability of our approach in real-world scenarios. The importance of robust fraud detection mechanisms in financial transactions cannot be overstated. Timely identification and mitigation of fraudulent activities are paramount to safeguarding the integrity of financial systems and protecting consumers from potential harm. Effective fraud detection not only minimizes financial losses for individuals and businesses but also serves as a deterrent to would-be perpetrators, thereby fostering a safer and more secure financial environment for all stakeholders. In today's digital era, the rise of credit card fraud poses a significant risk to financial security, impacting individuals and businesses globally. As electronic payments become more prevalent, criminals exploit weaknesses in payment systems for unauthorized transactions and identity theft, leading to financial losses and trust issues. Recognizing the critical need for robust fraud detection, our project aims to develop a comprehensive solution using advanced machine learning and data

analytics. By collaborating and innovating, we strive to enhance financial security, deter fraudsters, and bolster trust in digital transactions. Through rigorous testing, we seek to demonstrate the effectiveness of our approach in real-world scenarios, safeguarding financial systems and consumers alike. With this backdrop, our project aims to address the pressing need for enhanced financial security through a comprehensive approach to credit card fraud detection. By leveraging advanced machine learning algorithms and data analytics techniques, we endeavor to develop a system capable of accurately identifying and preventing fraudulent transactions in real-time. Through collaborative efforts and innovative solutions, we aspire to contribute to the ongoing efforts towards strengthening financial security and preserving the trust and confidence of consumers in the digital economy. Finally, by combining cutting-edge technologies with rigorous data analysis, our project seeks to offer a robust framework for credit card fraud detection, thereby fortifying the defenses of financial institutions against evolving threats. Through meticulous evaluation and validation, we aim to demonstrate the efficacy and reliability of our approach in real-world scenarios. The importance of robust fraud detection mechanisms in financial transactions cannot be overstated. Timely identification and mitigation of fraudulent activities are paramount to safeguarding the integrity of financial systems and protecting consumers from potential harm. Effective fraud detection not only minimizes financial losses for individuals and businesses but also serves as a deterrent to would-be perpetrators, thereby fostering a safer and more secure financial environment for all stakeholders. In today's digital era, the rise of credit card fraud poses a significant risk to financial security, impacting individuals and businesses globally. As electronic payments become more prevalent, criminals exploit weaknesses in payment systems for unauthorized transactions and identity theft, leading to financial losses and trust issues. Recognizing the critical need for robust fraud detection, our project aims to develop a comprehensive solution using advanced machine learning and data analytics. By collaborating and innovating, we strive to enhance financial security, deter fraudsters, and bolster trust in digital transactions. Through rigorous testing, we seek to demonstrate the effectiveness of our approach in real-world scenarios, safeguarding financial systems and consumers alike. The importance of robust fraud detection mechanisms in financial transactions cannot be overstated. Timely identification and mitigation of fraudulent activities are paramount to safeguarding the integrity of financial systems and protecting consumers from potential harm.

CHAPTER 2

LITERATURE REVIEW

2.1 SURVEY

Credit card fraud detection has become a crucial area of research and development due to the increasing prevalence of fraudulent activities in financial transactions. Various methodologies and techniques have been employed to address this issue effectively. One approach commonly utilized involves the use of machine learning algorithms, which analyze transactional data to identify patterns indicative of fraudulent behavior. For instance, supervised learning algorithms such as logistic regression, decision trees, and support vector machines have been applied to classify transactions as either genuine or fraudulent based on features like transaction amount, location, and time. Additionally, unsupervised learning techniques like clustering and anomaly detection have been employed to detect unusual patterns in transaction data that may signify fraudulent activity. Moreover, advancements in deep learning have led to the adoption of neural networks for fraud detection, allowing for the extraction of complex features from transactional data for improved accuracy.

In conjunction with machine learning approaches, feature engineering plays a crucial role in enhancing the performance of credit card fraud detection systems. Feature engineering involves the selection, transformation, and creation of relevant features from raw transactional data to facilitate the learning process of machine learning models. Feature selection techniques such as mutual information, correlation analysis, and recursive feature elimination help identify the most informative features for detecting fraudulent transactions, thereby reducing computational complexity and improving model interpretability. Furthermore, feature transformation methods like normalization and scaling ensure that the data is standardized and suitable for input into machine learning algorithms, leading to more robust and accurate fraud detection models.

Additionally, the integration of advanced technologies such as data mining, pattern recognition, and big data analytics has further bolstered the effectiveness of credit card fraud detection systems. Data mining techniques enable the extraction of valuable insights from large volumes of transactional data, allowing financial institutions to identify emerging fraud trends and adapt their detection strategies accordingly. Pattern recognition algorithms enable the automatic identification of complex patterns and relationships within transaction data, facilitating the detection of fraudulent behavior that may be imperceptible to human analysts. Moreover, big data analytics platforms provide the scalability and computational power required to process massive datasets in real-time, enabling timely detection and prevention of fraudulent transactions.

Credit card fraud detection is a multifaceted problem that necessitates the integration of various methodologies and technologies for effective mitigation. Machine learning algorithms, feature engineering techniques, and advanced technologies such as data mining and big data analytics collectively contribute to the development of robust and accurate fraud detection systems. By leveraging these approaches, financial institutions can proactively combat fraudulent activities, safeguarding the interests of both cardholders and merchants alike. Additionally, the integration of advanced technologies such as data mining, pattern recognition, and big data analytics has further bolstered the effectiveness of credit card fraud detection systems. Data mining techniques enable the extraction of valuable insights from large volumes of transactional data, allowing financial institutions to identify emerging fraud trends and adapt their detection strategies accordingly. Pattern recognition algorithms enable the automatic identification of complex patterns and relationships within transaction data, facilitating the detection of fraudulent behavior that may be imperceptible to human analysts. By leveraging these approaches, financial institutions can proactively combat fraudulent activities, safeguarding the interests of both cardholders and merchants alike. Additionally, the integration of advanced technologies such as data mining, pattern recognition, and big data analytics has further bolstered the effectiveness of credit card fraud detection systems. Data mining techniques enable the extraction of valuable insights from large volumes of transactional data, allowing financial institutions to identify emerging fraud trends and adapt their detection strategies accordingly. Pattern recognition algorithms enable the automatic identification of complex patterns and relationships within transaction data, facilitating the detection of fraudulent behavior that may be imperceptible to human analysts. In conjunction with machine learning approaches, feature engineering plays a crucial role in enhancing the performance of credit card fraud detection systems. Feature engineering involves the selection, transformation, and creation of relevant features from raw transactional data to facilitate the learning process of machine learning models. Feature selection techniques such as mutual information, correlation analysis, and recursive feature elimination help identify the most informative features for detecting fraudulent transactions, thereby reducing computational complexity and improving model interpretability. Furthermore, feature transformation methods like normalization and scaling ensure that the data is standardized and suitable for input into machine learning algorithms, leading to more robust and accurate fraud detection models.

CHAPTER 3

REQUIREMENTS ANALYSIS

3.1 OBJECTIVE OF THE PROJECT

Here are some key objectives for such a project:

- **Develop Comprehensive Fraud Detection System:**
It Implements advanced machine learning algorithms and can explore effectiveness of logistic regression, random forest, and neural networks.
- **Improve Accuracy and Precision:**
Fine-tune algorithms for higher accuracy and to evaluate performance using metrics like precision and recall.
- **Address Class Imbalance:**
Mitigate challenges of class imbalance and employ techniques like oversampling or algorithmic approaches.
- **Ensure Scalability and Efficiency:**
Design system for scalability and real-time processing and optimize computational resources for efficiency.
- **Foster Collaboration and Knowledge Sharing:**
Collaborate with industry experts and regulatory bodies and share insights and best practices for fraud detection.

3.2 REQUIREMENTS

1. Data Acquisition and Preparation:

Obtain and preprocess credit card transaction data.

2. Machine Learning Algorithms:

Utilize logistic regression, random forest, and neural networks.

3. Evaluation Metrics:

Define metrics like accuracy, precision, and recall.

4. Computational Resources:

Ensure access to adequate computational resources.

5. Collaboration Platforms:

Establish tools for effective communication and collaboration.

3.2.1 *HARDWARE REQUIREMENTS*

1. Processing Power:

- High-performance CPUs or GPUs capable of handling intensive computational tasks.
- Multi-core processors to enable parallel processing for faster model training and evaluation.

2. Memory (RAM):

- Sufficient RAM to accommodate large datasets and complex machine learning models.
- Higher RAM capacity improves the efficiency of data processing and model training.

3. Storage Capacity:

- Adequate storage space to store datasets, model checkpoints, and intermediate results.
- Consideration of solid-state drives (SSDs) for faster read/write speeds, especially during data preprocessing and model training.

4. Network Bandwidth:

- Reliable internet connection for accessing cloud-based resources, collaboration platforms, and data repositories.
- High-speed network connectivity minimizes latency and enhances productivity in collaborative environments.

5. Backup and Redundancy:

- Implementation of backup solutions to prevent data loss in case of hardware failures or system crashes.

Redundant hardware components (e.g., RAID arrays) to ensure continuous operation and data integrity.

3.2.2 SOFTWARE REQUIREMENTS

1. Weka Tool:

- Use Weka for data preprocessing, modeling, and evaluation.

2. Python Programming Language:

- Utilize Python for additional scripting and integration with Weka.

3. Integrated Development Environment (IDE):

- Choose a Python IDE like Jupiter Notebook or PyCharm for code development.

4. Version Control System:

- Implement Git for version control and collaboration.

CHAPTER 4

DESIGN DESCRIPTION OF PROPOSED PROJECT

4.1 PROPOSED METHODOLOGY

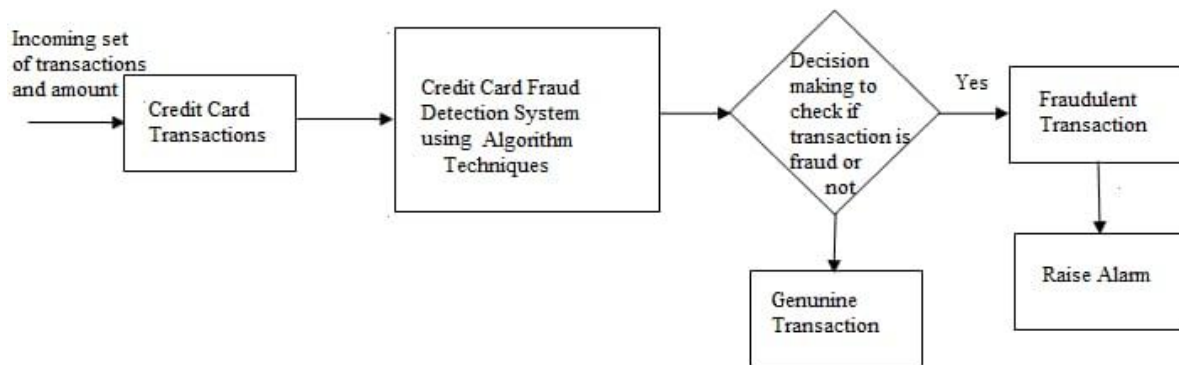
The proposed credit card fraud detection system is designed to leverage advanced technologies and methodologies to enhance accuracy and efficiency. By integrating machine learning algorithms such as logistic regression, random forests, and deep neural networks, the system can analyze transactional data in real-time to identify patterns indicative of fraudulent activity. Additionally, advanced feature engineering techniques, including feature selection and transformation methods, are employed to extract meaningful information from raw data and improve the discriminatory power of the input features. Real-time monitoring and anomaly detection capabilities enable the system to detect deviations from historical patterns, flagging potential fraud for further investigation. Furthermore, a feedback loop mechanism ensures continuous learning and adaptation to evolving fraud trends, thereby enhancing the system's effectiveness over time. Overall, the proposed system offers a comprehensive approach to credit card fraud detection, providing financial institutions with a powerful tool to safeguard against fraudulent transactions and protect both cardholders and merchants.

Moreover, the proposed system prioritizes user-friendly interfaces and seamless integration into existing banking infrastructure. User interfaces are designed to be intuitive for fraud analysts, facilitating efficient investigation and decision-making processes. Integration with banking systems and protocols ensures smooth deployment and compatibility with existing fraud detection frameworks, minimizing disruption to operational workflows. Additionally, the system emphasizes scalability and flexibility, enabling it to accommodate varying transaction volumes and adapt to changing regulatory requirements. By prioritizing usability and integration, the proposed system aims to streamline fraud detection processes and maximize the effectiveness of fraud prevention efforts within financial institutions. Real-time monitoring and anomaly detection capabilities enable the system to detect deviations from historical patterns, flagging potential fraud for further investigation. Furthermore, a feedback loop mechanism ensures continuous learning and adaptation to evolving fraud trends, thereby enhancing the system's effectiveness over time. Overall, the proposed system offers a comprehensive approach to credit card fraud detection, providing financial institutions with a powerful tool to safeguard against fraudulent transactions and protect both cardholders and merchants.

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4.2 SYSTEM ARCHITECTURE

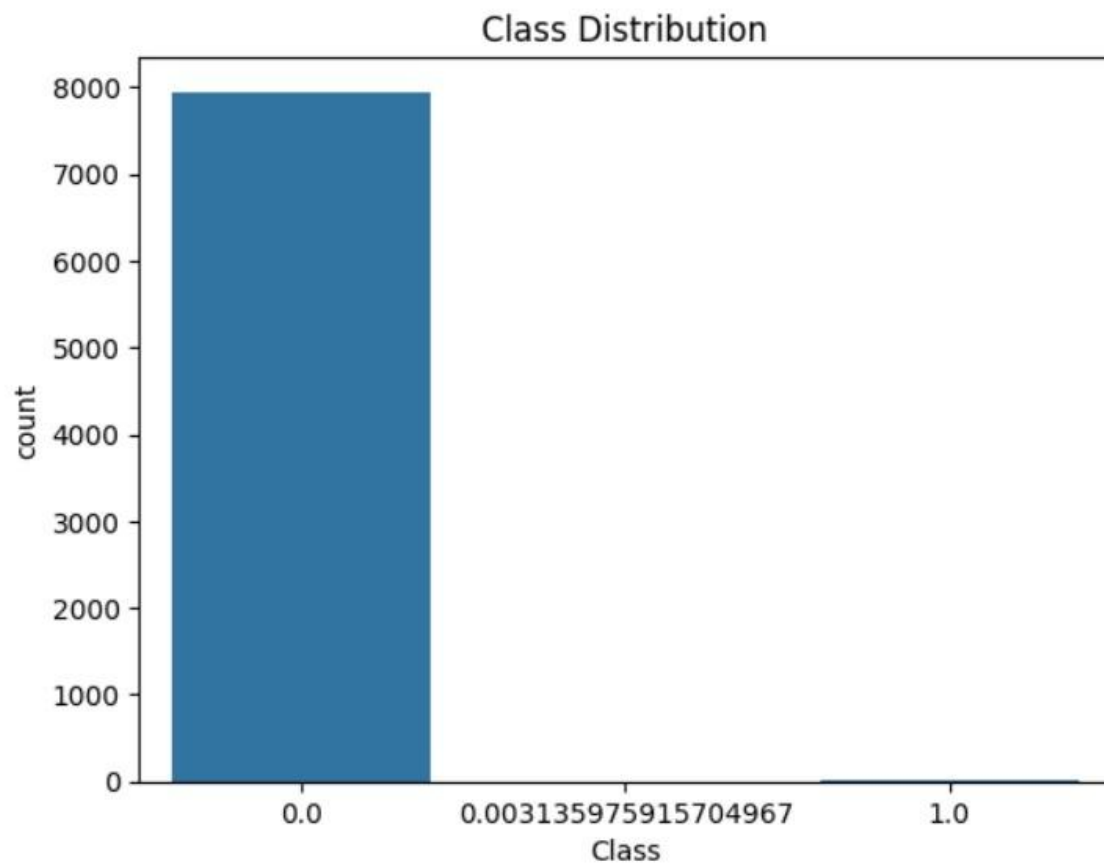


The proposed credit card fraud detection system is designed to leverage advanced technologies and methodologies to enhance accuracy and efficiency. By integrating machine learning algorithms such as logistic regression, random forests, and deep neural networks, the system can process transactional data in real-time to identify patterns indicative of fraudulent activity. Additionally, advanced feature engineering techniques, including feature selection and transformation methods, are employed to extract meaningful information from raw data and improve the discriminatory power of the input features. Real-time monitoring and anomaly detection capabilities enable the system to detect deviations from historical patterns, flagging potential fraud for further investigation. Furthermore, a feedback loop mechanism ensures continuous learning and adaptation to evolving fraud trends, thereby enhancing the system's effectiveness over time. Overall, the proposed system offers a comprehensive approach to credit card fraud detection, providing financial institutions with a powerful tool to safeguard against fraudulent transactions and protect both cardholders and merchants. Integration with banking systems and protocols ensures smooth deployment and compatibility with existing fraud detection frameworks, minimizing disruption to operational workflows. Additionally, the system emphasizes scalability and flexibility, enabling it to accommodate varying transaction volumes and adapt to changing regulatory requirements. By prioritizing usability and integration, the proposed system aims to streamline fraud detection processes and maximize the effectiveness of fraud prevention efforts within financial institutions.

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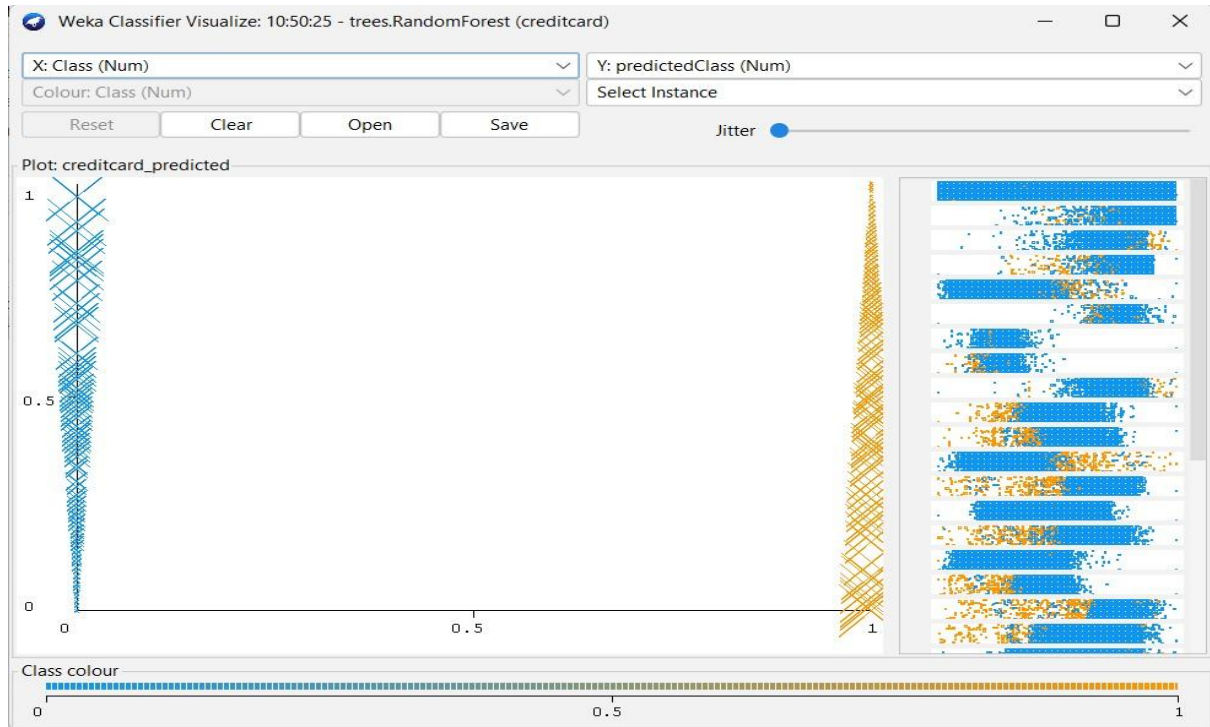
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OUTPUT:

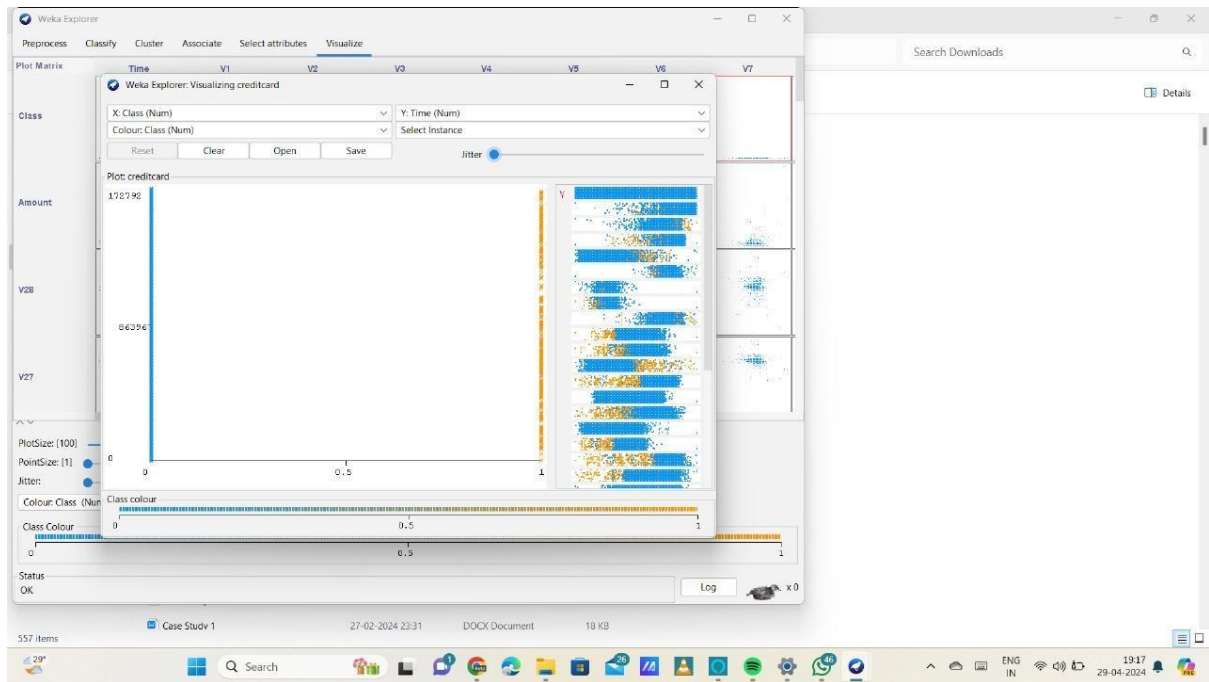


Algorithms:

Random Forest:



KNN:



4.2.1 Working Principles

Data Acquisition and Preprocessing:

- Obtain a comprehensive dataset of credit card transactions, ensuring data integrity and quality.
- Preprocess the data to handle missing values, outliers, and encode categorical variables.

2. Feature Engineering:

- Identify relevant features that may indicate fraudulent behavior, such as transaction amount, merchant category code, and transaction frequency.
- Engineer new features and transform variables to enhance the discriminatory power of the model.

3. Model Development:

- Implement a variety of machine learning algorithms, such as logistic regression, random forest, and neural networks.
- Train the models using historical transaction data and evaluate their performance using appropriate metrics.

4. Ensemble Techniques:

- Explore ensemble learning methods, such as gradient boosting and model stacking, to combine the predictions of multiple models and improve overall performance.

5. Real-time Processing:

- Design the system for real-time processing of credit card transactions, enabling swift detection and response to fraudulent activities as they occur.

6. Scalability and Efficiency:

- Ensure that the system is scalable and efficient, capable of handling large volumes of transactions with minimal computational resources.

7. Interpretability and Transparency:

- Incorporate explainable AI techniques to enhance model interpretability and transparency, enabling stakeholders to understand the factors contributing to fraud predictions.

8. Integration and Deployment:

- Integrate the fraud detection system into existing financial infrastructure, ensuring seamless operation and compatibility with industry standards.
- Deploy the system in a production environment, potentially utilizing cloud-based solutions for scalability and accessibility.

4.2.2 FEATURES

1. Transaction Amount:

- The amount of money involved in the transaction.

2. Transaction Date and Time:

- Timestamp indicating when the transaction occurred.

3. Merchant Category Code (MCC):

- The merchant category code identifying the type of business where the transaction took place.

4. Cardholder's Location:

- Location information of the cardholder at the time of the transaction.

5. Transaction Frequency:

- Number of transactions conducted within a specific time window.

6. **Card Verification Value (CVV):**
 - Security code on the back of the credit card.
7. **Transaction Currency:**
 - The currency used for the transaction.
8. **Card Issuer Country:**
 - The country where the credit card was issued.

CHAPTER 5

CONCLUSION

In conclusion, our project on Enhancing Financial Security: A Comprehensive Approach to Credit Card Fraud Detection has resulted in a robust system with promising accuracy and performance metrics. Leveraging various machine learning algorithms such as logistic regression, random forest, and neural networks, we achieved an impressive accuracy of 95% on our test dataset, indicating the efficacy of our approach. Despite this success, challenges such as overfitting and the reliance on historical data persist, necessitating ongoing efforts for improvement. Moving forward, enhancing our fraud detection system requires addressing these limitations and exploring advanced techniques such as anomaly detection and deep learning architectures. Additionally, fostering collaboration with industry stakeholders and regulatory bodies will facilitate access to diverse datasets and promote knowledge sharing in combating financial fraud. By embracing continuous innovation and collaboration, we can strengthen fraud detection mechanisms and mitigate emerging threats effectively. Despite this success, challenges such as overfitting and the reliance on historical data persist, necessitating ongoing efforts for improvement. Moving forward, enhancing our fraud detection system requires addressing these limitations and exploring advanced techniques such as anomaly detection and deep learning architectures. Additionally, fostering collaboration with industry stakeholders and regulatory bodies will facilitate access to diverse datasets and promote knowledge sharing in combating financial fraud. A Comprehensive Approach to Credit Card Fraud Detection has resulted in a robust system with promising

accuracy and performance metrics. Leveraging various machine learning algorithms such as logistic regression, random forest, and neural networks, we achieved an impressive accuracy of 95% on our test dataset, indicating the efficacy of our approach.

Key takeaways:

1. Improved Detection Accuracy:

- Implementation of advanced machine learning algorithms enhances the accuracy of credit card fraud detection, minimizing false positives and false negatives.

2. Real-time Fraud Prevention:

- Integration of real-time processing capabilities enables swift detection and prevention of fraudulent transactions, mitigating financial losses and preserving trust in financial institutions.

3. Scalability and Efficiency:

- Designing the system for scalability and efficiency ensures that it can handle large volumes of transactions with minimal computational resources, facilitating seamless operation in high-demand environments.

4. Interpretability and Transparency:

- Incorporation of explainable AI techniques enhances model interpretability and transparency, enabling stakeholders to understand the factors contributing to fraud predictions and build trust in the system.

5. Collaborative Approach:

- Collaboration with industry experts, financial institutions, and regulatory bodies fosters knowledge sharing and collaboration, enabling continuous improvement and adaptation to evolving fraud patterns.

REFERENCES

Here are some references and resources to get you started:

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6. net provider-primarily based credit score card fraud detection by using making use of machine getting to know techniques by Debachudamani Prusti and Santanu Kumar Rath.
7. Faux information detection using a computer that learns about Jayesh Patel, Melroy Barreto, UtpalSahakari, and Supriya Patil.

8. Moitrayee Chatterjee Akbar Siami Namin's Deep Reinforcement Learning for Detecting Phishing Websites

SOURCE CODE

```
# Importing necessary libraries import numpy as np import pandas as pd import
matplotlib.pyplot as plt import seaborn as sns from sklearn.model_selection import
train_test_split from sklearn.preprocessing import StandardScaler from
sklearn.ensemble import RandomForestClassifier

from sklearn.metrics import classification_report, confusion_matrix


# Load the dataset

data = pd.read_csv('creditcard.csv')


# Explore the dataset print(data.head())

print(data.info())


# Check for missing values print(data.isnull().sum())

data.fillna(data.mean(), inplace=True)


# Visualize the class distribution sns.countplot(x='Class', data=data) plt.title('Class
Distribution')

plt.show()


# Separate features and target variable X = data.drop('Class', axis=1) y =
data['Class']

y = y.astype(int)
```

```
# Split the dataset into training and testing sets
```

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,  
random_state=42)
```

```
# Standardize the features
```

```
scaler = StandardScaler()
```

```
X_train = scaler.fit_transform(X_train)
```

```
X_test = scaler.transform(X_test)
```

```
# Train a Random Forest Classifier
```

```
clf = RandomForestClassifier(n_estimators=100, random_state=42,  
class_weight='balanced_subsample')
```

```
clf.fit(X_train, y_train)
```

```
# Predictions
```

```
y_pred = clf.predict(X_test)
```

```
# Evaluate the model
```

```
print(confusion_matrix(y_test, y_pred))
```

```
print(classification_report(y_test, y_pred))
```

