Phase-2 Submission

Student Name: Poorna Kala G

Register Number: 410723104059

Institution: Dhanalakshmi College of Engineering

Department: CSE

Date of Submission: 07.05.2025

GitHub Repository Link:
https://github.com/Poornakala2006/NM_Poorna_DS.git

---

1. Problem Statement

Guarding transaction with AI-powered credit card fraud detection and prevention

Operational inefficiencies:

Manual review processes that are costly and time-consumingCredit card fraud continues to be a growing threat in the digital payments ecosystem, costing financial institutions, merchants, and consumers billions annually. Traditional rule-based fraud detection systems are increasingly inadequate against

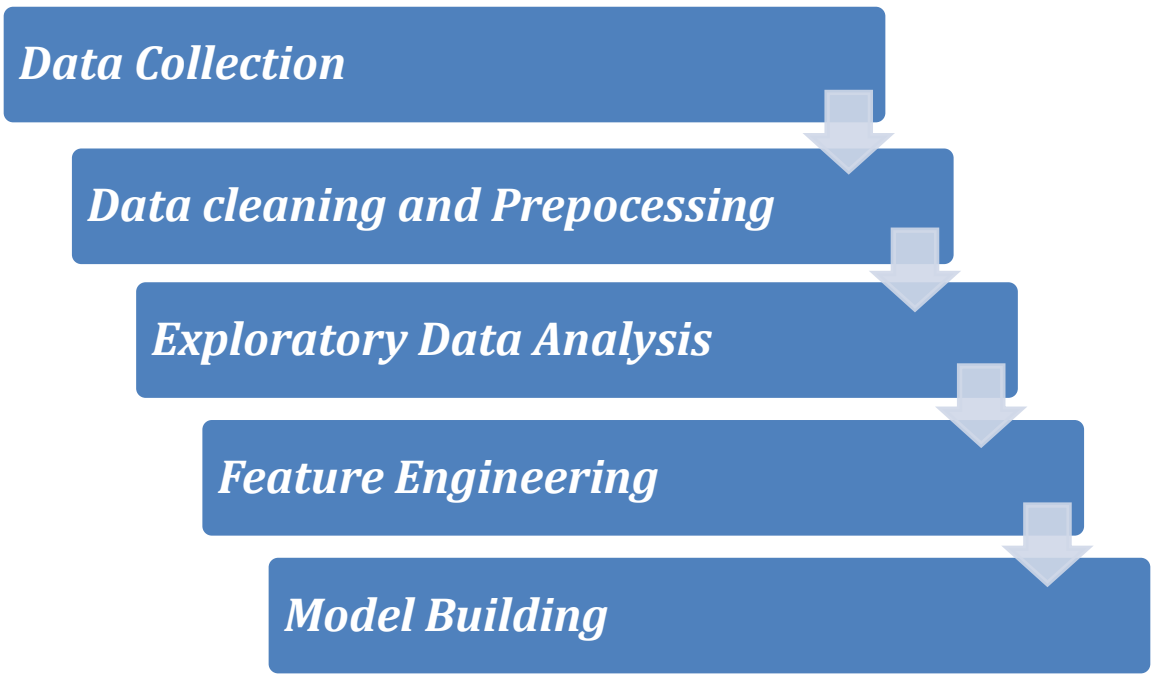
Sophisticated fraud patterns, leading to*:*

- ***High false positives :***
  Legitimate transactions being declined, causing customer frustration
- ***False negatives:***
  Fraudulent transactions slipping through, resulting in financial losses
- ***Inability to adapt:***
  Static rules can't keep pace with evolving fraud techniques

2. Project Objectives

- *Collect and preprocess transaction data to prepare a clean, balanced dataset for analysis.*
- *Analyze data patterns to identify key indicators and trends related to fraudulent activities.*
- *Develop and train machine learning models to accurately detect and classify fraudulent transactions.*
- *Evaluate model performance using metrics like precision, recall, F1-score, and AUC-ROC to ensure reliability.*
- *Design a practical fraud prevention framework for integrating the model into real-time transaction systems.*

3. Flowchart of the Project Workflow



4. Data Description

- ***Dataset Name:*** *Credit card transaction data set*
- ***Source:*** *Kaggle*
- ***Type of Data:*** *Structured tabular data*
- ***Records and Features:*** *100001 transactions data set (categorical + numerical data) and 8 features*
- ***Target Variable :*** *Is fraud(1= Fraud, 0 = Legitimate)*
- ***Static or Dynamic :****static data set*
- ***Attributes Covered :*** *TransactionID, TransactionDate, Amount, MerchantID, TransactionType , Location and IsFraud*

5. Data Preprocessing

- *Checked and confirmed no missing values*
- *Converted Date to datetime format and extracted hour-based features*
- *Encoded categorical variables like TransactionType and Location*
- *Normalized Amount using MinMaxScaler*
- *Handled imbalance using SMOTE to oversample fraudulent cases*
- *Split dataset into 80% training and 20% test sets*

6. Exploratory Data Analysis (EDA)

- *Univariate Analysis:*

- *Distribution of Amount (right-skewed)*
- *Count plot showing class imbalance*

- *Bivariate/Multivariate Analysis:*
  - *Boxplots of Amount by IsFraud*
  - *Bar plots of TransactionType and Location grouped by fraud*
- *Insights Summary:*
  - *Certain merchant IDs and transaction types correlate with fraud*
  - *High-value transactions are more likely to be flagged as fraud*

7. Feature Engineering

- *Extracted hour-of-day and weekday from Date*
- *Created Amount_per_hour = Amount / transaction hour*
- *Used one-hot encoding for categorical fields*
- *Removed low variance or redundant features*

8. Model Building

- ***Algorithms Used:***
  - *Logistic Regression (Baseline)*
  - *Random Forest Classifier*
  - *XG Boost Classifier*
  - *Isolation Forest (Anomaly Detection)*
- ***Data Split:***

- *Train-test split: 80% training, 20% testing using stratify=y*

- ***Metrics Evaluated:***
  - *Precision, Recall, F1-Score, ROC-AUC*
  - *Confusion Matrix*

9. Visualization of Results & Model Insights

- ***Feature Importance:***
  - *XG Boost and Random Forest identified V14, V10, V12, and V17 as critical predictors*
- ***Performance Summary:***
  - *XGBoost achieved the highest F1-score and AUC.*
  - *Logistic Regression had good precision but lower recall.*
  - *Random Forest balanced both.*
- ***Graphs & Charts:***
  - *ROC Curves for all models.*
  - *Confusion matrix for best-performing model.*
  - *Feature importance bar chart.*

10. Tools and Technologies Used

- ***Language:*** *Python 3*
- ***Environment:*** *Jupyter Notebook / Google Colab*
- **Libraries:**
  - *pandas, numpy – Data Manipulation*
  - *matplotlib, seaborn, plotly – Visualization*
  - *scikit-learn, xgboost, imbalanced-learn – ML Models*

- *Gradio– Model Deployment Interface*

11. Team Members and Contributions

S.No	*Team members*	*Roles*
1.	*Nirosha M*	*EDA*
2.	*Nithyashree S*	*Data cleaning*
3.	*Poorna Kala G*	*Feature Engineering*
4.	*Yalini Nachiyar S*	*Model development and Documentation and reporting*