Fraud Detection System Portfolio

1 Project Overview

This project develops a machine learning-based fraud detection system integrated with the transaction simulator (Project M) hosted at `http://transaction-simulator-frontend-roolph`. It analyzes credit card transactions in real-time to detect fraudulent activity, enhancing security for financial institutions and cardholders.

2 Objectives

- Develop an accurate fraud detection model using machine learning.
- Integrate with Project M's API to process real-time transactions.
- Deliver timely fraud predictions to mitigate financial risks.

3 Technical Approach

3.1 Data Processing

- **Input**: Transaction records with features such as amount, time, merchant category, and distance from home.
- **Preprocessing**: Numerical features are standardized, and categorical variables (e.g., merchant categories) are encoded.
- **Synthetic Data**: Generates synthetic transactions for training, simulating real-world patterns with a 2% fraud rate.

3.2 Model Development

- **Algorithm**: Random Forest Classifier with 100 estimators for robust and interpretable fraud detection.
- **Training**: Uses an 80/20 train-test split to ensure model generalization.
- **Evaluation**: Employs precision, recall, F1-score, and confusion matrix for performance assessment.

3.3 API Integration with Project M

- **Connection**: Interfaces with Project M's RESTful API at `http://transaction-simulator-fron`
- **Fetching Data**: Retrieves real-time transaction data via GET requests.
- **Prediction Delivery**: Sends fraud predictions and probabilities via POST requests to the API.
- **Error Handling**: Implements robust logging and retry mechanisms for reliable API communication.

4 Implementation Details

- **Language**: Python 3.8+
- **Libraries**: pandas, numpy, scikit-learn, requests, joblib

- **Key Features**:
    - Modular `FraudDetector` class for maintainability.
    - Scalable preprocessing pipeline for large datasets.
    - Persistent model storage for efficient redeployment.
    - Real-time integration with Project M's transaction simulator.

5 Outcomes

- **Accuracy**: High precision and recall on synthetic data, adaptable to real-world transaction datasets.
- **Scalability**: Handles high transaction volumes with efficient processing.
- **Integration**: Seamless real-time interaction with Project M's API.

6 Future Enhancements

- Implement real-time feature engineering for dynamic fraud patterns.
- Explore neural networks Fitsum to advanced deep learning models for improved accuracy.
- Enhance API security with advanced authentication protocols.

7 Conclusion

This fraud detection system, integrated with Project M, provides a scalable and accurate solution for real-time credit card fraud detection. It leverages machine learning and robust API integration to protect financial transactions effectively.