

# Fraud Detection ML Suite — One-Pager

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Platform: Python | Category: Machine Learning / Financial Risk Analytics

## Summary

The Fraud Detection ML Suite is a machine learning framework that reduces false positives and enhances fraud capture rate through gradient-boosted ensemble models and explainable AI (XAI). The pipeline supports model governance and regulatory compliance with transparent, interpretable decisions using SHAP explainability reports.

## Problem

Traditional fraud rules produce excessive false alerts and delayed decisions. Analysts face high manual review volumes and limited insight into why a transaction was flagged. Compliance demands transparent, data-driven justification for model decisions.

## Data and Sourcing

- Transaction dataset with labeled approvals and chargebacks.
- Features: device, network, merchant, transaction velocity, customer tenure.
- Leak-free temporal validation to simulate real-world production scoring.

## Approach

- Feature engineering with rolling aggregates and risk-based features.
- Balanced training via SMOTE and undersampling, cost-sensitive optimization.
- Gradient Boosting (LightGBM) model with Bayesian hyperparameter search.
- Explainability via SHAP (global + local) for model validation and reviewer guidance.
- FastAPI scoring endpoint containerized with Docker for deployment.

## Experiments and Evaluation

- Time-based cross-validation with ROC-AUC and PR-AUC monitoring.
- Threshold tuning to balance recall vs reviewer volume (Ops capacity curve).
- Out-of-time (OOT) backtesting for model stability and drift detection.

## Results and Impact

- 27% reduction in false positives at equivalent recall.
- 14% increase in fraud capture rate on OOT evaluation.
- Reduction in manual review workload without missing severe fraud cases.
- Governance-ready SHAP reports supporting model sign-off and audit trail.

## Technology Stack

Python, LightGBM, Scikit-learn, Pandas, Imbalanced-learn, SHAP, FastAPI, Docker, GitHub Actions, Postgres.

## Interactive Resources

Live Demo | GitHub Repository

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