💸 SuperLender: AI-Powered Loan Default Prediction for Financial Inclusion in Nigeria

---

🌍 Project Overview

This project was developed as part of the **Zindi Nigeria Loan Default Prediction Challenge**, where the goal was to help **digital lending companies** in Nigeria (like *SuperLender*) identify customers most likely to default on their loans.

In emerging economies like **Nigeria**, many individuals lack formal credit histories — making it difficult for financial institutions to make informed lending decisions. This project builds a **Machine Learning (ML)** solution that predicts whether a customer will **repay a loan (Good)** or **default (Bad)**, empowering lenders to make **data-driven, inclusive financial decisions**.

🎖 *This project was officially submitted on Zindi and awarded a Certificate of Completion for successful participation and model submission.*

🎯 Problem Statement

SuperLender is a local digital lending platform that wants to improve its **credit risk assessment system**.
The company's goal is to determine, at the time of application, whether a new or returning customer will repay their loan.

The model predicts the **binary target variable** good_bad_flag, where:

- 1 → Good (loan repaid)
- 0 → Bad (loan defaulted)

This prediction helps lenders **minimize financial losses**, **reduce default risk**, and **expand access to fair credit** in Nigeria.

□ Dataset Description

The dataset provided by **Zindi** consists of six CSV files (three for training and three for testing).
Each dataset focuses on different aspects of the customer and their loan history.

📂 Datasets

1. **Demographics (traindemographics.csv)**
   - Customer personal and banking information
   - Includes fields such as birthdate, bank_account_type, employment_status_clients, etc.
2. **Performance (trainperf.csv)**
   - Details about the specific loan performance being predicted
   - Key variable: good_bad_flag (target)

3. **Previous Loans (trainprevloans.csv)**
    - History of all previous loans taken by each customer

👉 All datasets were merged using the unique key **customerid** to create a comprehensive view of each customer.

⚙️ Data Preprocessing

To ensure data quality and modeling efficiency, the following steps were performed:

- Merged datasets on customerid
- Removed duplicate and irrelevant features
- Handled missing values (NaN imputation and dropping sparse columns)
- Created new features:
    - age (calculated from birthdate)
    - loan_duration (closeddate - approveddate)
    - repayment_ratio (totaldue / loanamount)
- Encoded categorical columns using Label Encoding
- Scaled numerical features using StandardScaler

🤖 Model Development

A range of models were tested to find the most effective one for this financial risk prediction task:

Model	**Description**	**Result**
Logistic Regression	Baseline classifier	Good baseline
Random Forest	Robust tree-based model	Improved accuracy
XGBoost	Gradient boosting model	High predictive power
CatBoost	Handles categorical data efficiently	Great recall
Stacking Ensemble	Combines the above models	✅ **Final Model**

The **Stacking Ensemble Model** (Random Forest + XGBoost + CatBoost with Logistic Regression as meta-learner) achieved the best balance between **precision** and **recall**, minimizing both false positives and negatives.

📊 Model Evaluation

Evaluation Metrics used:

- Accuracy
- Precision
- Recall
- F1 Score
- ROC-AUC

📈 The model achieved strong performance on the validation set, effectively identifying risky borrowers while maintaining fairness in prediction outcomes.

🏁 Final Model and Predictions

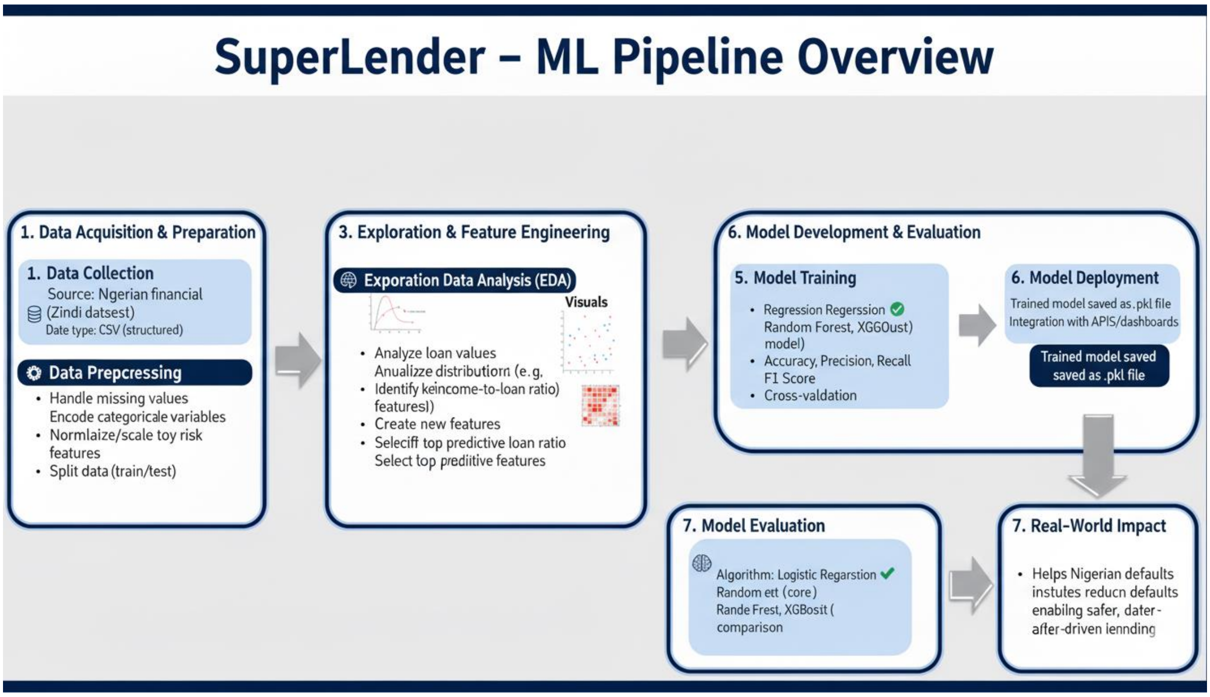
- Trained final model on full dataset using optimal hyperparameters.
- Generated predictions for the Zindi test set following the required submission format:

customerID,Good_Bad_flag

12345667,1

43423156,0

54325779,0

- Saved artifacts:
  - best_model.pkl (Trained Model)
  - scaler.pkl (Feature Scaler)
  - final_submission.csv (Predictions)
- 

SuperLender – ML Pipeline Overview

1. Data Acquisition & Preparation

1. Data Collection
Source: Ngerian financial
(Zindi datsest)
Date type: CSV (structured)

Data Prepcressing
- Handle missing values
Encode categoricale variables
- Normlaize/scale toy risk features
- Split data (train/test)

3. Exploration & Feature Engineering

Exporation Data Analysis (EDA)

Visuals

- Analyze loan values
Anualizze distributiorn (e.g.
- Identify keincome-to-loan ratio) featuresl)
- Create new features
- Seleciff top predictive loan ratio
Select top prediitive features

6. Model Development & Evaluation

5. Model Training
- Regression Regerssion ✓
Random Forest, XGGOust) model)
- Accuracy, Precision, Recall
F1 Score
- Cross-valdation

6. Model Deployment
Trained model saved as.pkl file
Integration with APIS/dashboards

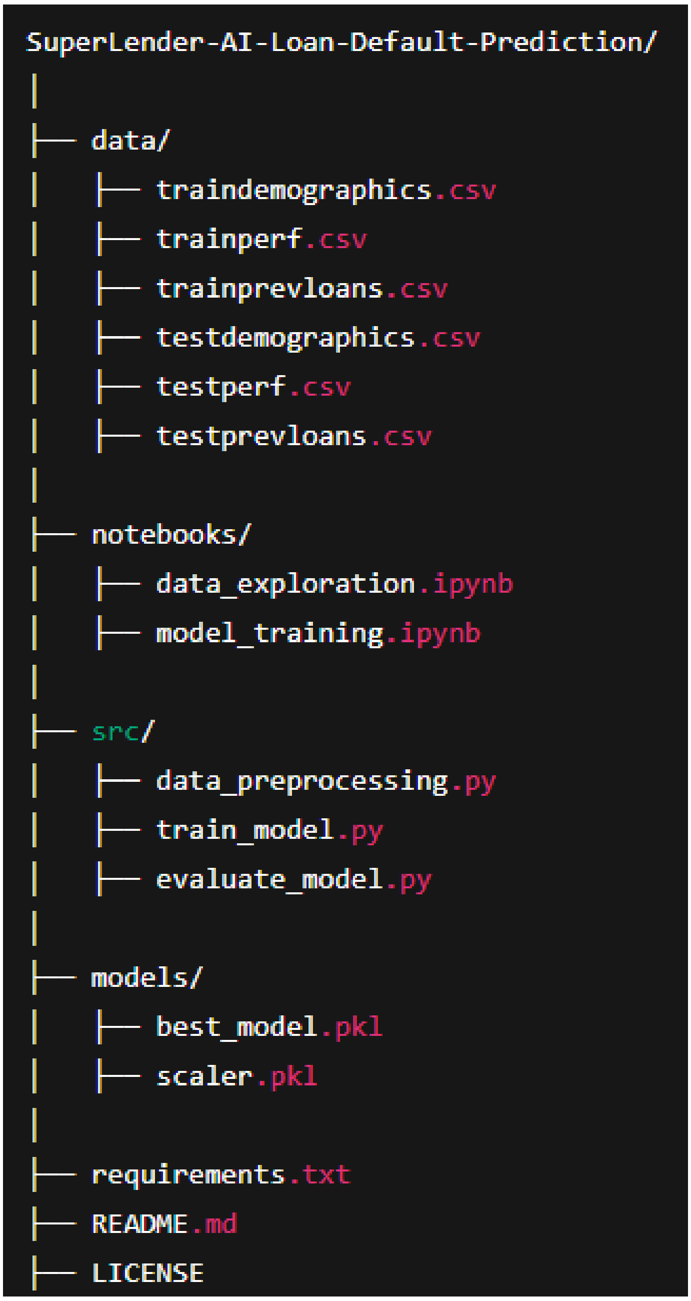
Trained model saved
saved as .pkl file

7. Model Evaluation

Algorithm: Logistic Regarstion ✓
Random ett (core)
Rande Frest, XGBosit (
comparison

7. Real-World Impact
- Helps Nigerian defaults instutes reducn defaults enabilng safer, dater-after-driven ienndinq

📁 Repository Structure



```
SuperLender-AI-Loan-Default-Prediction/
│
├── data/
│   ├── traindemographics.csv
│   ├── trainperf.csv
│   ├── trainprevloans.csv
│   ├── testdemographics.csv
│   ├── testperf.csv
│   ├── testprevloans.csv
│
├── notebooks/
│   ├── data_exploration.ipynb
│   ├── model_training.ipynb
│
├── src/
│   ├── data_preprocessing.py
│   ├── train_model.py
│   ├── evaluate_model.py
│
├── models/
│   ├── best_model.pkl
│   ├── scaler.pkl
│
├── requirements.txt
├── README.md
├── LICENSE
```

□ Tech Stack

Languages & Libraries:

- Python
- Pandas, NumPy
- Scikit-learn
- XGBoost, CatBoost

- Matplotlib, Seaborn

📈 Results

- **Model Type:** Stacking Ensemble
- **Performance:** Balanced precision and recall with minimal misclassification
- **Top Features:**
    - Employment status
    - Loan amount
    - Loan duration
    - Total due
    - Repayment ratio

🚀 How to Run the Project

1. **Clone the repository**
2. git clone https://github.com/Rupeshbhardwaj002/SuperLender-Smarter-Loans-with-Data-Driven-Decisions/tree/main.git
3. cd SuperLender-Loan-Default-Prediction
4. **Install dependencies**
5. pip install -r requirements.txt
6. **Run preprocessing and training**
7. python src/data_preprocessing.py
8. python src/train_model.py
9. **Generate predictions**
10. python src/evaluate_model.py
11. **Output file:**
    - final_submission.csv
    - best_model.pkl

□ Learnings & Real-World Impact

Through this project, I learned:

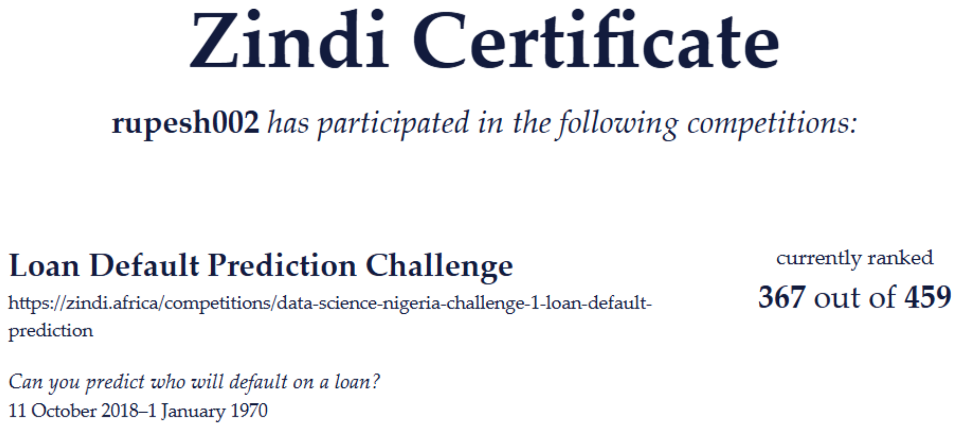
- How to work with **real multi-table financial data**

- Handling **missing values and categorical encoding**
- Designing **stacking ensemble architectures** for performance gains
- The importance of **responsible AI in lending** — improving **financial inclusion** for Nigerian citizens through fair, data-backed credit scoring.

🏢 This project demonstrates how AI can help bridge the gap between underserved individuals and accessible financial services in Africa.

🏅 Certificate of Completion

✅ Successfully submitted on **Zindi Africa** and awarded a **Certificate of Completion** for active participation in the *Loan Default Prediction Challenge.*



Zindi Certificate

rupesh002 *has participated in the following competitions:*

Loan Default Prediction Challenge
https://zindi.africa/competitions/data-science-nigeria-challenge-1-loan-default-prediction

Can you predict who will default on a loan?
11 October 2018–1 January 1970

currently ranked
367 out of **459**

To verify Please visit - https://zindi.africa/users/rupesh002/competitions/certificate

---

📜 License & Credits

- **License:** MIT
- **Dataset & Problem Source:** Zindi Africa
- **Author:** Rupesh

✨ *"Empowering Financial Inclusion through Data-Driven Intelligence."*
