

AI-Powered Loan Approval & Risk-Based Pricing System

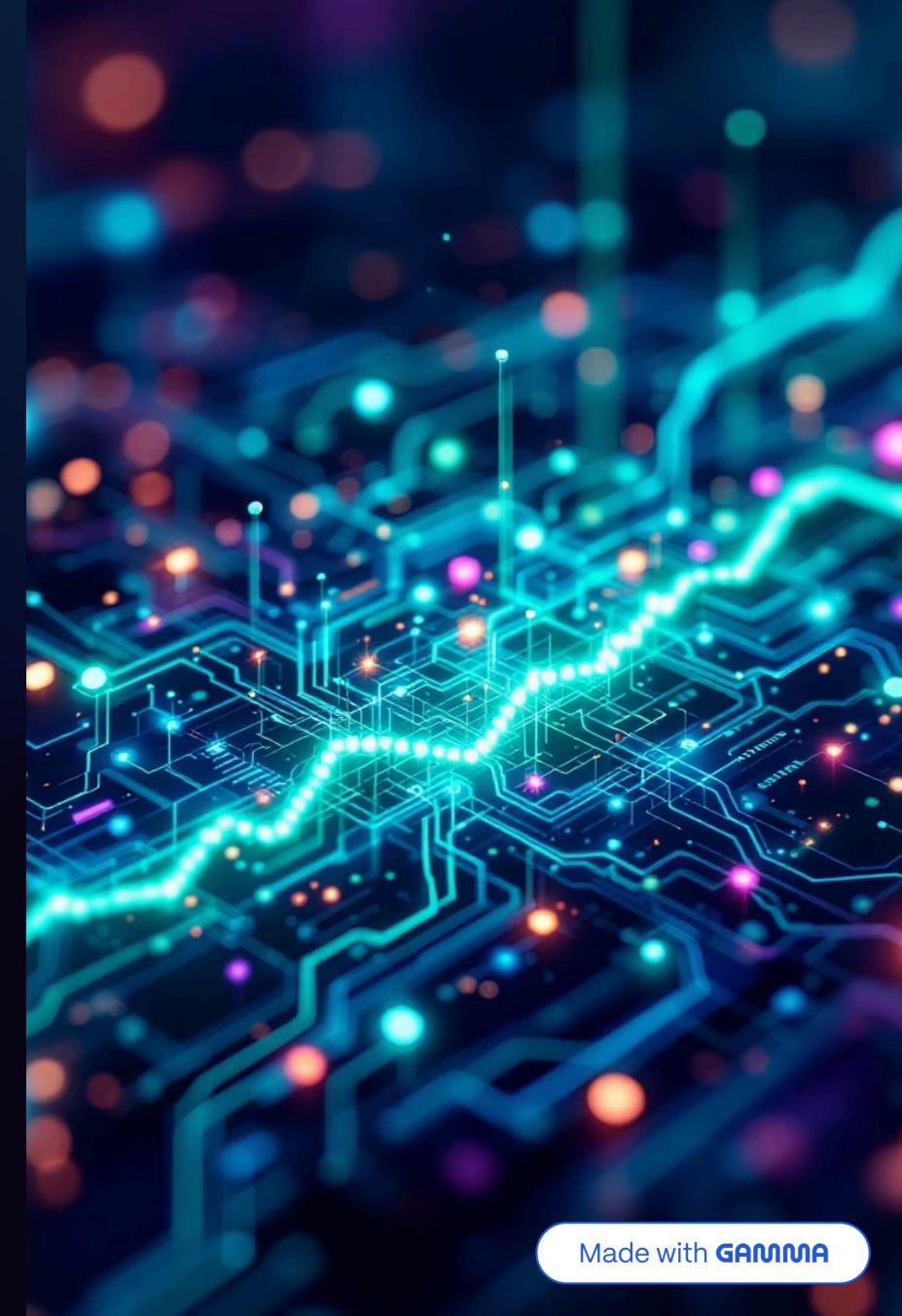
End-to-end machine learning system for automated credit decisions.

Built with classification, regression, and clustering models to transform traditional lending workflows.

MARTIN PETERSON

DATA SCIENTIST

APPLIED ML



The Challenge: Traditional Lending Falls Short

Legacy Systems Struggle

Traditional loan approval processes are plagued by inefficiencies that impact both lenders and borrowers. Manual review cycles create bottlenecks, while rigid rule-based systems fail to capture nuanced risk signals in borrower data.

Poor risk pricing leaves money on the table, and lack of scalability prevents lenders from competing effectively in fast-moving fintech markets.



Slow Manual Reviews

Days or weeks to process applications

Rigid Rule Systems

Inflexible logic misses qualified borrowers

Poor Risk Pricing

One-size-fits-all rates hurt profitability

Limited Scalability

Manual processes can't handle volume

Lenders need fast, consistent, and data-driven decisions that intelligently balance risk exposure with profitability goals.

Intelligent Automation Meets Lending

This project delivers a comprehensive automated loan decision system that transforms how lenders evaluate, approve, and price credit products. By combining multiple machine learning models with sophisticated business logic, the system provides instant, accurate, and auditable lending decisions.



Risk Evaluation

ML-powered borrower assessment



Loan Limits

Predicts maximum affordable amounts



Smart Pricing

Personalized interest rates by risk



Instant Decisions

Real-time approval via web interface



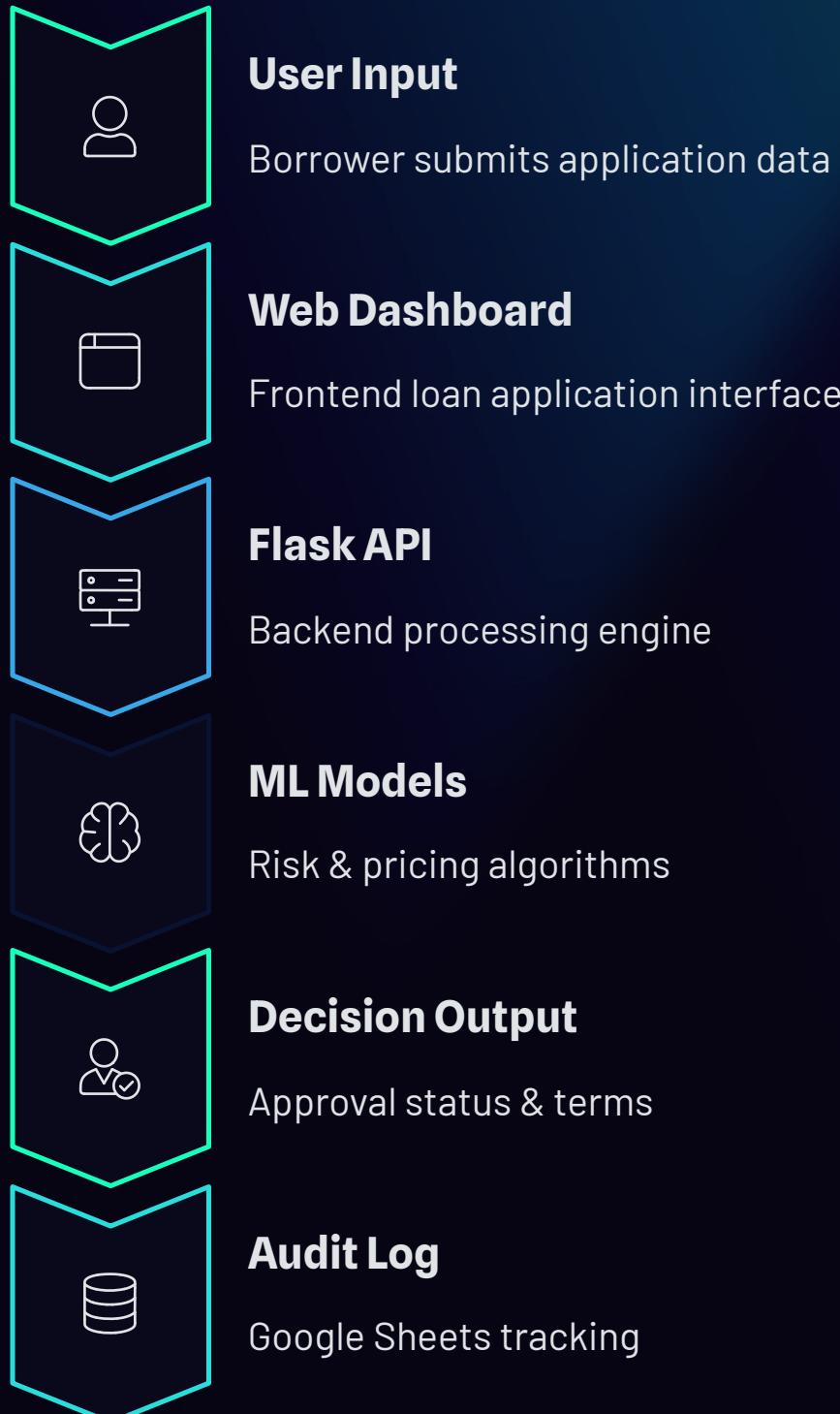
Audit Trail

Complete decision logging for compliance

- Designed to mirror real-world fintech lending workflows used by leading digital banks and alternative lenders.

System Architecture: Real-Time Decision Pipeline

The system follows a streamlined architecture that processes loan applications from submission to approval in seconds, with each component optimized for performance and reliability.



Frontend Layer

- Responsive loan dashboard
- Real-time result display
- EMI calculation interface

Processing Layer

- Flask REST API
- Model inference engine
- Business rule validation

Data Layer

- Decision logging
- Audit trail maintenance
- Performance monitoring

All components work together in real time, with sub-second response times for most loan applications.

Four-Model ML Architecture

The system leverages four specialized machine learning components, each solving a distinct business problem in the lending workflow. This modular approach enables independent model optimization and maintenance.

1

Loan Approval Model

Type: Binary Classification

Algorithm: XGBoost Classifier

Output: Approval probability and binary decision

Purpose: Determines whether applicant meets baseline creditworthiness criteria

2

Loan Amount Model

Type: Regression

Algorithm: XGBoost Regressor

Output: Maximum affordable loan amount

Purpose: Estimates lending capacity based on income, debt, and credit profile

3

Risk Segmentation

Type: Unsupervised Clustering

Algorithm: K-Means

Output: Risk category assignment

Purpose: Groups borrowers into distinct risk buckets for pricing strategy

4

Interest Rate Engine

Type: Rule-Based Pricing

Algorithm: Risk-adjusted rate calculation

Output: Personalized APR

Purpose: Converts risk assessment into competitive, profitable interest rates

Each model serves a clear business purpose and contributes to the final lending decision through a coordinated decision framework.

Approval Logic & Risk Assessment

The system separates risk evaluation from pricing decisions, ensuring consistent underwriting standards while enabling flexible rate strategies. This two-stage approach mirrors best practices in modern lending operations.

01

Probability Prediction

XGBoost classifier outputs approval probability score (0-1 scale)

02

Threshold Decision

Binary decision applied using calibrated cutoff threshold

03

Rejection Handling

Declined applicants logged with zero exposure, no pricing calculated

04

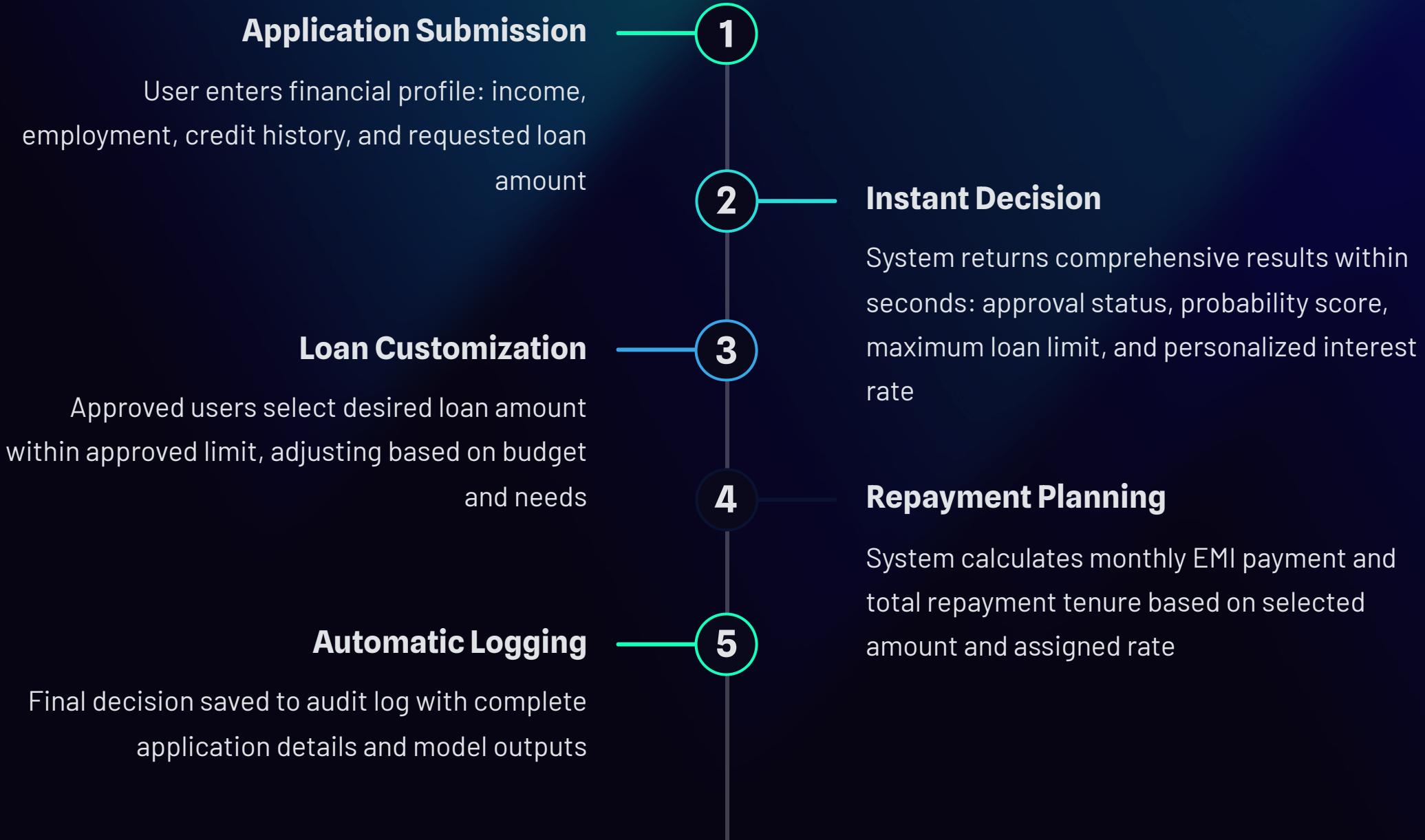
Approval Routing

Approved applicants advance to risk segmentation and pricing stage



Key Insight: Decoupling risk evaluation from pricing decisions enables independent optimization of underwriting standards and rate strategies, improving both approval accuracy and profit margins.

Seamless User Experience



- **Zero manual intervention required.** The entire workflow from application to decision occurs automatically, with human review only needed for exception cases or appeals.

Production-Ready Technology Stack

Built with deployment-first architecture using industry-standard tools and frameworks. Every component selected for reliability, scalability, and maintainability in production environments.



Backend Engine

- Python 3.9+
- Flask REST API
- Joblib serialization

ML Framework

- scikit-learn
- XGBoost
- NumPy & Pandas

Frontend Interface

- HTML5
- CSS3
- Vanilla JavaScript

Deployment

- Render hosting
- Google Apps Script
- Google Sheets logging

Why These Choices Matter

Flask provides lightweight, production-ready API serving. XGBoost delivers state-of-the-art accuracy for tabular data. Render enables simple, cost-effective deployment with zero infrastructure management.

Not Just Notebooks

This system is built for real-world deployment, not experimental analysis. Every component is production-hardened and designed for continuous operation under load.

Delivering Real-World ML Systems

What This Project Demonstrates

End-to-End System Design

From data to deployment, every component integrated into cohesive workflow

Real-Time Model Serving

Sub-second inference with production-grade API architecture

Risk-Aware Decision Logic

Business rules and ML predictions working in harmony

Production Deployment

Live system accessible via web, not trapped in notebooks

Audit-Friendly Logging

Complete decision trail for compliance and monitoring



Next Steps for Enhancement

1

2

Model Monitoring

Track performance drift and data quality

Fairness Analysis

Detect and mitigate algorithmic bias

3

4

Database Storage

Migrate from Sheets to scalable SQL/NoSQL

Authentication

Add secure user login and session management

Ready to scale: This foundation supports millions of loan decisions annually with minimal incremental investment.