CreditRisk.AI

Explainable AI Credit Risk Assessment Platform

Complete Platform Guide

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1. Introduction & Overview

CreditRisk.AI is a production-ready, explainable AI platform for credit risk assessment. It combines 6 state-of-the-art machine learning models with triple explainability (SHAP, LIME, and Counterfactual analysis) to help banks, fintechs, credit unions, and lending companies make fair, transparent, and compliant credit decisions.

Unlike traditional black-box credit scoring systems, CreditRisk.AI provides complete transparency into every decision — which exact factors contributed, how much each factor impacted the decision, and what the applicant can change to improve their outcome. This is not just a research prototype — it is a complete SaaS platform with a REST API, web frontend, authentication, rate limiting, and compliance with FCRA, ECOA, GDPR, and SR 11-7 regulations.

Key Capabilities

Capability	Description
6 ML Models	CatBoost, XGBoost, LightGBM, Random Forest, Gradient Boosting, Logistic Regression
50+ Application Fields	Comprehensive bank-grade credit application covering the 5 Cs of Credit
SHAP Explainability	Mathematically guaranteed fair attribution of each factor via game theory (Shapley values)
LIME Validation	Model-agnostic local interpretable explanations for dual-method verification
Counterfactual Analysis	"What-if" scenarios showing exactly what to change for approval
Fairness Auditing	Demographic parity and equalized odds detection via Fairlearn
Adverse Action Notices	FCRA-compliant legally required rejection notices with specific reasons
REST API	Production API with versioning (v1), authentication, rate limiting, batch processing
SaaS Website	Stunning dark-mode web interface for direct assessments
Regulatory Compliance	FCRA, ECOA, GDPR, and SR 11-7 (Federal Reserve Model Risk Management)

2. How to Use the Platform — Complete Flow

2.1 Installation

The platform requires Python 3.9 or higher. Follow these steps to install and run:

Step 1: Clone the repository

```
git clone https://github.com/keshav-kumar/credit-risk-platform.git
```

```
cd credit-risk-platform
```

Step 2: Install dependencies

```
pip install -r requirements.txt
```

Step 3: Start the platform

```
python -m uvicorn api.main:app --host 0.0.0.0 --port 8000
```

Step 4: Access the platform

Open your browser and navigate to http://localhost:8000 for the SaaS website, or http://localhost:8000/docs for the interactive API documentation (Swagger UI).

2.2 Complete User Flow

Step 1: Choose Assessment Mode

Quick Check (4 fields) for fast pre-qualification, or Full Assessment (50+ fields) for comprehensive bank-grade evaluation. The web interface offers both modes with a simple toggle switch.

Step 2: Fill in the Application Form

Enter the applicant's information across 9 sections: Personal Information, Employment & Income, Loan Details, Financial Profile, Debt Information, Credit Score & History, Assets & Collateral, Banking Relationship, and Additional Risk Factors. All fields have clear labels, descriptions, and validation ranges.

Step 3: Submit for Assessment

Click 'Assess Credit Risk' or 'Run Full Credit Assessment'. The platform processes the application through the feature engineering pipeline, runs the CatBoost ML model, computes SHAP explanations, calculates DTI and LTV ratios, and generates the complete risk report.

Step 4: View Results

Results appear instantly on screen with: (a) Decision (APPROVED/DECLINED), (b) Risk Grade (AAA to D), (c) Credit Score Equivalent (300-850), (d) Default Probability (%), (e) Risk Gauge visualization, (f) Top 10 SHAP factors with impact bars, (g) Human-readable explanation text.

Step 5: Review Explainability

Every decision shows which exact factors contributed and how much. SHAP factors are displayed as horizontal bars — green bars are factors that helped (risk-decreasing), red bars are factors that hurt (risk-increasing). Each factor has a human-readable explanation.

Step 6: If Declined — Adverse Action & Recommendations

For declined applications, the platform automatically generates: (a) FCRA-compliant Adverse Action Notice listing the exact reasons for rejection, (b) Actionable Recommendations on what to change, (c) Counterfactual 'What-If' analysis showing the minimum changes needed for approval.

2.3 API Integration Flow

For programmatic access, developers can integrate the REST API into any application. The flow is identical: (1) Send a POST request with application data, (2) Receive JSON response with decision, probability, risk grade, SHAP factors, explanations, and (if declined) adverse action notices.

Python Example:

```
import requests response = requests.post( 'http://localhost:8000/api/v1/assess',
json={'age': 35, 'credit_amount': 25000, 'duration': 36, 'annual_income': 85000,
'loan_purpose': 'auto_purchase'}, headers={'X-API-Key': 'demo-key-free-tier'} )
result = response.json() print(result['decision']) # APPROVED or DECLINED
print(result['risk_grade']) # AAA to D print(result['probability']) # 0.0 to 1.0
```

3. Who Can Use It & Access Control

3.1 Target Users

User Type	Use Case	Access Method
Large Banks	Regulatory-compliant, explainable credit decisioning at scale	Enterprise API + custom models
Regional/Community Banks	Affordable, transparent credit scoring with fairness audits	Business or Starter API tier
Credit Unions	Member-focused lending with clear explanations for rejections	Starter API or Web interface
Fintech Lenders	Rapid, scalable credit decisions for digital lending platforms	Business API with batch processing
NBFCs (Non-Banking Fin.)	Quick risk screening for consumer/micro-lending	Quick Check API or Web interface
Retail Lending Companies	Auto loans, personal loans, education loans decisioning	Full Assessment API
Mortgage Companies	Home loan risk assessment with LTV and DTI calculations	Enterprise API tier
Insurance Companies	Risk evaluation for credit-linked insurance products	Business API tier
Regulators / Auditors	Model validation, fairness audits, bias detection	Model Info + Fairness endpoints
Loan Officers	Manual decision support with AI recommendations	Web interface (SaaS website)
Researchers / Students	Study explainable AI in credit risk	Free tier (10/day)

3.2 Access Tiers & API Keys

Access is controlled via API keys passed in the X-API-Key HTTP header. Each tier has a daily prediction limit. Anonymous requests (no API key) are limited to 5/day.

Tier	Price	Daily Limit	Features
Free	$0/mo	10	Basic predictions, SHAP, Web dashboard
Starter	$99/mo	500	Full API, SHAP + LIME, Adverse notices, Email support
Business	$299/mo	5,000	Batch processing, Fairness audits, White-label, Priority support
Enterprise	$999/mo	Unlimited	Custom models, On-premise, 24/7 support, SLA, Audit trail

3.3 Authentication Flow

1. User signs up and receives an API key for their chosen tier. 2. API key is passed in the X-API-Key header with every request. 3. Server validates the key, checks the rate limit for the tier, and processes the request. 4. If the key is invalid, the server returns HTTP 401 (Unauthorized). 5. If the rate limit is exceeded, the server returns HTTP 429 (Too Many Requests). 6. Anonymous requests (no key) are allowed with a 5/day limit for evaluation purposes.

4. Technology Stack — What We Use & Why

4.1 Machine Learning Models

Model	Type	Role	Why It Matters
CatBoost	Gradient Boosted Trees	Primary (Best Performance)	Handles categorical features natively, excellent with imbalanced d
XGBoost	Gradient Boosted Trees	Secondary	Industry standard with regularization; widely trusted in banking
LightGBM	Gradient Boosted Trees	Secondary	Fastest training, handles large datasets with leaf-wise tree growth
Random Forest	Ensemble (Bagging)	Baseline Ensemble	Robust and easy to interpret; serves as sanity check
Gradient Boosting	Sequential Ensemble	Classic Method	Well-understood, provides comparison benchmark
Logistic Regression	Linear Model	Interpretable Baseline	Fully transparent, used for regulatory comparison

4.2 Explainability Methods

Method	Type	How It Contributes
SHAP (TreeExplainer)	Game Theory (Shapley Values)	Provides mathematically guaranteed fair attribution. Every feature gets an exac
LIME	Model-Agnostic Local	Creates a simplified interpretable model around each prediction. Used as seco
Counterfactual Analysis	Perturbation-Based	Shows applicants the minimum change needed for a different outcome, e.g., 'F
Adverse Action Notices	Template + SHAP	FCRA-legally required rejection notices with specific reasons and consumer rig
Actionable Recommendations	Rules + SHAP	Practical advice: 'Reduce existing debt', 'Consider shorter loan term'. Derived f

4.3 Fairness & Compliance

Component	Technology	Contribution
Bias Detection	Fairlearn	Detects demographic parity violations and equalized odds differences across pro
FCRA Compliance	Auto-generated notices	Legally required adverse action notices with specific reasons and consumer righ
ECOA Compliance	Fairness metrics	Ensures no discriminatory lending practices based on protected classes
GDPR Compliance	Explainability framework	Right to explanation for automated decisions — every prediction fully explained
SR 11-7 Compliance	Model card + audit trail	Federal Reserve model risk management — full documentation of model develo

4.4 Platform Stack

Layer	Technology	Why
API Framework	FastAPI (Python)	Fastest Python API framework, async support, auto-generated OpenAPI docs
Frontend	HTML/CSS/JS	No framework dependency, instant loading, works everywhere
ML Pipeline	scikit-learn + joblib	Industry-standard preprocessing, serialization of trained models
Data Processing	pandas + numpy	Fast in-memory data manipulation for feature engineering
Visualization	Plotly + SHAP plots	Interactive charts and SHAP force/waterfall plots
Database (Future)	PostgreSQL / SQLite	Persistent storage for audit trail and predictions
Containerization	Docker + docker-compose	One-command deployment: docker-compose up -d
PDF Reports	ReportLab	Generate professional PDF reports for each assessment

5. Deployment Guide — Free & Secure

You can deploy CreditRisk.AI completely free using several cloud platforms. Here are the best options, ranked by ease and suitability:

5.1 Option 1: Railway.app (Recommended — Free Tier)

Railway provides free hosting for web applications with a generous free tier (500 hours/month, 512 MB RAM). It supports Python applications natively and can run uvicorn directly.

1. Create a free account at railway.app
2. Create a new project from your GitHub repository
3. Set the start command: python -m uvicorn api.main:app --host 0.0.0.0 --port $PORT
4. Railway auto-detects requirements.txt and installs dependencies
5. Deploy! You get a public URL like: creditrisk-ai.up.railway.app

5.2 Option 2: Render.com (Free Tier)

Render offers a free tier for web services. Add a render.yaml file to your repo and connect your GitHub. Free tier includes 750 hours/month. The application sleeps after 15 minutes of inactivity but wakes automatically on request.

5.3 Option 3: Docker on Any Cloud (AWS/GCP/Azure Free Tier)

All major cloud providers offer free tiers: AWS EC2 t2.micro (12 months free), GCP e2-micro (always free), Azure B1S (12 months free). Deploy the Docker container with: docker-compose up -d

5.4 Option 4: HuggingFace Spaces (Free, ML-Focused)

HuggingFace Spaces supports Docker and Gradio/Streamlit apps. Perfect for ML demos. Create a Space, upload your code, and get a public URL. Free tier includes 2 vCPUs and 16 GB RAM.

5.5 Option 5: Fly.io (Free Tier)

Fly.io offers 3 free VMs with 256 MB RAM each. Supports Docker containers. Deploy with: flyctl launch && flyctl deploy

5.6 Deployment Configuration

```
# Procfile (for Railway/Render): web: python -m uvicorn api.main:app --host
0.0.0.0 --port $PORT # Docker (docker-compose.yml already included):
docker-compose up -d # Environment Variables: API_KEY_SECRET=your-secret-key
DATABASE_URL=postgresql://... LOG_LEVEL=info
```

6. Security Architecture

When pitching to banks and financial institutions, security is paramount. Here is how CreditRisk.AI ensures your data and intellectual property are protected:

Security Layer	Implementation	Protection
API Authentication	API key in X-API-Key header	Prevents unauthorized access; each user has unique key
Rate Limiting	Per-key daily limits (in-memory, Redis in prod)	Prevents misuse, DDoS, and API scraping
HTTPS (in prod)	TLS/SSL via reverse proxy (nginx/Caddy)	Encrypts all data in transit between client and server
Input Validation	Pydantic models with strict types and ranges	Prevents injection attacks and malformed requests
CORS Policy	Configurable allowed origins	Prevents cross-origin attacks from unauthorized websites
No PII Storage	Stateless API — no applicant data stored	No database breach risk; GDPR compliant by design
Model Protection	Model files on server only, not exposed via API	Your trained models are never downloadable
Audit Trail (Enterprise)	Per-request logging with timestamps	Full audit trail for regulatory compliance
Container Isolation	Docker containers with minimal attack surface	Isolates runtime environment from host system
Environment Variables	Secrets stored as env vars, not in code	API keys, DB credentials never in source code

6.1 Production Security Checklist

- Enable HTTPS via TLS certificates (Let's Encrypt for free)
- Use environment variables for all secrets (API keys, DB URLs)
- Replace in-memory rate limiting with Redis-based solution
- Add request logging to a database for audit trail
- Set CORS origins to your specific frontend domain(s) only
- Enable API key rotation and expiration policies
- Run the application behind a reverse proxy (nginx/Caddy/Traefik)
- Monitor application health and set up alerts (Prometheus/Grafana)
- Regular security scanning of dependencies (pip audit, Snyk)
- Implement JWT-based authentication for user management

7. Differentiating Factors — Why We're the Best

When pitching CreditRisk.AI to potential customers, investors, or partners, here are the key differentiating factors that set us apart from every competitor in the market:

7.1 Triple Explainability (No Competitor Has This)

Most credit scoring products use a single explainability method (usually basic feature importance). CreditRisk.AI uses THREE complementary methods — SHAP, LIME, and Counterfactual Analysis — providing the most comprehensive, auditable, and regulator-friendly explanation system in the industry. When SHAP and LIME agree on the top factors, confidence in the explanation is mathematically maximized.

7.2 Comprehensive Bank-Grade Application (50+ Fields)

Most competitors accept limited input fields. CreditRisk.AI covers ALL questions used by both large banks (JP Morgan, Wells Fargo, Bank of America) and small community banks, organized into the 5 Cs of Credit framework: Character, Capacity, Capital, Collateral, and Conditions. This includes credit score, DTI ratio, LTV ratio, employment history, assets, and 40+ other fields.

7.3 Built-In Regulatory Compliance

CreditRisk.AI auto-generates legally required FCRA adverse action notices. No other open-source or SaaS credit platform does this automatically. This saves banks hundreds of hours and reduces compliance risk. Additionally, Fairlearn-based bias detection ensures ECOA compliance.

7.4 Consumer-Friendly Counterfactual Analysis

When an applicant is declined, the platform tells them EXACTLY what to change for approval: 'Reduce your loan amount by 20%' or 'Reduce existing debt obligations'. This is a unique feature that builds consumer trust, reduces complaints, and drives repeat applications — directly impacting the lender's bottom line.

7.5 Dual Mode: Quick Check + Full Assessment

The Quick Check (4 fields) mode enables instant pre-qualification in under 10 seconds. The Full Assessment (50+ fields) provides comprehensive bank-grade evaluation. No competitor offers both in the same platform with a seamless toggle.

7.6 Competitive Comparison

Feature	CreditRisk.AI	FICO Score	Zest AI	Upstart
Explainability Methods	3 (SHAP+LIME+CF)	None	1 (proprietary)	1 (proprietary)
Open Source	Yes (MIT)	No	No	No

Feature	CreditRisk.AI	FICO Score	Zest AI	Upstart
Adverse Action Auto-Gen	Yes	No	Partial	Partial
Fairness Auditing	Yes (Fairlearn)	No	Limited	Limited
50+ Application Fields	Yes	Limited	Limited	Limited
Self-Hosted Option	Yes	No	No	No
API + Web Interface	Both	API only	API only	Web only
Free Tier	Yes (10/day)	No	No	No
Counterfactual Analysis	Yes	No	No	No
Regulatory Compliance	4 frameworks	FCRA only	Partial	Partial

8. Pitch-Ready Business Case

8.1 Market Opportunity

The global credit scoring market is expected to reach $30.1 billion by 2030 (CAGR 14.2%). Regulatory pressure for explainable AI is intensifying globally — the EU AI Act requires 'right to explanation' for all automated financial decisions. Banks that don't adopt explainable AI face regulatory penalties, consumer lawsuits, and reputational damage. CreditRisk.AI is perfectly positioned to capture this demand.

8.2 Revenue Model

Tier	Monthly Revenue	Annual Revenue	Target Customers
Free (Lead Gen)	$0	$0	Researchers, students, evaluators
Starter ($99/mo)	$99	$1,188	Small credit unions, NBFCs
Business ($299/mo)	$299	$3,588	Regional banks, fintechs
Enterprise ($999/mo)	$999	$11,988	Large banks, insurance

With just 10 Starter + 5 Business + 2 Enterprise customers, the platform generates $4,483/month ($53,796/year) in recurring revenue. The free tier serves as a powerful lead generation tool.

8.3 Elevator Pitch (30 Seconds)

"CreditRisk.AI is an explainable AI platform that helps banks make transparent, fair, and compliant credit decisions. Unlike black-box credit scores, we show exactly WHY every decision was made — using three different AI explanation methods. We auto-generate legally required rejection notices, detect bias, and tell declined applicants exactly what to change for approval. Banks save compliance costs, reduce lawsuits, and increase repeat applications. We're the only platform that combines triple explainability, fairness auditing, and 50+ field bank-grade assessment — and it's available as SaaS or self-hosted."

9. Appendix: API Reference

Method	Endpoint	Description	Auth Required
POST	/api/v1/assess	Full 50+ field credit assessment with SHAP	Yes
POST	/api/v1/quick-check	Rapid 4-field screening	Yes
POST	/api/v1/batch-assess	Batch (up to 100 applications)	Yes
POST	/api/v1/explain/lime	LIME model-agnostic explanation	Yes
GET	/api/v1/health	Health check and uptime	No
GET	/api/v1/model-info	Model performance and metadata	No
GET	/api/v1/pricing	Pricing tiers	No
GET	/api/v1/application-fields	All available fields with types	No
GET	/docs	Interactive Swagger UI	No
GET	/redoc	ReDoc API documentation	No

For complete field-level documentation, visit http://localhost:8000/docs — the Swagger UI provides interactive documentation with example requests and responses for every endpoint.