### **Information Document for the Developer**

#### **System Overview**

We are building a Loan Application Management System that leverages machine learning to assess applicant eligibility and manage the end-to-end workflow of loan applications. The system is designed for both loan applicants and admins, with separate dashboards for each.

### **Key Features**

1. User Registration and Authentication
   * Loan Applicant:
     + Can register and log in to apply for loans.
   * Admin:
     + Accounts created manually with secure keys for access.
2. Loan Application Process
   * Form Submission:
     + Applicants submit required details via an application form.
   * Eligibility Check:
     + AI model evaluates eligibility based on the input data.
     + Result:
       - Eligible: Notified to proceed with document verification.
       - Not Eligible: Notified with suggestions for other government loans and can reapply after 3 months.
3. Document Verification
   * Eligible applicants upload mandatory documents (e.g., proof of identity, business ownership).
   * Admins review and approve/reject submissions.
4. Admin Dashboard
   * Manage loan applications.
   * View and approve/reject documents.
   * Approve loan disbursements.
5. Applicant Dashboard
   * Apply for loans.
   * Upload documents.
   * Track application status.
6. Loan Disbursement
   * Final admin approval triggers loan disbursement.

### **AI Model Overview**

1. Model Type:
   * Random Forest Classifier.
2. Training Details:
   * Input Features:
     + Business Information:
       - Business activity duration.
       - Business type.
       - Industry.
       - Business location (LGA and town).
     + Financial Information:
       - Bank account status.
       - Use of digital payment systems.
       - Financial management style.
     + Challenges and Needs:
       - Challenges faced by the business.
       - Preferred government support.
       - Growth drivers for the business.
     + Loan History:
       - Previous loan application history.
     + Regulatory Challenges:
       - Issues faced with government rules/taxes.
   * Target:
     + Loan eligibility (Yes/No).
   * Data Preparation:
     + Label encoding for structured inputs (e.g., business type, LGA).
     + One-hot encoding for categorical features.
   * Performance Metrics:
     + Test Accuracy: ~99%.
     + F1 Score: High precision and recall for both eligible and ineligible classes.
3. Model Input and Output:
   * Input: Preprocessed application data.
   * Output: Eligibility prediction (1 = Yes, 0 = No).

### **Developer Tasks**

#### **Frontend Development**

1. User Interface:
   * Design and develop forms for:
     + Loan application.
     + Document upload.
   * User and admin dashboards.
2. Document Upload:
   * Secure file upload system with progress indicators.
   * Ensure documents are stored securely in the backend.

#### **Backend Development**

1. Authentication and Authorization:
   * Implement user authentication (e.g., JWT tokens).
   * Role-based access control (applicant/admin).
2. API Endpoints:
   * Loan application submission.
   * Eligibility prediction using the trained model.
   * Document upload and verification.
   * Admin actions (approve/reject applications).
3. Database Schema:
   * Tables for:
     + Users (applicant/admin).
     + Applications (status, timestamps, decisions).
     + Documents (file metadata, verification status).
4. Integration with AI Model:
   * Load and use the trained Random Forest model for real-time predictions.

#### **Deployment**

1. Cloud Platform:
   * Deploy the system on Google Cloud Run.
   * Ensure secure and scalable infrastructure.
2. Security:
   * Encrypt sensitive data (e.g., documents, applicant details).
   * Implement rate limiting and logging for API calls.
3. Version Control:
   * Use Git for collaborative development.

### **Detailed Information for Loan Application System Development**

### **Application Form**

#### **1. Personal Information**

* Fields (These are for user identification and are not used for the model predictions):
  + Full Name:
    - First Name: Text input.
    - Last Name: Text input.
    - Other Names (Optional): Text input.
  + Date of Birth:
    - Date picker input (to calculate age automatically).
  + Gender:
    - Dropdown: Male, Female, Other.
  + Contact Information:
    - Email Address: Text input (validated for email format).
    - Phone Number: Text input (validated for phone number format).
  + Address:
    - Residential Address: Text input.
    - Local Government Area (LGA): Dropdown with all available LGAs.
    - State of Origin: Dropdown with all Nigerian states.

#### **2. Business Information**

* Fields:
  + Business Name: Text input.
  + Business Address: Text input.
  + How long has your business been active? (Used for model predictions):
    - Dropdown: Less than 1 year, 1-3 years, 4-7 years, Over 7 years.
  + What type of business do you run? (Used for model predictions):
    - Dropdown: Nanoenterprise (0-4 employees), Microenterprise (5-9 employees), Small Enterprise (10-49 employees), Medium Enterprise (50-249 employees).
  + In which industry does your business operate? (Used for model predictions):
    - Dropdown: Retail, Services (e.g., hairdressing, tailoring), Agriculture, Manufacturing, Technology, Other.
  + LGA of business (Used for model predictions):
    - Dropdown with all available LGAs.
  + Town of business: Text input.

#### **3. Financial and Operational Information**

* Fields:
  + Do you have a bank account for your business? (Used for model predictions):
    - Dropdown: Yes, No.
  + Do you use any digital payment systems? (Used for model predictions):
    - Dropdown: Yes, No.
  + How do you manage your business finances? (Used for model predictions):
    - Dropdown: Formal accounting system, Basic bookkeeping, No formal system, Outsourced accountant.

#### **4. Challenges and Needs**

* Fields:
  + What are the biggest challenges your business faces? (Used for model predictions):
    - Dropdown: Access to finance, High costs of operations, Getting customers, Competition, Regulatory compliance, Other.
  + What kind of support would you like from the government? (Used for model predictions):
    - Dropdown: Easier access to loans, Lower taxes or fees, Better infrastructure, More business advice and training.
  + What would help your business grow the most? (Used for model predictions):
    - Dropdown: More access to money, Better equipment, Lower business costs, Better infrastructure, More skilled workers.

#### **5. Loan History**

* Fields:
  + Have you ever tried to get a loan for your business? (Used for model predictions):
    - Dropdown: Yes, No.
  + If Yes, how did you get the loan? (Used for model predictions):
    - Dropdown: Bank/Financial institution, Family/Friend, Other.
  + If you did not get a loan, what was the main reason? (Used for model predictions):
    - Dropdown: Didn't know how to apply, Interest rates too high, No collateral, Other.

#### **6. Regulatory Challenges**

* Fields:
  + Have you faced any issues with government rules or taxes? (Used for model predictions):
    - Dropdown: Yes, No.

### **Dashboards**

#### **1. Admin Dashboard**

* Features:
  + Loan Application Overview:
    - List of all applications with key details (Name, Business Name, Eligibility Status, Verification Status, Loan Amount).
  + Review Applications:
    - Detailed view of each application with all the information collected.
    - Ability to approve or reject eligible applications.
    - Comments section for providing feedback to applicants.
  + Verification Status:
    - View the status of submitted documents for eligible applications.
    - Mark documents as verified or request resubmission.
  + Reports and Analytics:
    - Visualization of loan approvals, rejections, and pending applications.
    - Summary of most common challenges and requested supports.
  + Admin Management:
    - Add or remove admins with access keys.

#### **2. Applicant Dashboard**

* Features:
  + Application Status:
    - View current loan application status (Submitted, Under Review, Approved, Rejected).
  + Eligibility Result:
    - If ineligible: Display rejection message with reasons and redirect options to other programs.
    - If eligible: Display success message and guide to document verification.
  + Document Submission:
    - Upload required documents for verification.
    - Status of document verification (Pending, Verified, Rejected with reasons).
  + Application History:
    - History of previous applications with statuses and details.
  + Profile Management:
    - Update contact information or business details (limited fields).

### **Key Notes for Developer**

1. API Integration:
   * The AI model's API will evaluate loan eligibility based on fields marked as Model Input.
2. Database Design:
   * Separate tables for users, loan applications, and admin actions.
3. Document Verification:
   * Store uploaded documents securely with metadata (e.g., file type, size, upload date).
4. Notifications:
   * Email or SMS notifications for application updates.
5. User Roles:
   * Role-based authentication to differentiate admin and applicants.

# API Documentation for Loan Eligibility Model Deployment

## Overview

This API is designed to determine the loan eligibility of applicants using an AI model trained on various business, financial, and operational data. The API evaluates loan applications and returns predictions on whether the applicant is eligible for a loan.

## Base URL

The API will be hosted on a platform like Google Cloud Run, and the base URL will be provided during deployment (e.g., https://loan-eligibility-api.run.app).

## Authentication

* Admins: Access secured via API keys or JWT tokens. Admins manage loan applications and approve eligible applicants.
* Users: No authentication required for accessing the eligibility endpoint, but account creation/login may be required for integrated systems.

## Endpoints

### 1. **Check Loan Eligibility**

Endpoint: /predict

Method: POST

Description: This endpoint accepts loan application data and returns a prediction on loan eligibility.

#### **Request Body**

The request body should include all the fields the model requires for making predictions. These are either categorical or numerical features.

Request Example:

json

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{

"how\_long\_has\_your\_business\_been\_active": "1-3 years",

"what\_type\_of\_business\_do\_you\_run": "Nanoenterprise (0-4 employees)",

"in\_which\_industry\_does\_your\_business\_operate": "Retail",

"lga\_of\_business": "Enugu South",

"town\_of\_business": "Nsukka",

"do\_you\_have\_a\_bank\_account\_for\_your\_business": "Yes",

"do\_you\_use\_any\_digital\_payment\_systems": "No",

"how\_do\_you\_manage\_your\_business\_finances": "Basic book-keeping",

"what\_are\_the\_biggest\_challenges\_your\_business\_faces": "Access to finance",

"what\_kind\_of\_support\_would\_you\_like\_from\_government": "Easier access to loans",

"what\_would\_help\_your\_business\_grow\_the\_most": "More access to money",

"have\_you\_ever\_tried\_to\_get\_a\_loan\_for\_your\_business": "No",

"if\_yes\_how\_did\_you\_get\_the\_loan": "Unknown",

"if\_you\_did\_not\_get\_a\_loan,\_what\_was\_the\_main\_reason": "Unknown",

"have\_you\_faced\_any\_issues\_with\_government\_rules\_or\_taxes": "No"

}

#### **Response**

The response will indicate whether the applicant is eligible for a loan.

Response Example (Eligible):

json

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{

"loan\_eligibility": "Eligible",

"message": "You are eligible for a loan. Please proceed to verification."

}

Response Example (Not Eligible):

json

Copy code

{

"loan\_eligibility": "Not Eligible",

"message": "You are not eligible for a loan. You can reapply after 3 months or explore other government loan options."

}

### 2. **Submit Verification Documents**

Endpoint: /verify-documents

Method: POST

Description: This endpoint allows eligible applicants to submit required documents for further verification.

#### **Request Body**

json

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{

"applicant\_id": "12345",

"documents": {

"id\_card": "base64\_encoded\_string\_or\_url",

"business\_certificate": "base64\_encoded\_string\_or\_url",

"bank\_statement": "base64\_encoded\_string\_or\_url"

}

}

#### **Response**

Success:

json

Copy code

{

"status": "Verification Submitted",

"message": "Your documents have been submitted successfully. The admin will review and notify you of the decision."

}

Error:

json

Copy code

{

"status": "Error",

"message": "Invalid document format or missing required documents."

}

### 3. **Admin Loan Approval**

Endpoint: /admin/approve-loan

Method: POST

Description: Allows admins to approve or reject loan applications.

#### **Request Body**

json

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{

"applicant\_id": "12345",

"admin\_decision": "Approve",

"remarks": "The loan has been approved based on eligibility and verification."

}

#### **Response**

Success:

json

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{

"status": "Loan Approved",

"message": "The loan application has been approved. Funds will be disbursed shortly."

}

Rejection:

json

Copy code

{

"status": "Loan Rejected",

"message": "The loan application has been rejected. Remarks: Missing verification documents."

}

## Error Handling

### Common Errors

1. 400 Bad Request:
   * Cause: Missing or invalid input fields.
   * Response:

json

Copy code

{

"error": "Invalid request data. Please check your input and try again."

}

1. 401 Unauthorized:
   * Cause: Missing or invalid API key for admin routes.
   * Response:

json

Copy code

{

"error": "Unauthorized access. Please provide a valid API key."

}

1. 500 Internal Server Error:
   * Cause: Server error during processing.
   * Response:

json

Copy code

{

"error": "An unexpected error occurred. Please try again later."

}

## Deployment Notes

* Scaling: Ensure auto-scaling is enabled on Google Cloud Run to handle high traffic.
* Security: Use HTTPS for secure communication and encrypt sensitive data.
* Monitoring: Integrate logging and monitoring tools (e.g., Stackdriver, Sentry) for performance tracking.

## Summary

This API provides endpoints for evaluating loan eligibility, handling verification, and admin management. With the combination of the AI model and admin oversight, this system ensures transparency and fairness in loan disbursement processes.

Admin Dashboard

#### **Purpose:** Allows admins to manage loan applications, verify documents, and approve/reject applications.

#### **Key Sections:**

1. Dashboard Overview
   * Statistics:
     + Total applications received.
     + Pending applications.
     + Approved applications.
     + Rejected applications.
     + Applications under verification.
   * Graphs/Charts:
     + Loan application trends over time.
     + Success rates (Eligible vs. Non-eligible).
   * Search Bar:
     + Quickly find applications by applicant name, ID, or status.
2. Applications Management
   * Tabs:
     + All Applications: List of all applications.
     + Pending Applications: Applications awaiting admin review.
     + Under Verification: Applications pending document verification.
     + Approved Applications: Applications approved for disbursement.
     + Rejected Applications: Rejected applications.
   * Actions:
     + View details of a loan application.
     + Approve or reject applications.
     + Add admin comments or notes.
3. Verification Management
   * View documents uploaded by applicants.
   * Mark verification as successful or failed.
   * Request additional documents or clarifications from users.
4. Notifications
   * Real-time notifications for new applications or verification results.
5. Admin Management
   * Add new admins to the system.
   * View admin activity logs for accountability.
6. Settings
   * Update loan eligibility criteria (if adjustable).
   * Configure notification settings (email/SMS).

### **User Dashboard**

#### **Purpose:** Allows applicants to view their loan application status, submit applications, and upload verification documents.

#### **Key Sections:**

1. Dashboard Overview
   * Application Status:
     + Displays the status of the user's current or past loan applications (e.g., Pending, Approved, Rejected).
   * Notifications:
     + Updates about their loan application, e.g., verification requests or admin decisions.
2. Apply for a Loan
   * Form Fields:
     + Personal and business information.
     + Financial and operational details.
     + Challenges and needs.
   * Submit Button:
     + After submission, the system checks eligibility using the AI model.
3. Verification
   * Document Upload:
     + Upload identification, business registration, and other required documents.
   * Verification Status:
     + Displays the status of submitted documents (e.g., Verified, Pending, Rejected).
   * Re-upload Option:
     + Users can re-upload documents if verification fails.
4. Loan History
   * Displays previous applications with:
     + Submission date.
     + Eligibility result.
     + Admin decision.
     + Loan amount (for approved applications).