Platform

jupyter

Enhancement

IDE

FastAPI

API Serving

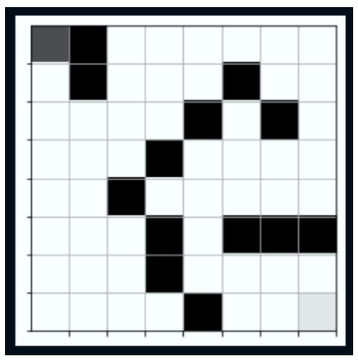
WSL

Windows Subsystem for Linux

docker

Containerization

Data Presentation (UI)



Enhancement

Chart.js

Interactive Charts

React

Web UI

TAURI

Desktop

Database

Enhancement

PostgreSQL

Relational Database

SQLAlchemy

Python & Postgres Interface

Algorithms & Modeling

Keras

A deep learning library

Enhancement

scikit learn

Linear regression, preprocessing, metrics

PROPHET

Time Series Forecasting

PyTorch

Reinforcement Learning

Data Source & Transformation

NumPy

Enhancement

BLS

BUREAU OF LABOR STATISTICS
U.S. DEPARTMENT OF LABOR

Bureau of Labor & Statistics

United States Census Bureau

US Census API

FRED

ECONOMIC DATA | SINCE 1991

Federal Reserve & Economic Data

polars

Data Transformation

Pandas

Data Transformation

System Architecture

Data & ETL

A1. External Data Sources

US Census (ACS/ BPS)

Bureau of Labor & Statistics (JOLTS/ Unemployment)

Federal Reserve & Economic Data (rates)

A2. ETL & Orchestration

Requests + Rate Limiting, Retries, Secrets via .env

Batch ID, idempotent upserts, logging

A3. Data Processing

Clean, Validate (nulls, ranges), normalize, feature engineering

Storage & Models

B1. PostgreSQL (Schemas: raw, stg, core, ml)

core.population_observations, core.indicator_values

Ml.feature_matrix (materialized view)

Indexes incl. uq_fm_geo_year

B2. Model Training (Dockerized)

Linear regression, preprocessing, metrics

Time Series Forecasting

Reinforcement Learning

Evaluation & Selection (MAE/MAPE)

B3. Model Artifacts / Registry

Repository Structure

```
/PopulationPredictionPlatform
| ── /data # Raw & processed Census data
| ── /models # Trained model artifacts
| ── /notebooks # Prototyping and experimentation
| ── /api # FastAPI service
```

models/ + metadata.json (versioned)

API & UI

C1. FastAPI Service (SQL Alchemy)

/predicts, /metrics, /health; Auth (JWT/basic)

C2. React (Web) / Tauri (Desktop)

Scenario inputs, Chart.js forecasts, export PNG/CSV

Security & Observability

PostgreSQL

Row Based Access Control

Docker

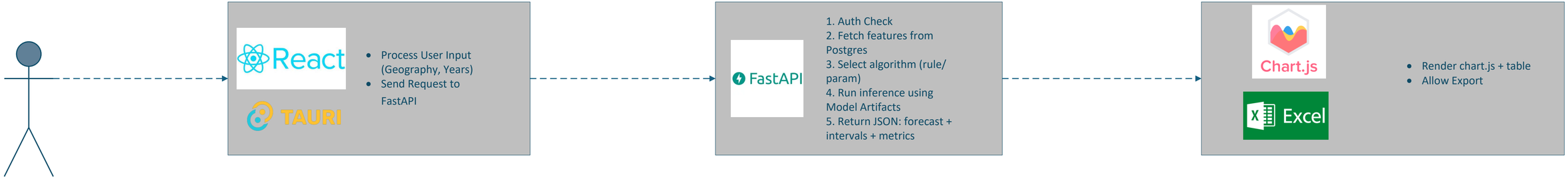
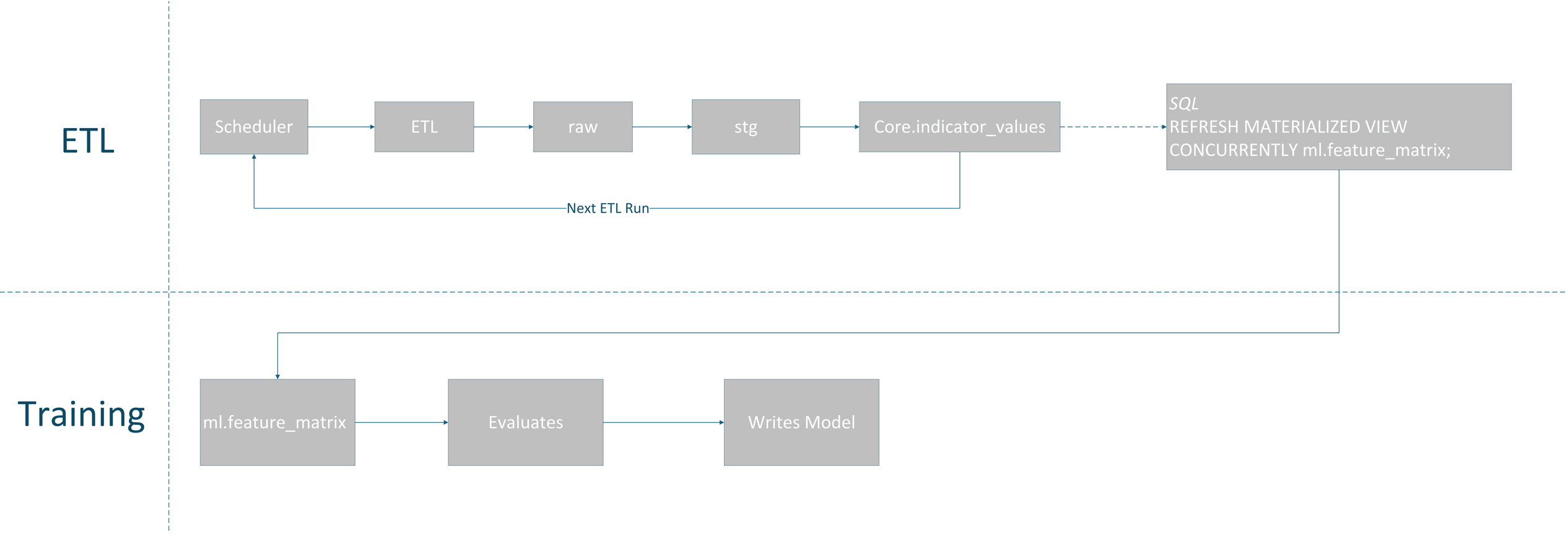
Secret management (.env)

Container Hardening

Structured Logs

Health Checks & Metrics

Request -> Predict -> Visualize



ETL Training Loop