

Platform



Jupyter

Enhancement



IDE

FastAPI

API Serving

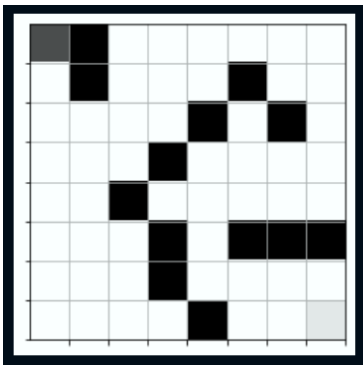


Docker
Containerization



Windows
Subsystem for
Linux

Data
Presentation
(UI)



Enhancement



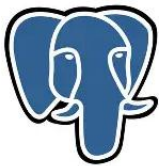
Web UI



Chart.js
Interactive
Charts

Database

Enhancement

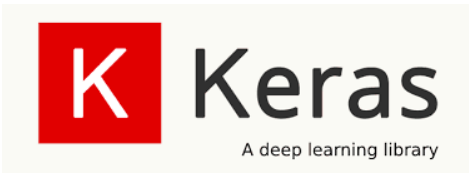


PostgreSQL
Relational
Database



SQLAlchemy
Python & Postgres Interface

Algorithms &
Modeling



Keras
A deep learning library

Enhancement



Linear regression,
preprocessing, metrics



Time Series
Forecasting



Reinforcement
Learning

Data Source &
Transformation



NumPy

Enhancement



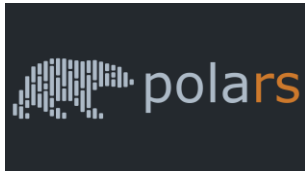
Bureau of Labor &
Statistics



Federal Reserve
& Economic
Data



US Census API



Data Transformation



Data Transformation

System Architecture

Data & ETL

A1. External Data Sources



US Census (ACS/
BPS)



Bureau of Labor &
Statistics (JOLTS/
Unemployment)



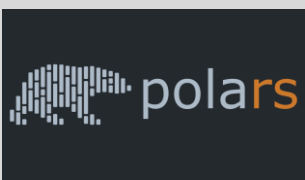
Federal Reserve &
Economic Data (rates)

A2. ETL & Orchestration



Requests + Rate Limiting, Retries, Secrets via .env
Batch ID, idempotent upserts, logging

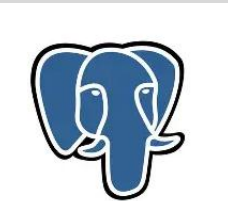
A3. Data Processing



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

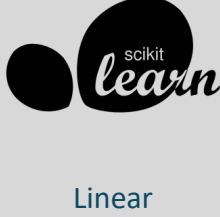
Storage &
Models

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)



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)

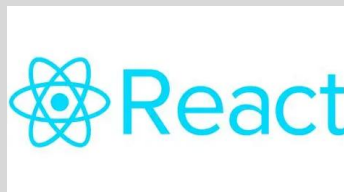
API & UI

C1. FastAPI Service (SQLAlchemy)



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

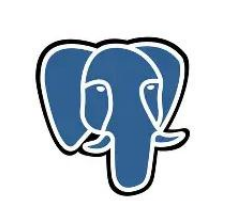
C2. React (Web) / Tauri (Desktop)



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

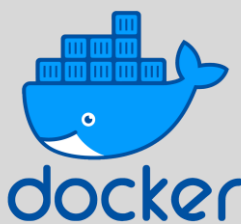
Security &
Observability

PostgreSQL



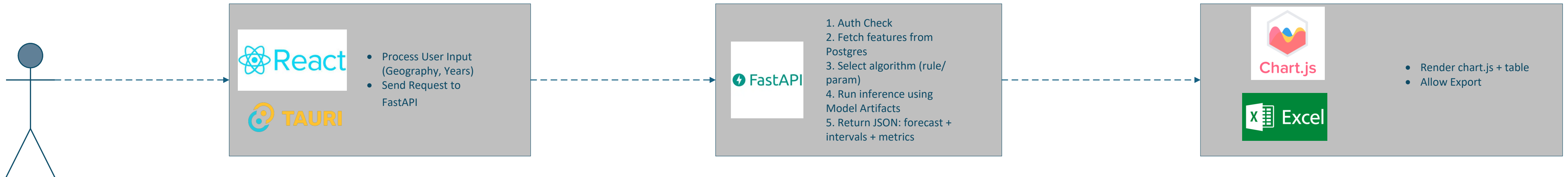
Row Based Access Control

Docker



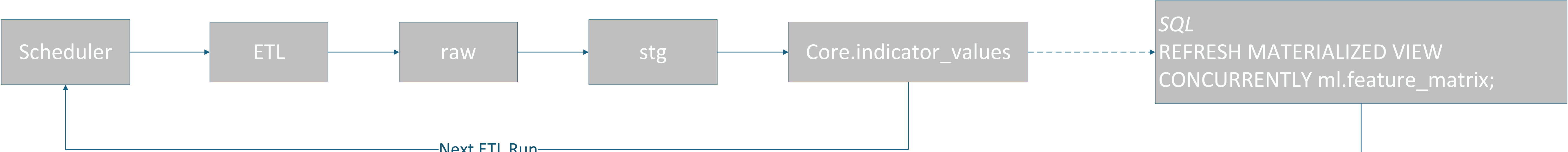
Secret management (.env)
Container Hardening
Structured Logs
Health Checks & Metrics

Request -> Predict -> Visualize



ETL Training Loop

ETL



Training

