CLIMATRACK – INTELLIGENT WEATHER AND CLIMATE FORECASTING

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PROJECT OVERVIEW

ClimaTrack is a platform that analyzes weather patterns and climate trends to provide accurate, data-driven insights. By entering a location, users can access real-time weather updates, while AI-powered forecasts predict future conditions and extreme weather events. The platform uses reliable data from NOAA and trusted weather APIs to ensure precision. Designed for individuals, researchers, and policymakers, ClimaTrack empowers users to make informed decisions about weather and climate-related challenges.

BUSINESS UNDERSTANDING

In this project, we seek to answer several critical questions:

- **How can ClimaTrack provide highly localized and accurate weather forecasts to help users make more informed decisions about daily activities and long-term planning?**

- **How can ClimaTrack leverage advanced AI predictions to improve understanding and preparedness for climate anomalies and extreme weather events?**

- **How can ClimaTrack offer tailored climate insights to support the needs of individuals, researchers, and policymakers in a world increasingly impacted by climate change?**

PROBLEM STATEMENT

- As climate change accelerates, there is a growing need for accurate, localized weather data, climate reports, and predictions about extreme weather events.
- Existing solutions often fail to provide granular forecasts or predictions related to climate anomalies.
- ClimaTrack seeks to fill this gap by offering detailed insights into weather patterns and climate events, empowering users to make data-driven decisions and better prepare for environmental changes.

OBJECTIVES

Objective 1

Develop a scalable ETL pipeline to ingest, process, and analyze large-scale weather data from NOAA and weather APIs.

Objective 2

Implement machine learning models to predict localized weather trends and extreme weather events.

Objective 3

Provide interactive reports and visualizations for users to understand long-term climate trends and short-term weather anomalies.

Objective 4

Enable user-friendly access to customized weather analytics based on location inputs.

USE CASES AND APPLICATIONS

- **Personalized Weather Insights & Alerts: Provide localized forecasts and real-time alerts for safer planning.**
- **Operational Planning for Businesses & Agriculture: Offer seasonal weather trends for resource optimization and better planning.**
- **Climate Change Research & Predictive Modeling: Enable access to historical data and models for climate analysis and policy support.**
- **Climate Risk Mitigation for Government & Disaster Management: Equip agencies with tools for proactive climate strategies and disaster preparedness.**

STAKEHOLDERS

- **Individuals**

  Personalized weather insights and extreme weather alerts.

- **Researchers and environmentalists**

  Access to detailed climate change trends and predictive models.

- **Business and Agriculture**

  Seasonal weather trend analysis for operational planning.

- **Government & Disaster Management Agencies**

  Proactive strategies for mitigating climate risks.

DATA UNDERSTANDING

- We will utilize various weather data sources to build a weather forecasting and anomaly detection system.
- The dataset contains weather data from NOAA and Third-Party APIs. It includes both historical climate data (temperature, precipitation, etc.) and real-time/forecast data (from OpenWeather, AccuWeather, WeatherStack).

DATA FLOW AND PROCESS

ETL Process

- **Extract data from NOAA and APIs, Transform it by cleaning and normalizing, and Load it into a cloud-based database for easy access.**

Machine Learning Models

- **Models are trained on the historical and real-time data to predict future weather and detect anomalies like extreme weather events.**

Visualization & Reporting

- **Dashboards and custom reports help users understand and act on weather patterns and anomalies, turning complex data into actionable insights.**

DATA PREPARATION

- Dataset Loading: Loaded weather data (990 rows, 7 columns) from a CSV file using Pandas.
- Data Cleaning: Dropped columns with formatting errors or missing values (e.g., "99999" invalid entries).
- Validation: Applied functions to ensure proper data formatting and handle missing or erroneous values.
- Column Parsing: Used functions like parseTemperature(), parseRainfall(), and parseWindSpeed() to clean individual columns.
- Key Columns: Extracted 5 columns (WND, AAI, TMP, SLP, DEW) for analysis.
- Cleaned Data: Resulted in a validated dataset (990 rows, 5 columns) ready for modeling.

MODELLING

- For prediction tasks (supervised learning), we adopted a time series approach, which leverages historical weather data to forecast future conditions. This method captures temporal dependencies and trends, which are crucial for accurate weather predictions.
- For anomaly detection (unsupervised learning), we used a Random Forest Classifier, which is effective at identifying outliers and unusual weather patterns. This approach helps detect extreme events such as storms, unusual temperature spikes, or unexpected changes in wind speed.

WEB APP AND USER INTERACTION

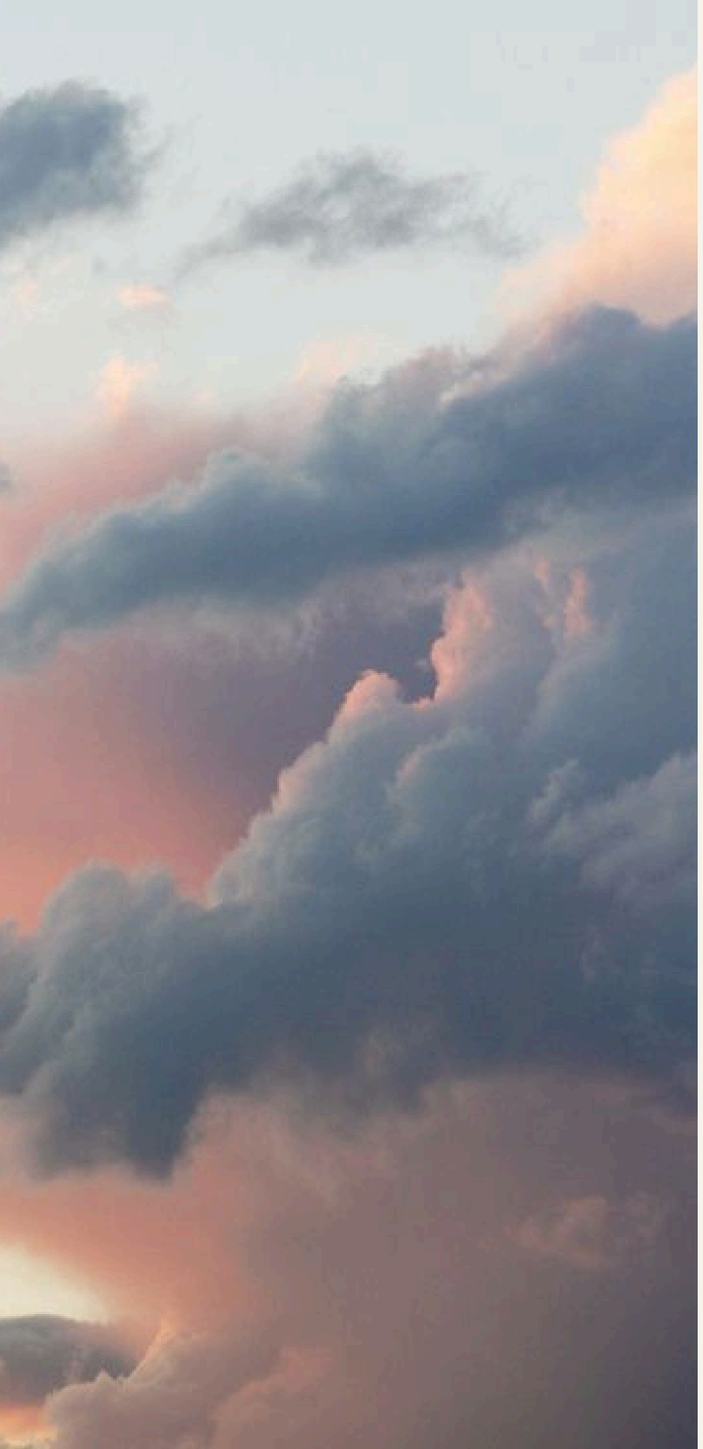
- User Input: Users enter their geolocation (city or coordinates).
- Weather Insights: The app presents real-time weather conditions (temperature, wind, precipitation, pressure) and predictions for future trends.
- Anomaly Detection: Highlights extreme weather events or unusual patterns detected in the data.
- Personalized Alerts: Users can sign up for weather alerts specific to their location.
- Decision Support: Provides timely, tailored weather data to help users stay informed and prepared.

DEPLOYMENT

- Docker Deployment: The application is packaged with Docker, ensuring portability, scalability, and efficient management of microservices across environments.
- Microservices Architecture: The app is divided into modules (e.g., data retrieval, anomaly detection, user management) as microservices.
- Reverse Proxy: A reverse proxy routes requests between microservices, ensuring smooth communication.
- Frontend-Backend Interaction: Frontend calls backend services via APIs, and the services return processed data for display.

CONCLUSION

- ClimaTrack harnesses advanced technologies and a data-driven approach to deliver accurate, localized weather forecasts and actionable climate insights. By combining real-time data with AI-driven predictions and anomaly detection, ClimaTrack empowers users—from individuals to policymakers—to make informed decisions in a rapidly changing climate.
- With an intuitive web app and a robust Docker-based microservices architecture, the platform ensures seamless scalability and performance. Featuring personalized weather alerts and easy access to climate trends, ClimaTrack is leading the way in enhancing preparedness and resilience against extreme weather events.



THANK YOU

Any Questions?

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