FOREST FIRE RISK PREDICTION SYSTEM

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Introduction

Forest fires are severe natural disasters that pose significant threats to the environment, economy and society. Once initiated, they spread rapidly and are challenging to manage effectively. They are often caused by conditions such as high temperatures, low humidity, strong winds, and human activities like deforestation or negligence.

Problem Statement

- Forest fires are highly **unpredictable**, making early detection and prevention critical.
- Lack of tools to **accurately predict** fire-prone areas before disasters occur.
- Visualizing fire risks geographically can improve **resource allocation** and **response planning**.

Project Overview and Objective

Project Goal:

- Accurately predict forest fire occurrences using historical and environmental data.
- Identify and visualize fire-prone areas to support proactive disaster management.

Key Objectives:

- Utilize advanced machine learning models (Logistic Regression, SVM, Random Forest, Gradient Boosting etc.) for fire prediction.
- Enhance data by converting spatial coordinates to Latitude and Longitude for better interpretation.
- Map and visualize fire risk zones over time using tools like Kepler.

Dataset Overview

Key Features in the Dataset

X	Y	FFMC	DMC	DC	ISI	Temp	RH	Wind	Rain	y
35.4	-13.5	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	1

Environmental Factors(Features): FFMC, DMC, DC, ISI, Temperature, RH, Wind, Rain.

Spatial Data: Coordinates (X, Y) indicating specific locations.

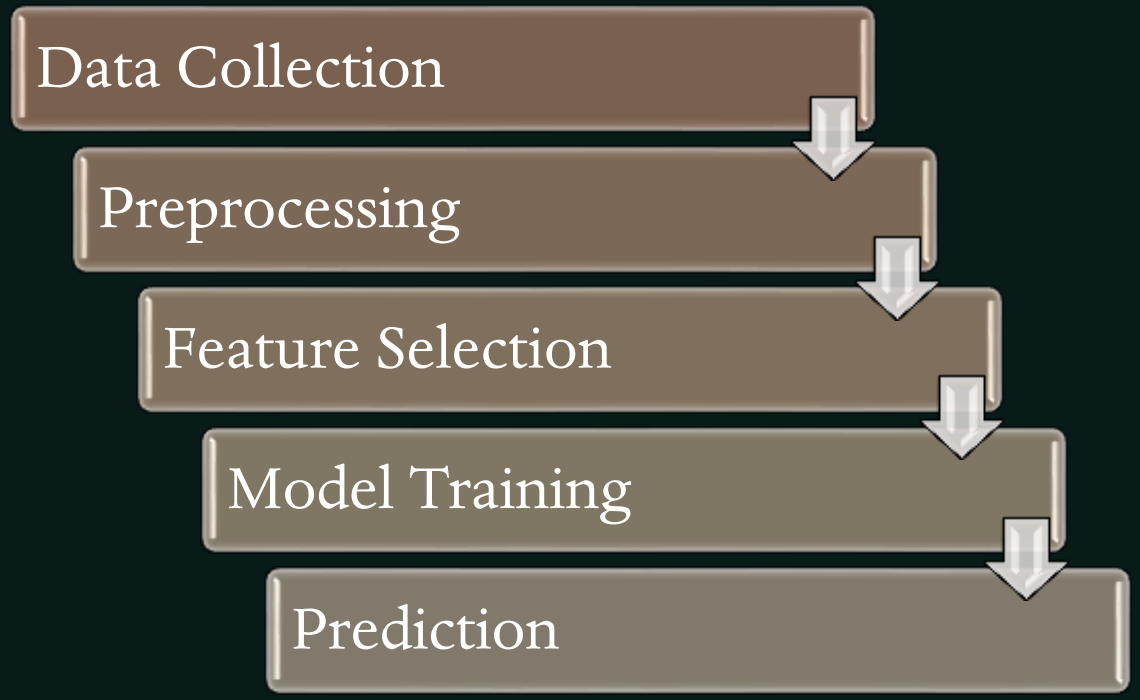
Fire Occurrence (Target Variable): y → 0 (no fire) & y→ 1 (fire)

Model Implementation and Prediction

ML Algorithms Used

- Logistic Regression
- Support Vector Machine (SVM)
- Random Forest
- Gradient Boosting Classifier

Implementation



Geospatial Processing

Steps

- Coordinate Scaling
- Coordinate Conversion to Latitude and Longitude
- Point ID Assignment

Point ID	Scaled_ Lat	Scaled_ Lon	FFMC	DMC	DC	ISI	Temp	RH	Wind	Rain	y (Fire)
1	42.354	-13.488	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	1

Visualization with Kepler.gl

Why Kepler.gl?

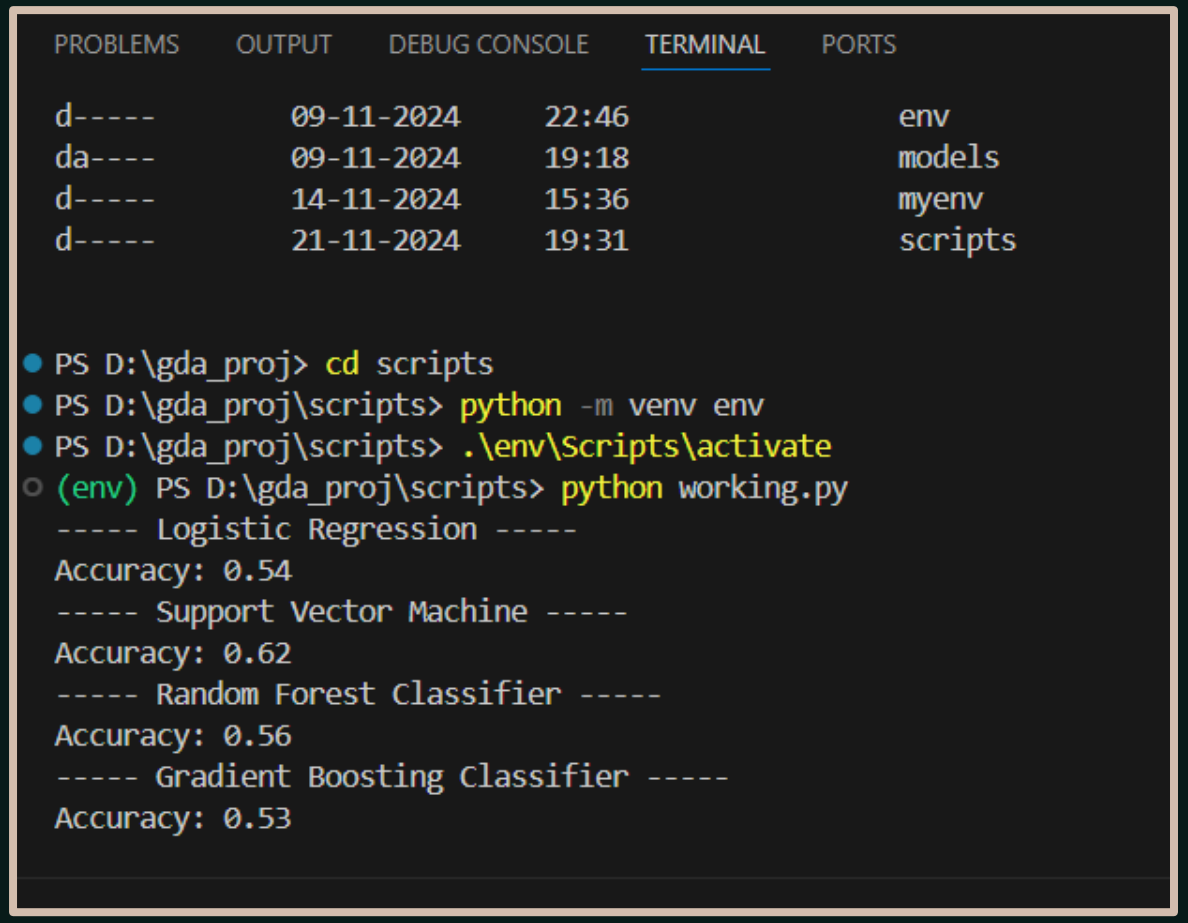
- **Interactive** and **user-friendly** geospatial tool.
- Showcases fire-prone areas visually on a map.

Visualization Example:

- **Red Points**: High Fire Risk.
- **Yellow Points**: No Fire Risk.

Results

Model Accuracy

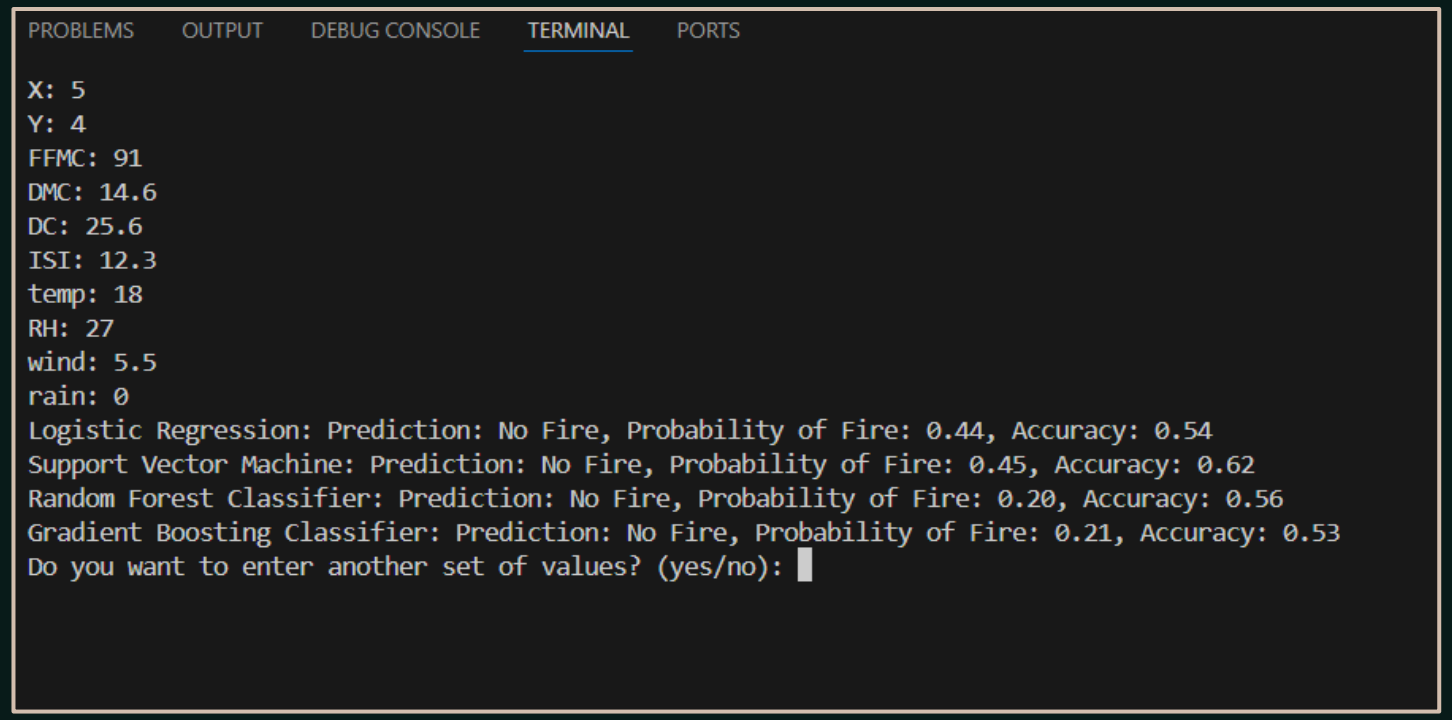


Logistic Regression: 54% Accuracy
Support Vector Machine (SVM): 62% Accuracy
Random Forest Classifier: 56% Accuracy
Gradient Boosting Classifier: 53% Accuracy

Results

Test Case 1: No Fire

Feature	X	Y	FFMC	DMC	DC	ISI	Temperature	RH	Wind	Rain
Value	5	4	91	14.6	25.6	12.3	18	27	5.5	0



Results

Test Case 2: Fire

Feature	X	Y	FFMC	DMC	DC	ISI	Temperature	RH	Wind	Rain
Value	7	5	96.1	181.1	671.2	14.3	21.9	22	10	0

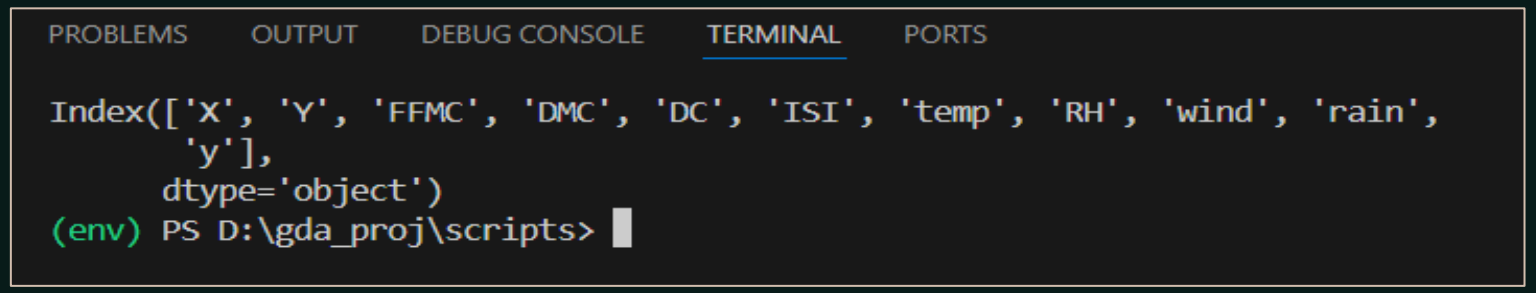
```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

Gradient Boosting Classifier: Prediction: No Fire, Probability of Fire: 0.21, Accuracy: 0.53
Do you want to enter another set of values? (yes/no): yes

Enter the values for the following features:
X: 7
Y: 5
FFMC: 96.1
DMC: 181.1
DC: 671.2
ISI: 14.3
temp: 21.9
RH: 22
wind: 10
rain: 0
Logistic Regression: Prediction: Fire, Probability of Fire: 0.72, Accuracy: 0.54
Support Vector Machine: Prediction: Fire, Probability of Fire: 0.54, Accuracy: 0.62
Random Forest Classifier: Prediction: Fire, Probability of Fire: 0.64, Accuracy: 0.56
Gradient Boosting Classifier: Prediction: Fire, Probability of Fire: 0.92, Accuracy: 0.53
Do you want to enter another set of values? (yes/no):
```

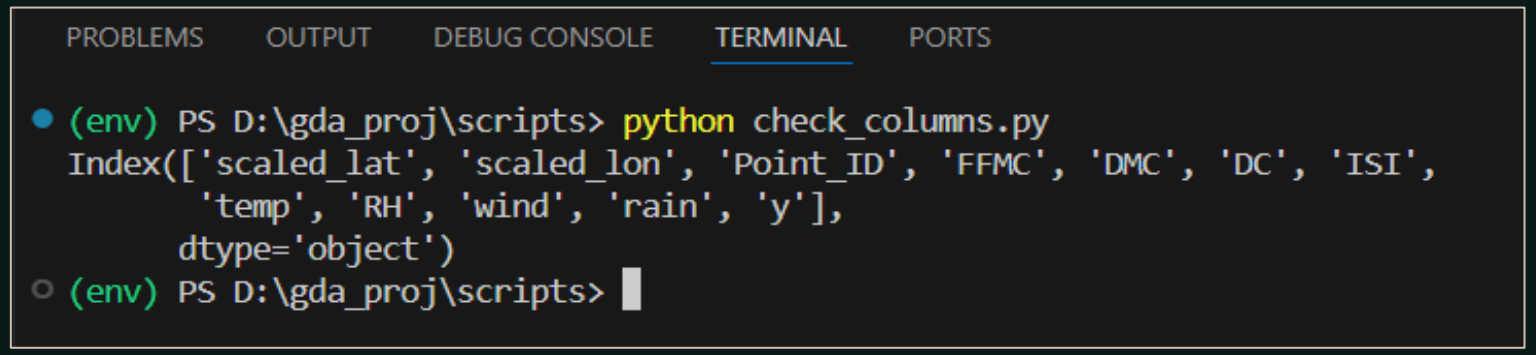
Results: Old and new Coordinates

X	Y	FFMC	DMC	DC	ISI	Temp	RH	Wind	Rain	Fire Prediction (y)



OLD

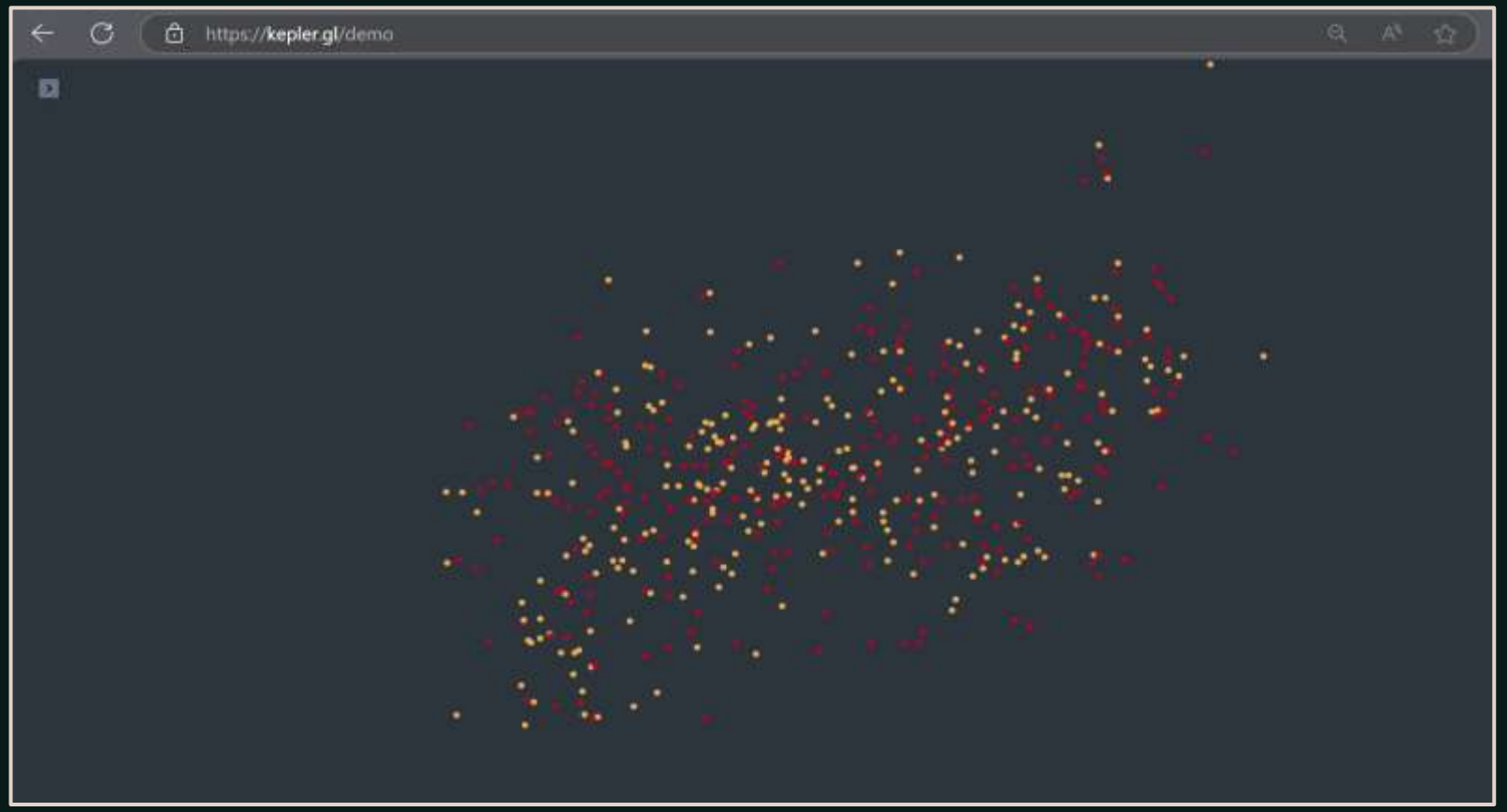
Scaled Latitude	Scaled Longitude	Point ID	FFMC	DMC	DC	ISI	Temp	RH	Wind	Rain	Fire Prediction (y)



NEW

Results: Kepler Visualization

Kepler Visualization of Forest Fire Data Points in Montesinho,Portugal



Red Points: Fire Areas
Yellow Points: Non-fire areas

Future Scope and Conclusion

Future Scope:

- **Enhanced Accuracy:** Improve predictions by integrating additional features and exploring deep learning models.
- **Real-time Application:** Implement live data streams for real-time fire prediction.

Conclusion:

- **Successful Prediction:** Accurate forest fire forecasting with high precision.
- **Effective Visualization:** Actionable insights through Kepler maps for identifying fire-prone areas.

Thank you