AI-Based Weather Data Prediction

Exploring Classification and Regression

problem Statement

Proposed Methodology

Related Work

Results

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Problem Statement

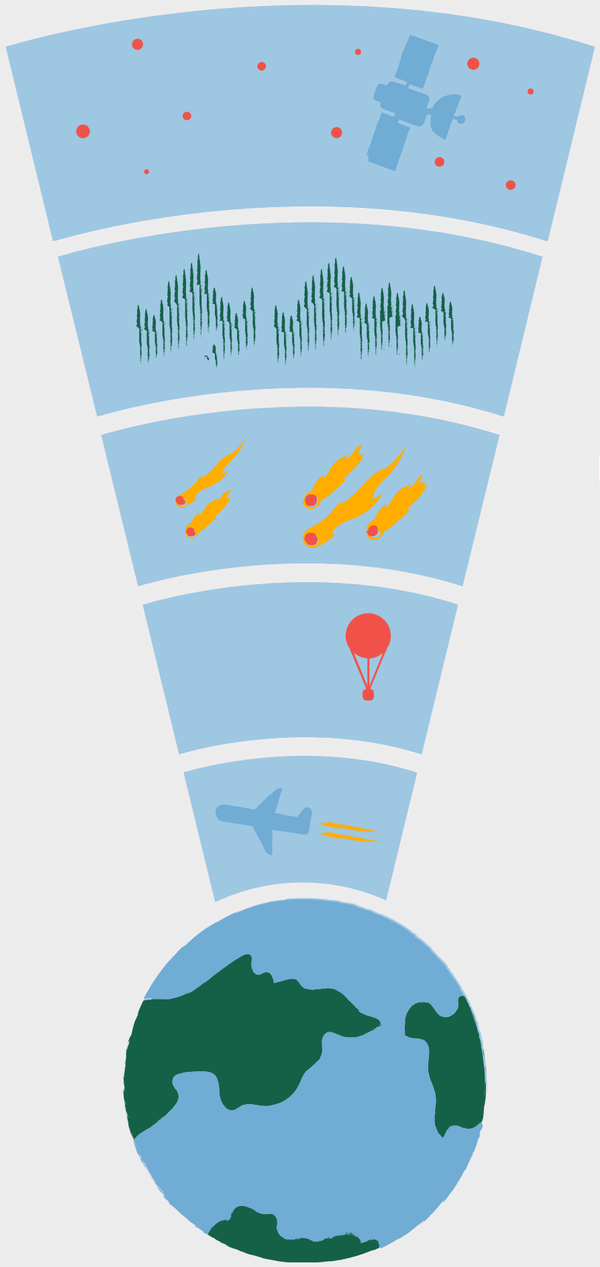
1

Current weather prediction models often fail to provide high accuracy and generalization for diverse and dynamic weather conditions.

Problem Statement

1. Current weather prediction models often fail to provide high accuracy and generalization for diverse and dynamic weather conditions.

2. Existing methods struggle to adapt to complex, real-time weather data, resulting in suboptimal predictions.



Objective

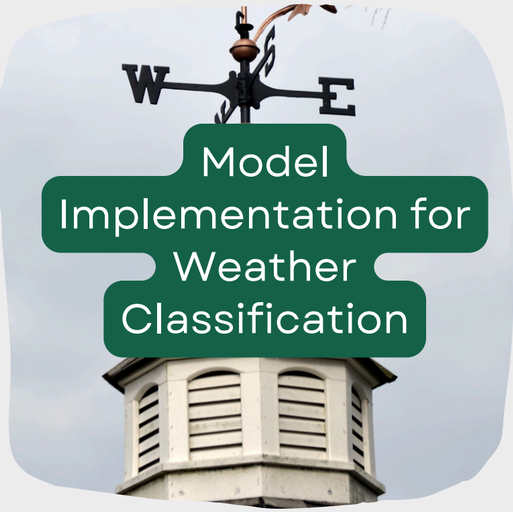
1

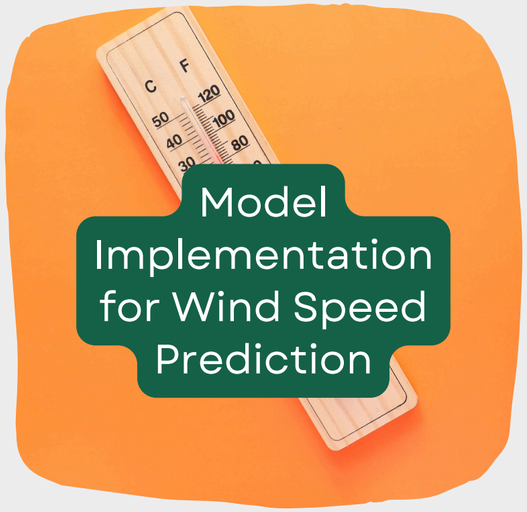
Classification of weather types using KNN, SVC, Logistic Regression, and Decision Trees

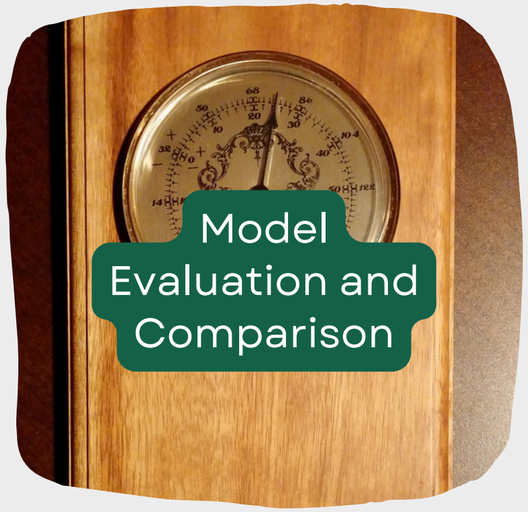
2

Regression for wind speed prediction using SVR, Linear Regression, and Ensemble techniques.

Proposed Methodology







Data Collection and Preprocessing

Data Sources:

- Collect historical weather data, including:Temperature, Humidity, Atmospheric Pressure, Wind Speed, and Weather Type

preprocessing Steps:

- ***Feature Normalization:*** Normalize continuous variables (e.g., temperature, pressure).
- ***Categorical Encoding:*** Encode categorical variables such as Wind Type using label encoding.
- ***Create new features:***
  - e.g., Weather_Index, Humidity_Temperature, Log_Humidity to improve model performance.

Feature Engineering

Weather Classification Features:

- Use features such as Temp , UV Index,Precipitation, Visibility ,Cloud Cover

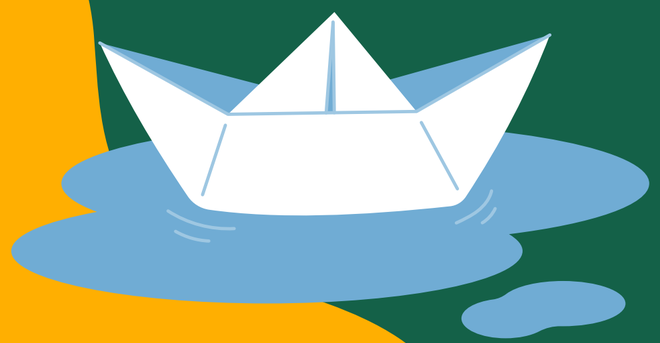
Wind Speed Prediction Features:

- Use features such as Previous Wind Speed, Temperature, Pressure, and Humidity for wind speed prediction.

Model Selection and Implementation

Classification Models:

- K-Nearest Neighbors (KNN)
- Support Vector Classifier (SVC)
- Logistic Regression
- Decision Trees



Regression Models:

- Support Vector Regression (SVR)
- Linear Regression
- Ensemble Methods (e.g.Voting)

Model Evaluation

Classification Evaluation:	• Evaluate models using accuracy, precision, recall. • Use confusion matrices to visualize performance and understand misclassifications.
Regression Evaluation:	• Evaluate models using Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared. • Compare predicted vs. actual wind speeds to assess model performance.

Classification Model Results (Weather Type Prediction)

	Accuracy	Precision	Recall	F1-Score
Logistic Regression	87.2%	0.87	0.90	0.89
KNN	90.8%	0.91	0.91	0.91
SVC	91.0%	0.91	0.91	0.91
Decision Tree	91.1%	0.91	0.91	0.91

Regression Model Results (Wind Speed Prediction)

	MSE	RMSE	MAE
Linear Regression	0.0031	0.0556	0.0446
SVR	0.0045	0.0668	0.0606

Related Work

- Weather Classification:
- Many studies use KNN, SVC, and Decision Trees for weather classification based on factors like temperature, humidity, etc.
  - Example: SVC for weather classification
  - Example: KNN in weather prediction
- Wind Speed Prediction:
- Linear Regression and SVR are commonly used, with SVR showing better performance in non-linear cases.
  - Example: SVR for wind speed prediction
  - Example: Linear Regression for weather prediction

- Summary:
  - Machine learning models successfully classify weather types and predict wind speed with high accuracy.

- Impact:
  - Improved weather prediction contributes to better planning in agriculture, renewable energy, and disaster management.
- Future Work:
  - Incorporate deep learning models for further accuracy.
  - Explore real-time weather data integration for dynamic predictions.

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