"Python Programming"

Assignment-4

Topic – Data Analysis and Visualisation with Real-World Weather Data

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Course – B. Tech CSE (AI & ML)

Section – A

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Introduction

Weather conditions play a vital role in agriculture, transportation, health, and environmental planning. With data analysis tools like Python, NumPy, and Pandas, as well as visualisation libraries, we can convert raw datasets into meaningful insights. This project focuses on weather data analysis using data cleaning, statistical computation, and visual representation.

Objectives

-To clean and preprocess the raw weather dataset by handling missing values and formatting dates.

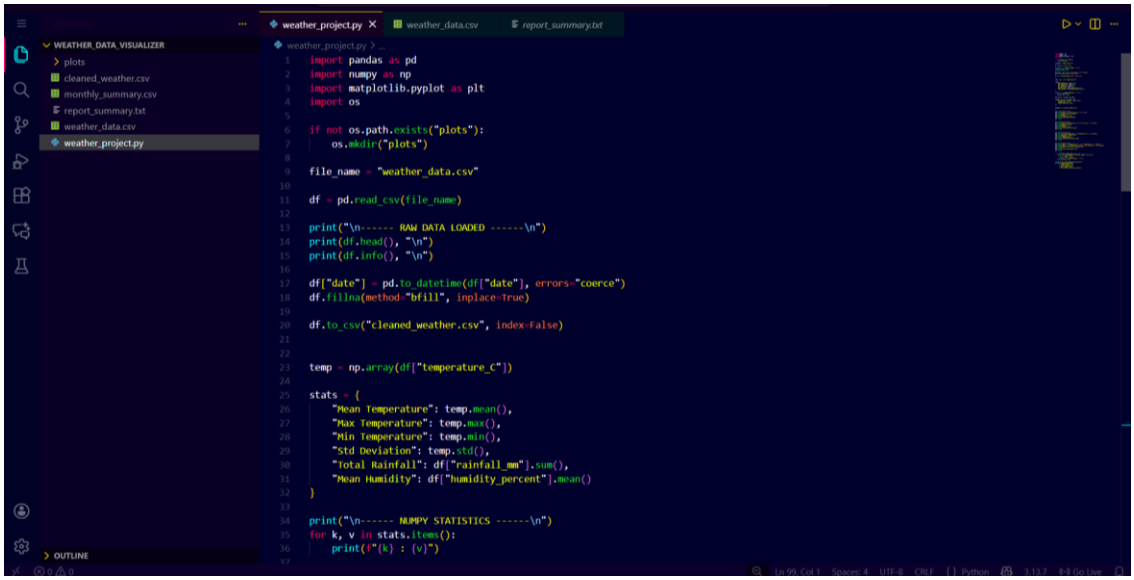
To calculate important weather statistics such as mean, maximum, minimum temperature, total rainfall, and humidity patterns.
-To generate monthly weather summaries for comparative analysis.
-To visualise weather trends using line plots, bar charts, and scatter plots.
-To export analytical results into files for further interpretation (summary CSV and text report).

Program Description

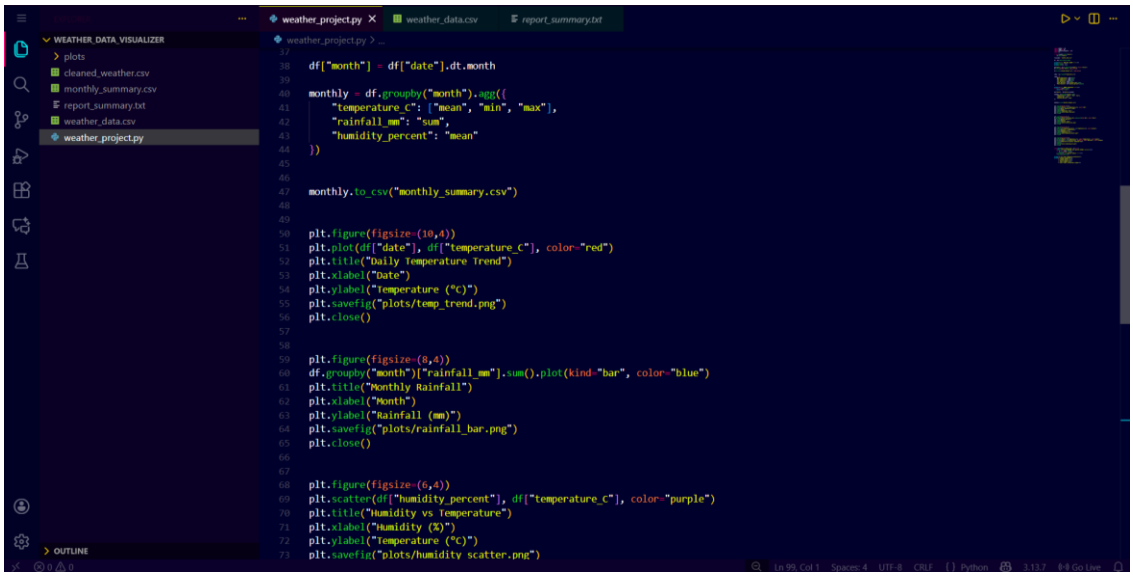
This project processes and analyses weather data stored in a CSV file using Python. It performs data cleaning, calculates essential statistical values, groups data every month, and visualises important weather patterns.

The script reads the dataset, converts date formats, handles missing values, and generates a cleaned file for further use. The project also creates monthly summaries including temperature trends, rainfall distribution, humidity vs. temperature scatter, and combined weather plots. Results are exported as files like CSV summaries, graphs, and a final report.

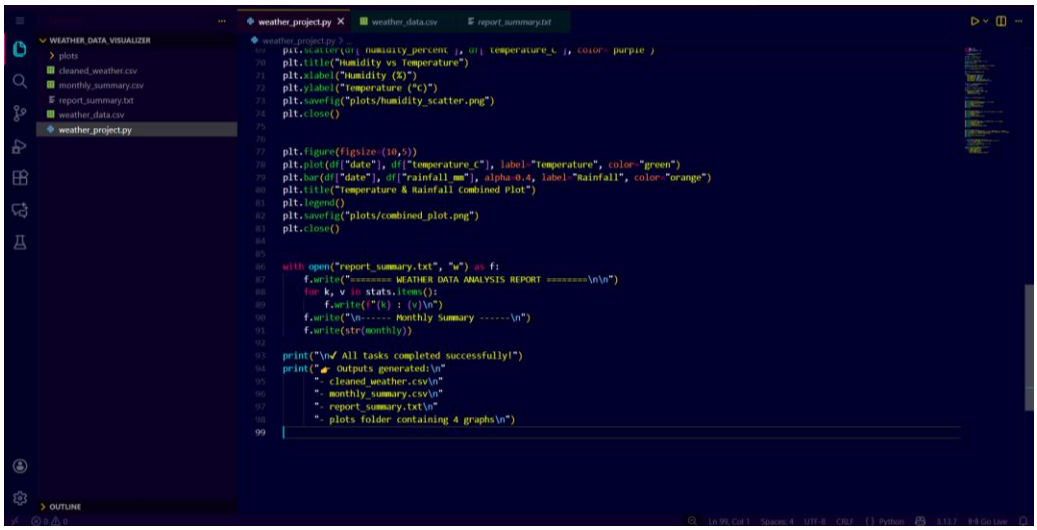
Program Code

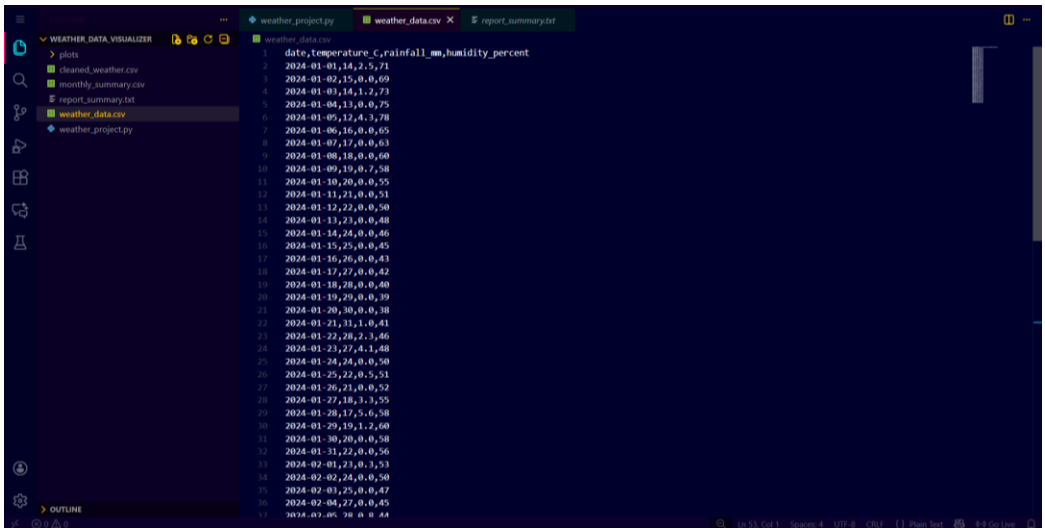


```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import os

if not os.path.exists("plots"):
    os.mkdir("plots")

file_name = "weather_data.csv"

df = pd.read_csv(file_name)

print("\n------ RAW DATA LOADED ------\n")
print(df.head(), "\n")
print(df.info(), "\n")

df["date"] = pd.to_datetime(df["date"], errors="coerce")
df.fillna(method="bfill", inplace=True)

df.to_csv("cleaned_weather.csv", index=False)


temp = np.array(df["temperature_C"])

stats = {
    "Mean Temperature": temp.mean(),
    "Max Temperature": temp.max(),
    "Min Temperature": temp.min(),
    "Std Deviation": temp.std(),
    "Total Rainfall": df["rainfall_mm"].sum(),
    "Mean Humidity": df["humidity_percent"].mean()
}

print("\n------ NUMPY STATISTICS ------\n")
for k, v in stats.items():
    print(f"{k} : {v}")
```

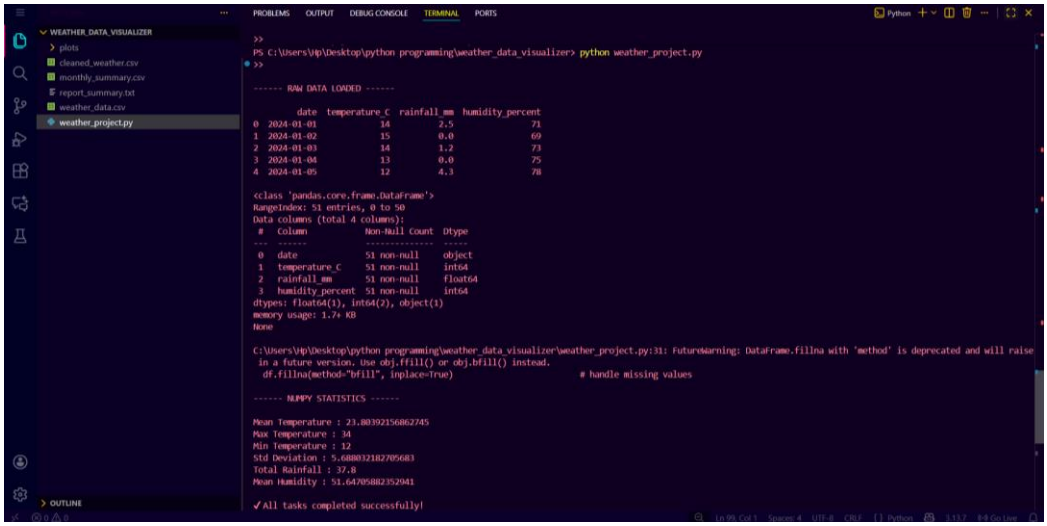


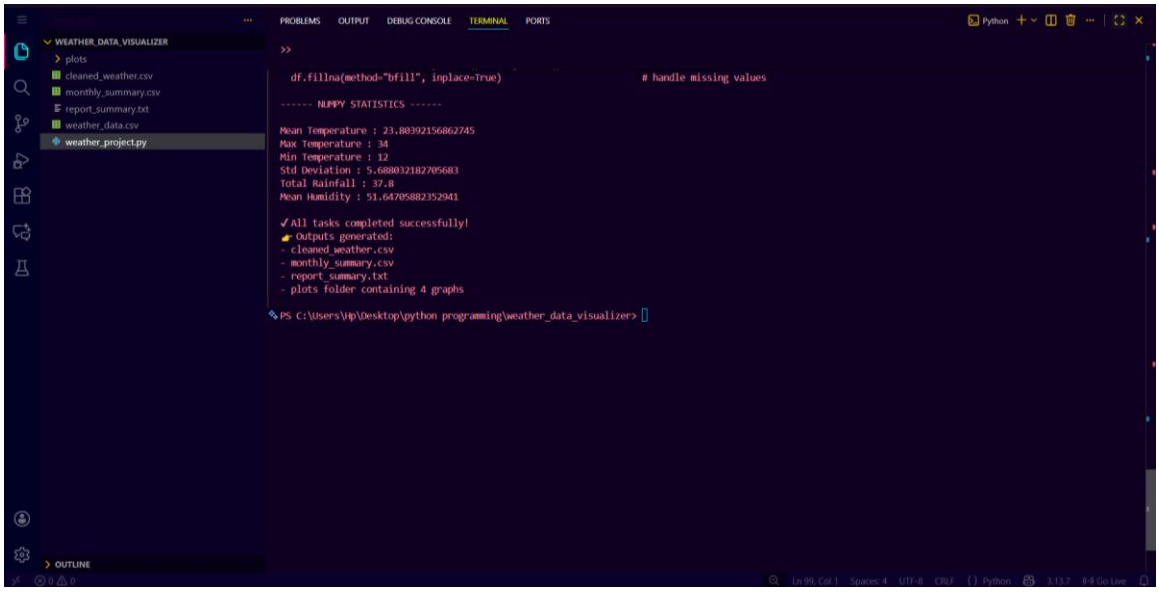
```python
df["month"] = df["date"].dt.month

monthly = df.groupby("month").agg({
    "temperature_C": ["mean", "min", "max"],
    "rainfall_mm": "sum",
    "humidity_percent": "mean"
})


monthly.to_csv("monthly_summary.csv")


plt.figure(figsize=(10,4))
plt.plot(df["date"], df["temperature_C"], color="red")
plt.title("Daily Temperature Trend")
plt.xlabel("Date")
plt.ylabel("Temperature (°C)")
plt.savefig("plots/temp_trend.png")
plt.close()


plt.figure(figsize=(8,4))
df.groupby("month")["rainfall_mm"].sum().plot(kind="bar", color="blue")
plt.title("Monthly Rainfall")
plt.xlabel("Month")
plt.ylabel("Rainfall (mm)")
plt.savefig("plots/rainfall_bar.png")
plt.close()


plt.figure(figsize=(6,4))
plt.scatter(df["humidity_percent"], df["temperature_C"], color="purple")
plt.title("Humidity vs Temperature")
plt.xlabel("Humidity (%)")
plt.ylabel("Temperature (°C)")
plt.savefig("plots/humidity scatter.png")
```

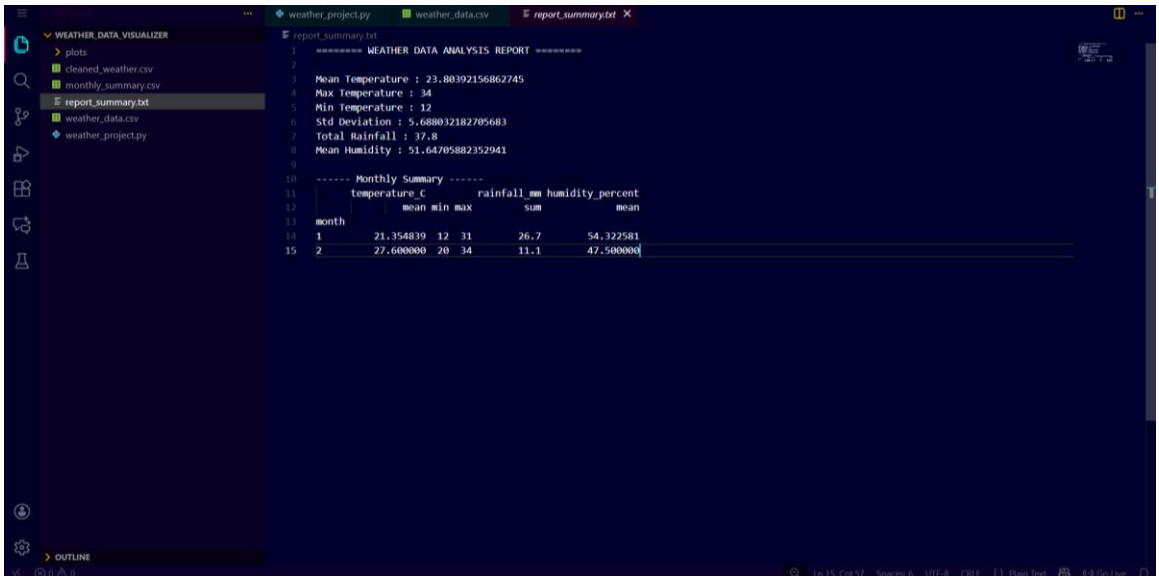




Sample Output







Conclusion

This project successfully analyses weather data by cleaning the dataset, calculating key statistics, and visualising temperature, rainfall, and humidity trends. It shows how Python can effectively convert raw climate data into useful insights for weather monitoring and decision-making.