In [ ]:
```
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COURSE: CL I
CLASS: BE AI&DS.
```

In [107…
```
# 1. Register and obtain API key from OpenWeatherMap.
```

In [108…
```
# 2. Interact with the OpenWeatherMap API using the API key to retrieve weather dat
```

In [111…
```
import requests
import pandas as pd
import matplotlib.pyplot as plt
from datetime import datetime
import seaborn as sns
```

In [112…
```
api_key = 'c15c676d2f9d0dada63d7fa10c76ce01'
location = 'India'
url = f'http://api.openweathermap.org/data/2.5/forecast?q=India&appid=c15c676d2f9d0
response = requests.get(url)
data = response.json()
```

In [113…
```
if response.status_code == 200:
    "Data retrieved successfully for India"
else:
    data = response.json()
    f"Error: {data.get('message', 'Failed to retrieve data')}"
```

In [114…
```
data
```

Out[114…


```
{'cod': '200',
 'message': 0,
 'cnt': 40,
 'list': [{'dt': 1720774800,
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    'humidity': 95,
    'temp_kf': -1.63},
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     'icon': '10d'}],
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    'icon': '10d'}],
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   'icon': '10n'}],
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  'humidity': 77,
  'temp_kf': 0},
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 'clouds': {'all': 86},
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 'wind': {'speed': 2.68, 'deg': 171, 'gust': 3.64},
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  'wind': {'speed': 1.85, 'deg': 168, 'gust': 2.53},
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   'humidity': 98,
   'temp_kf': 0},
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    'description': 'light rain',
    'icon': '10n'}],
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  'temp_max': 12,
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  'grnd_level': 818,
  'humidity': 95,
  'temp_kf': 0},
 'weather': [{'id': 804,
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  'pressure': 1015,
  'sea_level': 1015,
  'grnd_level': 818,
  'humidity': 82,
  'temp_kf': 0},
 'weather': [{'id': 803,
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  'grnd_level': 818,
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  'temp_kf': 0},
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 'pop': 0,
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  'temp_max': 26.09,
  'pressure': 1012,
  'sea_level': 1012,
  'grnd_level': 818,
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  'temp_kf': 0},
 'weather': [{'id': 800,
   'main': 'Clear',
   'description': 'clear sky',
   'icon': '01d'}],
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 'visibility': 10000,
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  'sea_level': 1014,
  'grnd_level': 818,
  'humidity': 62,
  'temp_kf': 0},
 'weather': [{'id': 804,
   'main': 'Clouds',
   'description': 'overcast clouds',
   'icon': '04d'}],
 'clouds': {'all': 85},
 'wind': {'speed': 1.66, 'deg': 175, 'gust': 2.59},
 'visibility': 10000,
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```

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  'temp_max': 19.13,
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  'grnd_level': 819,
  'humidity': 78,
  'temp_kf': 0},
 'weather': [{'id': 500,
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   'description': 'light rain',
   'icon': '10d'}],
 'clouds': {'all': 74},
 'wind': {'speed': 1.73, 'deg': 173, 'gust': 1.67},
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 'sys': {'pod': 'd'},
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  'temp_max': 14.86,
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  'temp_kf': 0},
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   'description': 'scattered clouds',
   'icon': '03n'}],
  'clouds': {'all': 39},
  'wind': {'speed': 1, 'deg': 12, 'gust': 1.01},
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    'icon': '04n'}],
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  'visibility': 10000,
  'pop': 0,
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  'dt_txt': '2024-07-15 03:00:00'},
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   'temp_min': 18,
   'temp_max': 18,
   'pressure': 1019,
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   'grnd_level': 821,
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  'weather': [{'id': 803,
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    'description': 'broken clouds',
    'icon': '04d'}],
  'clouds': {'all': 53},
  'wind': {'speed': 0.9, 'deg': 72, 'gust': 1.19},
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   'grnd_level': 821,
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  'temp_kf': 0},
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   'icon': '10d'}],
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 'wind': {'speed': 1.5, 'deg': 142, 'gust': 2.09},
 'visibility': 10000,
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 'sys': {'pod': 'd'},
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  'grnd_level': 820,
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  'temp_kf': 0},
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   'main': 'Rain',
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   'icon': '10d'}],
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 'visibility': 10000,
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  'temp_max': 23.22,
  'pressure': 1015,
  'sea_level': 1015,
  'grnd_level': 820,
  'humidity': 56,
  'temp_kf': 0},
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   'main': 'Rain',
   'description': 'light rain',
   'icon': '10d'}],
 'clouds': {'all': 53},
 'wind': {'speed': 1.57, 'deg': 159, 'gust': 2.38},
 'visibility': 10000,
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```

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  'grnd_level': 820,
  'humidity': 77,
  'temp_kf': 0},
 'weather': [{'id': 500,
   'main': 'Rain',
   'description': 'light rain',
   'icon': '10d'}],
 'clouds': {'all': 58},
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  'temp_max': 14.79,
  'pressure': 1019,
  'sea_level': 1019,
  'grnd_level': 820,
  'humidity': 94,
  'temp_kf': 0},
 'weather': [{'id': 800,
   'main': 'Clear',
   'description': 'clear sky',
   'icon': '01n'}],
 'clouds': {'all': 5},
 'wind': {'speed': 0.86, 'deg': 144, 'gust': 0.9},
 'visibility': 10000,
 'pop': 0,
 'sys': {'pod': 'n'},
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  'temp_max': 13.73,
  'pressure': 1018,
  'sea_level': 1018,
  'grnd_level': 820,
  'humidity': 92,
  'temp_kf': 0},
 'weather': [{'id': 800,
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   'description': 'clear sky',
   'icon': '01n'}],
 'clouds': {'all': 4},
 'wind': {'speed': 0.24, 'deg': 348, 'gust': 0.49},
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 'visibility': 10000,
 'pop': 0,
 'sys': {'pod': 'n'},
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  'temp_max': 13,
  'pressure': 1018,
  'sea_level': 1018,
  'grnd_level': 819,
  'humidity': 91,
  'temp_kf': 0},
 'weather': [{'id': 800,
   'main': 'Clear',
   'description': 'clear sky',
   'icon': '01n'}],
 'clouds': {'all': 0},
 'wind': {'speed': 0.98, 'deg': 331, 'gust': 0.87},
 'visibility': 10000,
 'pop': 0,
 'sys': {'pod': 'n'},
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  'feels_like': 18.23,
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  'temp_max': 18.47,
  'pressure': 1017,
  'sea_level': 1017,
  'grnd_level': 820,
  'humidity': 71,
  'temp_kf': 0},
 'weather': [{'id': 800,
   'main': 'Clear',
   'description': 'clear sky',
   'icon': '01d'}],
 'clouds': {'all': 2},
 'wind': {'speed': 1.05, 'deg': 333, 'gust': 1.55},
 'visibility': 10000,
 'pop': 0,
 'sys': {'pod': 'd'},
 'dt_txt': '2024-07-16 06:00:00'},
{'dt': 1721120400,
 'main': {'temp': 23.02,
  'feels_like': 22.81,
  'temp_min': 23.02,
  'temp_max': 23.02,
  'pressure': 1016,
  'sea_level': 1016,
  'grnd_level': 820,
  'humidity': 55,
  'temp_kf': 0},
 'weather': [{'id': 500,
   'main': 'Rain',
```

```
   'description': 'light rain',
   'icon': '10d'}],
  'clouds': {'all': 6},
  'wind': {'speed': 1.25, 'deg': 17, 'gust': 1.55},
  'visibility': 10000,
  'pop': 0.77,
  'rain': {'3h': 0.58},
  'sys': {'pod': 'd'},
  'dt_txt': '2024-07-16 09:00:00'},
 {'dt': 1721131200,
  'main': {'temp': 20.45,
   'feels_like': 20.54,
   'temp_min': 20.45,
   'temp_max': 20.45,
   'pressure': 1017,
   'sea_level': 1017,
   'grnd_level': 821,
   'humidity': 76,
   'temp_kf': 0},
  'weather': [{'id': 500,
    'main': 'Rain',
    'description': 'light rain',
    'icon': '10d'}],
  'clouds': {'all': 37},
  'wind': {'speed': 0.79, 'deg': 19, 'gust': 1.08},
  'visibility': 9486,
  'pop': 1,
  'rain': {'3h': 2.69},
  'sys': {'pod': 'd'},
  'dt_txt': '2024-07-16 12:00:00'},
 {'dt': 1721142000,
  'main': {'temp': 17.63,
   'feels_like': 17.77,
   'temp_min': 17.63,
   'temp_max': 17.63,
   'pressure': 1019,
   'sea_level': 1019,
   'grnd_level': 821,
   'humidity': 89,
   'temp_kf': 0},
  'weather': [{'id': 500,
    'main': 'Rain',
    'description': 'light rain',
    'icon': '10d'}],
  'clouds': {'all': 100},
  'wind': {'speed': 2.08, 'deg': 45, 'gust': 3.13},
  'visibility': 10000,
  'pop': 1,
  'rain': {'3h': 2.21},
  'sys': {'pod': 'd'},
  'dt_txt': '2024-07-16 15:00:00'},
 {'dt': 1721152800,
  'main': {'temp': 16.96,
   'feels_like': 17.09,
   'temp_min': 16.96,
   'temp_max': 16.96,
```

```
   'pressure': 1020,
   'sea_level': 1020,
   'grnd_level': 822,
   'humidity': 91,
   'temp_kf': 0},
  'weather': [{'id': 500,
    'main': 'Rain',
    'description': 'light rain',
    'icon': '10d'}],
  'clouds': {'all': 84},
  'wind': {'speed': 1, 'deg': 43, 'gust': 1.16},
  'visibility': 10000,
  'pop': 1,
  'rain': {'3h': 0.95},
  'sys': {'pod': 'd'},
  'dt_txt': '2024-07-16 18:00:00'},
 {'dt': 1721163600,
  'main': {'temp': 13.69,
   'feels_like': 13.54,
   'temp_min': 13.69,
   'temp_max': 13.69,
   'pressure': 1023,
   'sea_level': 1023,
   'grnd_level': 823,
   'humidity': 93,
   'temp_kf': 0},
  'weather': [{'id': 800,
    'main': 'Clear',
    'description': 'clear sky',
    'icon': '01n'}],
  'clouds': {'all': 0},
  'wind': {'speed': 1.43, 'deg': 28, 'gust': 1.3},
  'visibility': 10000,
  'pop': 0,
  'sys': {'pod': 'n'},
  'dt_txt': '2024-07-16 21:00:00'},
 {'dt': 1721174400,
  'main': {'temp': 12.81,
   'feels_like': 12.57,
   'temp_min': 12.81,
   'temp_max': 12.81,
   'pressure': 1023,
   'sea_level': 1023,
   'grnd_level': 823,
   'humidity': 93,
   'temp_kf': 0},
  'weather': [{'id': 801,
    'main': 'Clouds',
    'description': 'few clouds',
    'icon': '02n'}],
  'clouds': {'all': 20},
  'wind': {'speed': 1.34, 'deg': 24, 'gust': 1.26},
  'visibility': 10000,
  'pop': 0,
  'sys': {'pod': 'n'},
  'dt_txt': '2024-07-17 00:00:00'},
```

```
 {'dt': 1721185200,
  'main': {'temp': 12.19,
   'feels_like': 11.84,
   'temp_min': 12.19,
   'temp_max': 12.19,
   'pressure': 1023,
   'sea_level': 1023,
   'grnd_level': 823,
   'humidity': 91,
   'temp_kf': 0},
  'weather': [{'id': 802,
    'main': 'Clouds',
    'description': 'scattered clouds',
    'icon': '03n'}],
  'clouds': {'all': 43},
  'wind': {'speed': 1.11, 'deg': 27, 'gust': 1.05},
  'visibility': 10000,
  'pop': 0,
  'sys': {'pod': 'n'},
  'dt_txt': '2024-07-17 03:00:00'},
 {'dt': 1721196000,
  'main': {'temp': 17.26,
   'feels_like': 17.1,
   'temp_min': 17.26,
   'temp_max': 17.26,
   'pressure': 1022,
   'sea_level': 1022,
   'grnd_level': 824,
   'humidity': 79,
   'temp_kf': 0},
  'weather': [{'id': 801,
    'main': 'Clouds',
    'description': 'few clouds',
    'icon': '02d'}],
  'clouds': {'all': 23},
  'wind': {'speed': 0.47, 'deg': 115, 'gust': 0.63},
  'visibility': 10000,
  'pop': 0,
  'sys': {'pod': 'd'},
  'dt_txt': '2024-07-17 06:00:00'}],
 'city': {'id': 3168508,
  'name': 'Innichen',
  'coord': {'lat': 46.7406, 'lon': 12.2797},
  'country': 'IT',
  'population': 3107,
  'timezone': 7200,
  'sunrise': 1720754957,
  'sunset': 1720811002}}
```


In [115…
```
# 3. Extract Relevant Weather Attributes.
```

In [116…
```
weather_list = data['list']
weather_data = {'datetime': [], 'teampreature': [], 'humidity': [], 'wind_speed': [
for entry in weather_list:
    weather_data['datetime'].append(datetime.fromtimestamp(entry['dt']))
    weather_data['teampreature'].append(entry['main']['temp'])
```

```
    weather_data['humidity'].append(entry['main']['humidity'])
    weather_data['wind_speed'].append(entry['wind']['speed'])
    precipitation = entry['rain'].get('3h', 0) if 'rain' in entry else 0
    weather_data['precipitation'].append(precipitation)
```

In [117…
```
import pandas as pd
df = pd.DataFrame(weather_data)
df.head()
```

Out[117…

	datetime	teampreature	humidity	wind_speed	precipitation
0	2024-07-12 14:30:00	15.82	95	1.35	2.38
1	2024-07-12 17:30:00	18.21	90	1.74	3.68
2	2024-07-12 20:30:00	20.88	83	2.04	3.51
3	2024-07-12 23:30:00	18.24	95	1.89	1.91
4	2024-07-13 02:30:00	14.46	99	1.71	4.05

In [118…
```
# 4. Clean and Preprocess the Data.
```

In [119…
```
df.isnull().sum()
```

Out[119…
```
datetime         0
teampreature     0
humidity         0
wind_speed       0
precipitation    0
dtype: int64
```

In [120…
```
# 5. Perform Data Modelling.
```

In [37]:
```
avg_temp = df['teampreature'].mean()
```

In [39]:
```
avg_temp
```

Out[39]:
```
17.82775
```

In [40]:
```
max_temp = df['teampreature'].max()
min_temp = df['teampreature'].min()
```

In [42]:
```
max_temp
```

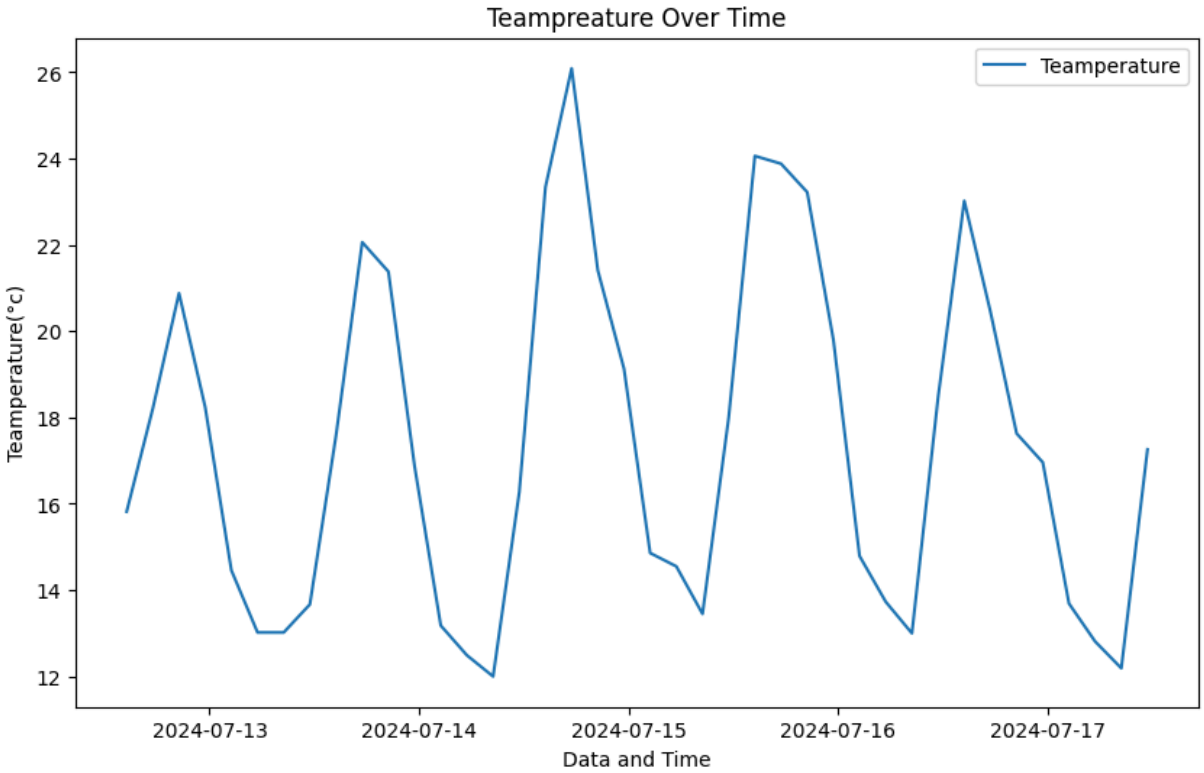
Out[42]:
```
25.93
```

In [43]:
```
min_temp
```

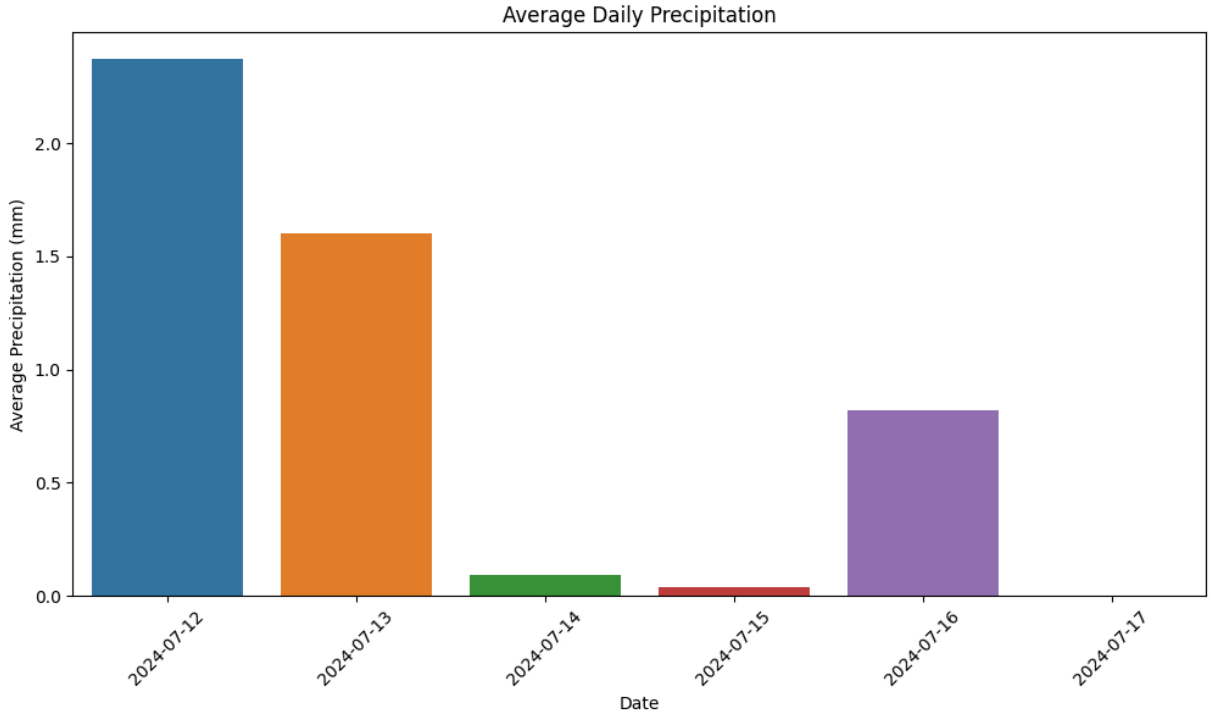
Out[43]:
```
11.81
```

In [121…
```
# 6. Visualize the Weather Data.
```

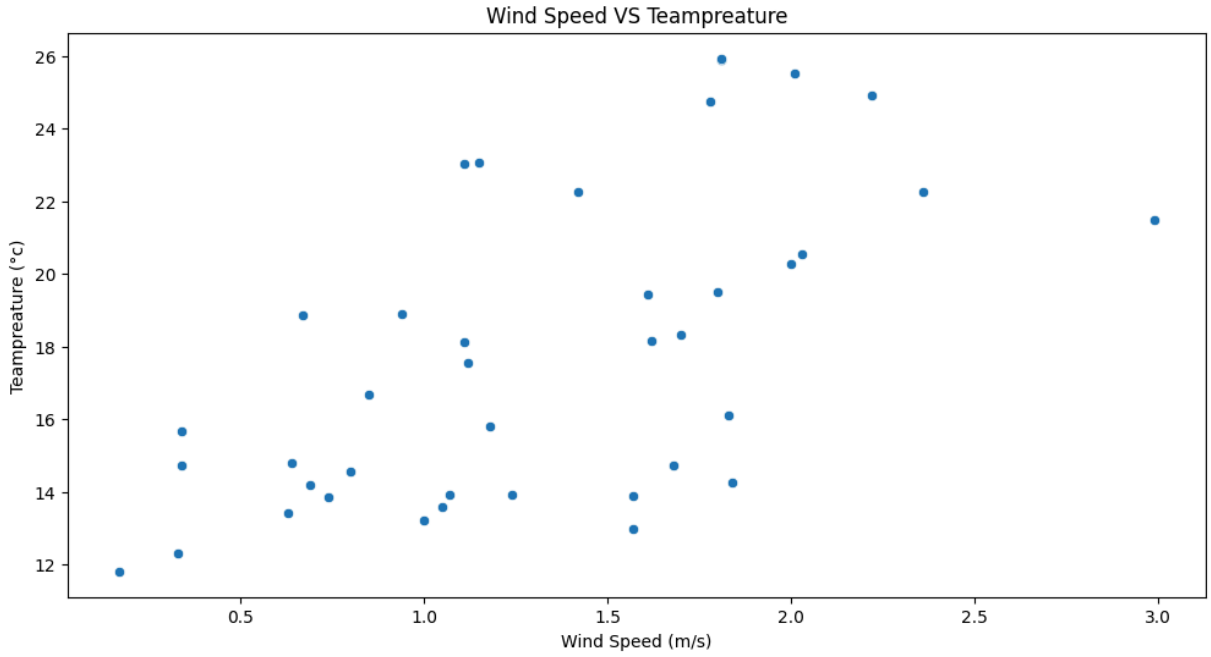
In [122…
```
# 1. Line Chart
plt.figure(figsize=(10, 6))
plt.plot(df['datetime'], df['teampreature'], label='Teamperature')
plt.xlabel('Data and Time')
plt.ylabel('Teamperature(°c)')
plt.title('Teampreature Over Time')
plt.legend()
plt.show()
```



In [56]:
```
# 2. Bar Plot
plt.figure(figsize=(12, 6))
sns.barplot(data=daily_precipitation, x='date', y='precipitation')
plt.xlabel('Date')
plt.ylabel('Average Precipitation (mm)')
plt.title('Average Daily Precipitation')
plt.xticks(rotation=45)
plt.show()
```



In [57]:
```
# 3. Scatter Plot.
plt.figure(figsize=(12, 6))
sns.scatterplot(data=df, x='wind_speed', y='teampreature')
plt.xlabel('Wind Speed (m/s)')
plt.ylabel('Teampreature (°c)')
plt.title('Wind Speed VS Teampreature')
plt.show()
```



In [58]:
```
# 7. Apply Data Aggregation Techniques.
```

In [62]:
```
# 1. Daily Aggregation
daily_weather = df.resample('D').agg({'teampreature': 'mean', 'humidity': 'mean', '
```

```
daily_weather.head()
```

Out[62]:

datetime	teampreature	humidity	wind_speed
2024-07-12	18.17000	90.600	2.03
2024-07-13	16.73500	83.000	2.99
2024-07-14	18.30750	70.125	2.22
2024-07-15	19.69875	68.875	2.01
2024-07-16	17.78000	81.250	1.62

In [63]:
```
# 2. Monthly Aggregation.
monthly_weather = df.resample('M').agg({'teampreature': 'mean', 'humidity': 'mean',
monthly_weather.head()
```

Out[63]:

datetime	teampreature	humidity	wind_speed
2024-07-31	17.82775	78.725	2.99

In [70]:
```
# 3. Seasnoal Aggregation.
def get_season(month):
    if month in [12, 1, 2]:
        return 'Winter'
    elif month in [3, 4, 5]:
        return 'Spring'
    elif month in [6, 7, 8]:
        return 'Summer'
    else:
        return 'Autumn'

df['season'] = df.index.month.map(get_season)

seasonal_weather = df.groupby('season').agg({'temperature': 'mean', 'humidity': 'me
seasonal_weather
```

Out[70]:

season	temperature	humidity	wind_speed
Summer	26.0	84.2	9

In [91]:
```
# 8. Incorporate Geographical Information
```

In [92]:
```
pip install folium
```

```
Note: you may need to restart the kernel to use updated packages.
Requirement already satisfied: folium in c:\users\saira\appdata\local\programs\pytho
n\python310\lib\site-packages (0.17.0)
Requirement already satisfied: branca>=0.6.0 in c:\users\saira\appdata\local\program
s\python\python310\lib\site-packages (from folium) (0.7.2)
Requirement already satisfied: jinja2>=2.9 in c:\users\saira\appdata\local\programs
\python\python310\lib\site-packages (from folium) (3.1.2)
Requirement already satisfied: numpy in c:\users\saira\appdata\local\programs\python
\python310\lib\site-packages (from folium) (1.26.4)
Requirement already satisfied: requests in c:\users\saira\appdata\local\programs\pyt
hon\python310\lib\site-packages (from folium) (2.31.0)
Requirement already satisfied: xyzservices in c:\users\saira\appdata\local\programs
\python\python310\lib\site-packages (from folium) (2024.6.0)
Requirement already satisfied: MarkupSafe>=2.0 in c:\users\saira\appdata\local\progr
ams\python\python310\lib\site-packages (from jinja2>=2.9->folium) (2.1.3)
Requirement already satisfied: charset-normalizer<4,>=2 in c:\users\saira\appdata\lo
cal\programs\python\python310\lib\site-packages (from requests->folium) (3.2.0)
Requirement already satisfied: idna<4,>=2.5 in c:\users\saira\appdata\local\programs
\python\python310\lib\site-packages (from requests->folium) (3.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in c:\users\saira\appdata\local\pr
ograms\python\python310\lib\site-packages (from requests->folium) (2.0.4)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\saira\appdata\local\pr
ograms\python\python310\lib\site-packages (from requests->folium) (2023.7.22)
[notice] A new release of pip is available: 24.0 -> 24.1.2
[notice] To update, run: python.exe -m pip install --upgrade pip
```

In [94]:

```python
# 1. Fetch Weather Data for Multiple Locations.


# Replace 'your_api_key' with your actual API key
api_key = 'c15c676d2f9d0dada63d7fa10c76ce01'

locations = [
    {'name': 'New York', 'lat': 40.7128, 'lon': -74.0060},
    {'name': 'London', 'lat': 51.5074, 'lon': -0.1278},
    {'name': 'Tokyo', 'lat': 35.6895, 'lon': 139.6917},
    # Add more locations as needed
]

weather_data = []

for loc in locations:
    url = f'http://api.openweathermap.org/data/2.5/weather?lat={loc["lat"]}&lon={lo
    response = requests.get(url)
    data = response.json()

    if response.status_code == 200:
        weather_data.append({
            'name': loc['name'],
            'temperature': data['main']['temp'],
            'humidity': data['main']['humidity'],
            'wind_speed': data['wind']['speed'],
            'latitude': loc['lat'],
            'longitude': loc['lon']
        })
```

```
    else:
        print(f"Error fetching data for {loc['name']}: {data.get('message', 'Unknow
```

In [95]:
```
weather_data
```

Out[95]:
```
[{'name': 'New York',
  'temperature': 23.3,
  'humidity': 73,
  'wind_speed': 1.54,
  'latitude': 40.7128,
  'longitude': -74.006},
 {'name': 'London',
  'temperature': 13.5,
  'humidity': 87,
  'wind_speed': 4.12,
  'latitude': 51.5074,
  'longitude': -0.1278},
 {'name': 'Tokyo',
  'temperature': 24.13,
  'humidity': 91,
  'wind_speed': 1.03,
  'latitude': 35.6895,
  'longitude': 139.6917}]
```

In [96]:
```
# 2. Create a Geospatial visualization using Folium.
# Create a map centered at a specific location (e.g., New York)
map_center = [40.7128, -74.0060]
mymap = folium.Map(location=map_center, zoom_start=3)

# Add markers for each location with weather information
for data in weather_data:
    popup_text = f"<b>{data['name']}</b><br>Temperature: {data['temperature']}°C<br
    folium.Marker(location=[data['latitude'], data['longitude']], popup=popup_text)

# Save the map as an HTML file
mymap.save('weather_map.html')
```

In [123…
```
mymap
```

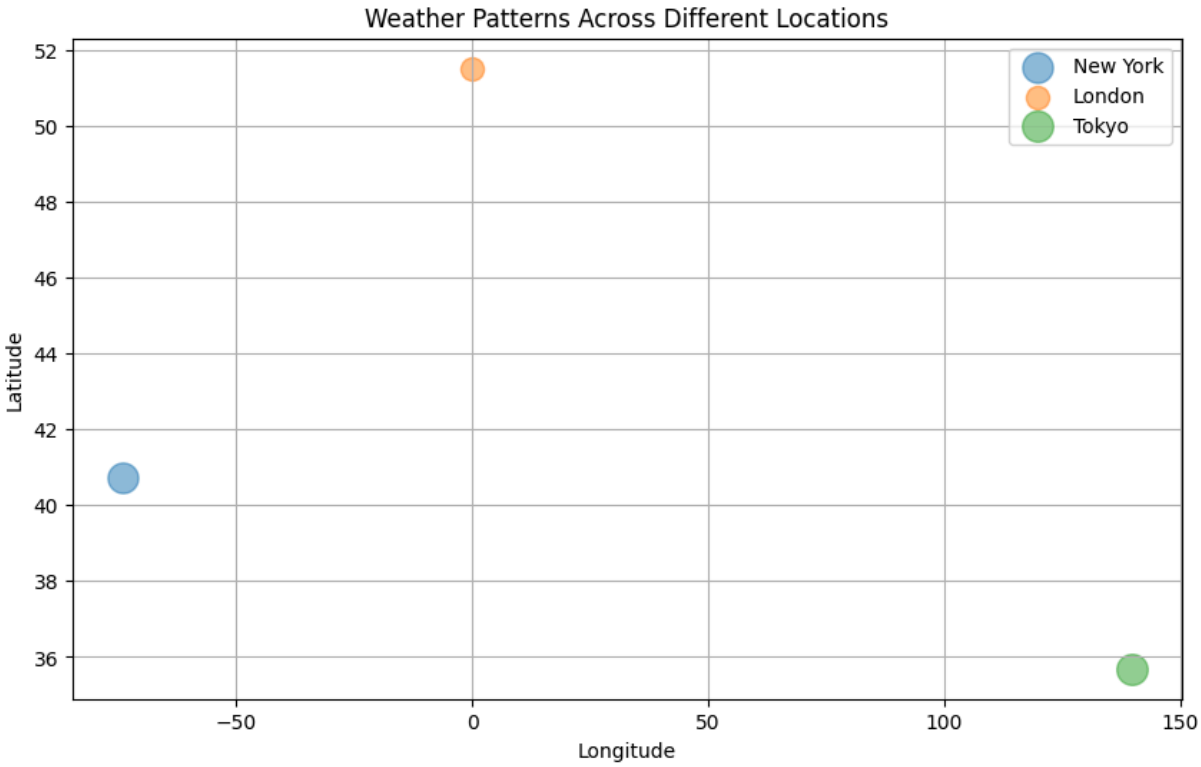
Out[123…

In [98]:

```
# 3. Viualize Weather Patterns on a Static Map using Matplotlib.
# Plot each location with a scatter plot based on temperature
plt.figure(figsize=(10, 6))

for data in weather_data:
    plt.scatter(data['longitude'], data['latitude'], s=data['temperature']*10, alph

plt.xlabel('Longitude')
plt.ylabel('Latitude')
plt.title('Weather Patterns Across Different Locations')
plt.legend()
plt.grid(True)
plt.show()
```

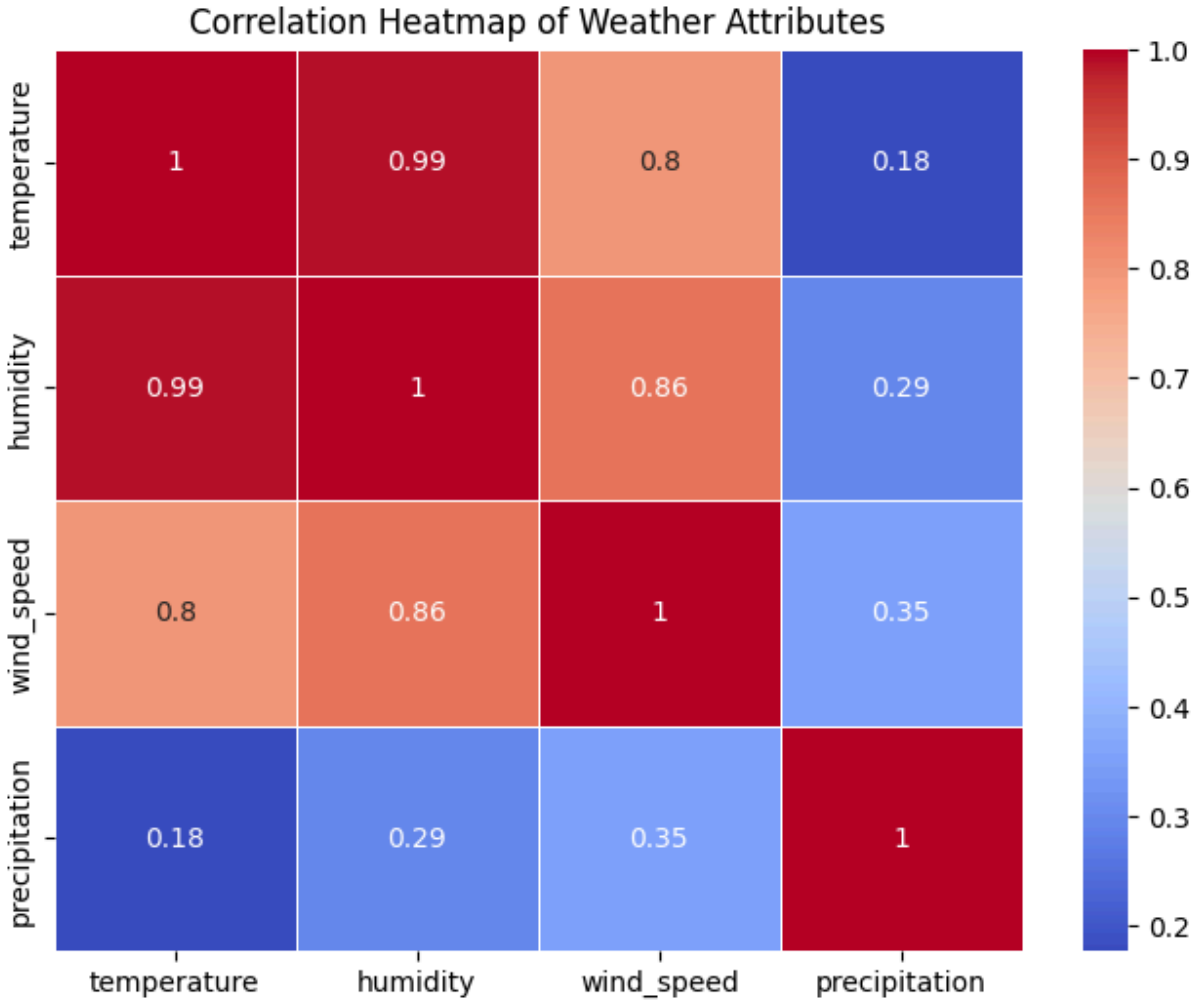


In [105…
```
# 9. Explore and Visualize Realationships.
```

In [106…
```
# Calculate correlation matrix
correlation_matrix = df[['temperature', 'humidity', 'wind_speed', 'precipitation']]
print(correlation_matrix)

# Plot heatmap
plt.figure(figsize=(8, 6))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', linewidths=0.5)
plt.title('Correlation Heatmap of Weather Attributes')
plt.show()
```

```
               temperature  humidity  wind_speed  precipitation
temperature       1.000000  0.988483    0.800000       0.176777
humidity          0.988483  1.000000    0.864923       0.294875
wind_speed        0.800000  0.864923    1.000000       0.353553
precipitation     0.176777  0.294875    0.353553       1.000000
```


Correlation Heatmap of Weather Attributes
temperature
humidity
wind_speed
precipitation
1
0.99
0.8
0.18
0.99
1
0.86
0.29
0.8
0.86
1
0.35
0.18
0.29
0.35
1
temperature
humidity
wind_speed
precipitation
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2

In [ ]: