Upload Database

```python
from google.colab import files
uploaded = files.upload()
```

Choose files air_quality.csv
- **air_quality.csv**(text/csv) - 499254 bytes, last modified: 03/05/2025 - 100% done
Saving air_quality.csv to air_quality.csv

Load the Dataset

```python
import pandas as pd

df = pd.read_csv('air_quality.csv')  # replace with your actual dataset name
df.head()
```

	AQI Value	CO AQI Value	Ozone AQI Value	NO2 AQI Value	PM2.5 AQI Value	lat	lng
0	51	1	36	0	51	44.7444	44.2031
1	41	1	5	1	41	-5.2900	-44.4900
2	41	1	5	1	41	-11.2958	-41.9869
3	66	1	39	2	66	37.1667	15.1833
4	34	1	34	0	20	53.0167	20.8833

Data Exploration

```python
print("Shape:", df.shape)
print("Columns:", df.columns.tolist())
df.info()
df.describe()
```

```
Shape: (16695, 7)
Columns: ['AQI Value', 'CO AQI Value', 'Ozone AQI Value', 'NO2 AQI Value', 'PM2.5 AQI Value', 'lat', 'lng']
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 16695 entries, 0 to 16694
Data columns (total 7 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   AQI Value        16695 non-null  int64
 1   CO AQI Value     16695 non-null  int64
 2   Ozone AQI Value  16695 non-null  int64
 3   NO2 AQI Value    16695 non-null  int64
 4   PM2.5 AQI Value  16695 non-null  int64
 5   lat              16695 non-null  float64
 6   lng              16695 non-null  float64
dtypes: float64(2), int64(5)
memory usage: 913.1 KB
```

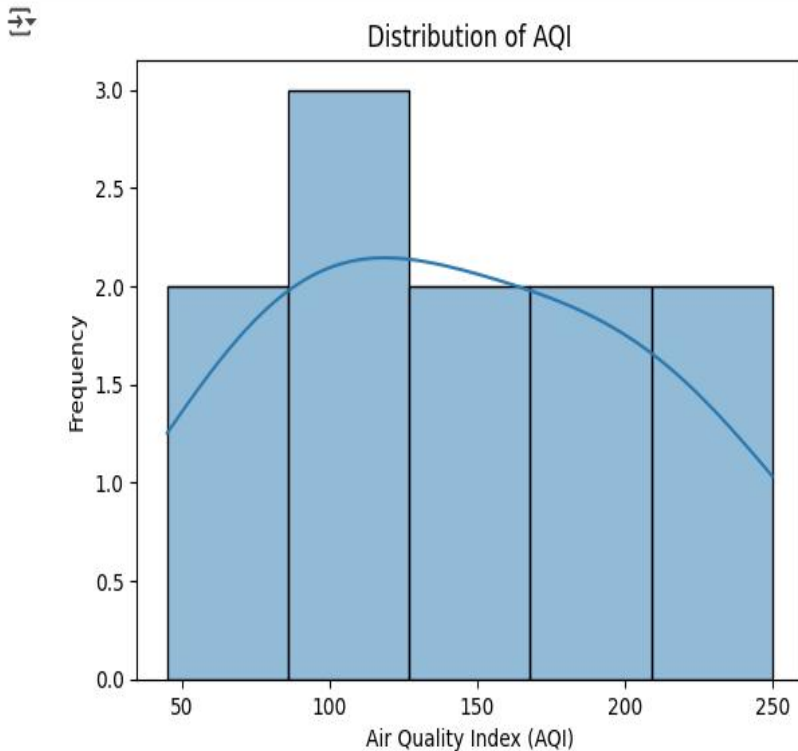|	AQI Value	CO AQI Value	Ozone AQI Value	NO2 AQI Value	PM2.5 AQI Value	lat	lng
count	16695.000000	16695.000000	16695.000000	16695.000000	16695.000000	16695.000000	16695.000000
mean	62.998682	1.342138	31.767355	3.819647	59.821324	30.267148	-3.944485
std	43.091971	2.371379	22.839343	5.880677	43.208298	22.947398	73.037148
min	7.000000	0.000000	0.000000	0.000000	0.000000	-54.801900	-171.750000
25%	38.500000	1.000000	20.000000	0.000000	34.000000	16.515450	-75.180000
50%	52.000000	1.000000	29.000000	2.000000	52.000000	38.815800	5.643100
75%	69.000000	1.000000	38.000000	5.000000	69.000000	46.683300	36.275000
max	500.000000	133.000000	222.000000	91.000000	500.000000	70.767000	178.017800

Check for missing values and duplicates

```
[ ]  print(df.isnull().sum())
     print("Duplicate rows:", df.duplicated().sum())
```

```
AQI Value          0
CO AQI Value       0
Ozone AQI Value    0
NO2 AQI Value      0
PM2.5 AQI Value    0
lat                0
lng                0
dtype: int64
Duplicate rows: 0
```

Visualize a few features

```python
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
data = {'AQI': [45, 67, 89, 100, 120, 135, 160, 180, 200, 220, 250]}
df = pd.DataFrame(data)
sns.histplot(df['AQI'], kde=True)
plt.title('Distribution of AQI')
plt.xlabel('Air Quality Index (AQI)')
plt.ylabel('Frequency')
plt.show()
```

Identify target and features

```
[ ]    target = 'AQI'
       features = df.columns.drop(target)
```

One-hot encoding

```
[ ]    df_encoded = pd.get_dummies(df, drop_first=True)
```

Feature scaling

```
[ ]    from sklearn.preprocessing import StandardScaler
       if len(df_encoded.columns.drop('AQI')) > 0:
         X = df_encoded.drop('AQI', axis=1)
         scaler = StandardScaler()
         X_scaled = scaler.fit_transform(X)
         y = df_encoded['AQI']
       else:
         print("No features available for scaling after dropping target variable.")
```

```
⇥    No features available for scaling after dropping target variable.
```

Train -test split

```
[19]   from sklearn.model_selection import train_test_split
       import pandas as pd
       target = 'target'
       X = df.drop(columns=[target])
       y = df[target]
       X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

Model building

```
✓   [21]   from sklearn.ensemble import RandomForestRegressor
0s         from sklearn.metrics import mean_squared_error, r2_score
           from sklearn.model_selection import train_test_split
           from sklearn.preprocessing import StandardScaler
           import pandas as pd

           # Assuming df is your DataFrame with features and target
           target = 'target'
           X = df.drop(columns=[target])
           y = df[target]
           X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

           # Scale the training and testing data
           scaler = StandardScaler()
           X_train_scaled = scaler.fit_transform(X_train)
           X_test_scaled = scaler.transform(X_test)

           # Now you can fit the model
           model = RandomForestRegressor(n_estimators=100, random_state=42)
           model.fit(X_train_scaled, y_train)
           y_pred = model.predict(X_test_scaled)
```

Evaluation

```
[22] mse = mean_squared_error(y_test, y_pred)
     r2 = r2_score(y_test, y_pred)
     print(f"Mean Squared Error (MSE): {mse:.2f}")
     print(f"R² Score: {r2:.2f}")
```

```
Mean Squared Error (MSE): 40136.00
R² Score: -15.05
```

Make prediction from new input

```
[24] new_data = pd.DataFrame({  # Create a sample DataFrame for demonstration
         'feature1': [25],  # Example values for your features
         'feature2': [30]   # Example values for your features
     })
     new_data_scaled = scaler.transform(new_data)
```

Convert to dataframe and encode

```
[27] new_data = pd.DataFrame([{
         'feature1': 37.0,  # Replace with the actual value for feature1
         'feature2': 52.0   # Replace with the actual value for feature2
     }])
     new_data_scaled = scaler.transform(new_data)
     predicted_aqi = model.predict(new_data_scaled)
     print(f"Predicted AQI: {predicted_aqi[0]:.2f}")
```

```
Predicted AQI: 439.00
```

Deployment-building an interactive app

```
[28] !pip install gradio
     import gradio as gr

     def predict_aqi(PM25, PM10, NO2, CO, O3):
         input_data = pd.DataFrame([{
             'PM2.5': PM25,
             'PM10': PM10,
             'NO2': NO2,
             'CO': CO,
             'O3': O3,
             # Add other features here
         }])

         df_temp = pd.concat([df.drop('AQI', axis=1), input_data], ignore_index=True)
         df_temp_encoded = pd.get_dummies(df_temp, drop_first=True)
         df_temp_encoded = df_temp_encoded.reindex(columns=df_encoded.drop('AQI', axis=1).columns, fill_value=0)

         input_scaled = scaler.transform(df_temp_encoded.tail(1))
         prediction = model.predict(input_scaled)
         return round(prediction[0], 2)
```

```
Requirement already satisfied: gradio in /usr/local/lib/python3.11/dist-packages (5.29.0)
Requirement already satisfied: aiofiles<25.0,>=22.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (24.1.0)
Requirement already satisfied: anyio<5.0,>=3.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (4.9.0)
Requirement already satisfied: fastapi<1.0,>=0.115.2 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.115.12)
Requirement already satisfied: ffmpy in /usr/local/lib/python3.11/dist-packages (from gradio) (0.5.0)
Requirement already satisfied: gradio-client==1.10.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (1.10.0)
Requirement already satisfied: groovy~=0.1 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.1.2)
Requirement already satisfied: httpx>=0.24.1 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.28.1)
Requirement already satisfied: huggingface-hub>=0.28.1 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.30.2)
Requirement already satisfied: jinja2<4.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (3.1.6)
Requirement already satisfied: markupsafe<4.0,>=2.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (3.0.2)
Requirement already satisfied: numpy<3.0,>=1.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (2.0.2)
Requirement already satisfied: orjson~=3.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (3.10.17)
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Requirement already satisfied: pillow<12.0,>=8.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (11.2.1)
Requirement already satisfied: pydantic<2.12,>=2.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (2.11.3)
Requirement already satisfied: pydub in /usr/local/lib/python3.11/dist-packages (from gradio) (0.25.1)
Requirement already satisfied: python-multipart>=0.0.18 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.0.20)
Requirement already satisfied: pyyaml<7.0,>=5.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (6.0.2)
Requirement already satisfied: ruff>=0.9.3 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.11.8)
Requirement already satisfied: safehttpx<0.2.0,>=0.1.6 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.1.6)
Requirement already satisfied: semantic-version~=2.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (2.10.0)
Requirement already satisfied: starlette<1.0,>=0.40.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.46.2)
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Requirement already satisfied: typer<1.0,>=0.12 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.15.3)
Requirement already satisfied: typing-extensions~=4.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (4.13.2)
Requirement already satisfied: uvicorn>=0.14.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.34.2)
Requirement already satisfied: fsspec in /usr/local/lib/python3.11/dist-packages (from gradio-client==1.10.0->gradio) (2025.3.2)
Requirement already satisfied: websockets<16.0,>=10.0 in /usr/local/lib/python3.11/dist-packages (from gradio-client==1.10.0->gradio) (15.0.1)
Requirement already satisfied: idna>=2.8 in /usr/local/lib/python3.11/dist-packages (from anyio<5.0,>=3.0->gradio) (3.10)
Requirement already satisfied: sniffio>=1.1 in /usr/local/lib/python3.11/dist-packages (from anyio<5.0,>=3.0->gradio) (1.3.1)
Requirement already satisfied: certifi in /usr/local/lib/python3.11/dist-packages (from httpx>=0.24.1->gradio) (2025.4.26)
Requirement already satisfied: httpcore==1.* in /usr/local/lib/python3.11/dist-packages (from httpx>=0.24.1->gradio) (1.0.9)
Requirement already satisfied: h11>=0.16 in /usr/local/lib/python3.11/dist-packages (from httpcore==1.*->httpx>=0.24.1->gradio) (0.16.0)
Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-packages (from huggingface-hub>=0.28.1->gradio) (3.18.0)
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Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.11/dist-packages (from pandas<3.0,>=1.0->gradio) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas<3.0,>=1.0->gradio) (2025.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/dist-packages (from pandas<3.0,>=1.0->gradio) (2025.2)
Requirement already satisfied: annotated-types>=0.6.0 in /usr/local/lib/python3.11/dist-packages (from pydantic<2.12,>=2.0->gradio) (0.7.0)
Requirement already satisfied: pydantic-core==2.33.1 in /usr/local/lib/python3.11/dist-packages (from pydantic<2.12,>=2.0->gradio) (2.33.1)
Requirement already satisfied: typing-inspection>=0.4.0 in /usr/local/lib/python3.11/dist-packages (from pydantic<2.12,>=2.0->gradio) (0.4.0)
Requirement already satisfied: click>=8.0.0 in /usr/local/lib/python3.11/dist-packages (from typer<1.0,>=0.12->gradio) (8.1.8)
Requirement already satisfied: shellingham>=1.3.0 in /usr/local/lib/python3.11/dist-packages (from typer<1.0,>=0.12->gradio) (1.5.4)
Requirement already satisfied: rich>=10.11.0 in /usr/local/lib/python3.11/dist-packages (from typer<1.0,>=0.12->gradio) (13.9.4)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.8.2->pandas<3.0,>=1.0->gradio) (1.1
Requirement already satisfied: markdown-it-py>=2.2.0 in /usr/local/lib/python3.11/dist-packages (from rich>=10.11.0->typer<1.0,>=0.12->gradio)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in /usr/local/lib/python3.11/dist-packages (from rich>=10.11.0->typer<1.0,>=0.12->gradio
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests->huggingface-hub>=0.28.1->gra
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests->huggingface-hub>=0.28.1->gradio) (
Requirement already satisfied: mdurl~=0.1 in /usr/local/lib/python3.11/dist-packages (from markdown-it-py>=2.2.0->rich>=10.11.0->typer<1.0,>=0.
```

Create the gradio interface

```python
!pip install gradio
import gradio as gr

def predict_aqi(PM25, PM10, NO2, CO, O3):
    input_data = pd.DataFrame([{
        'PM2.5': PM25,
        'PM10': PM10,
        'NO2': NO2,
        'CO': CO,
        'O3': O3,
        # Add other features here
    }])

    df_temp = pd.concat([df.drop('AQI', axis=1), input_data], ignore_index=True)
    df_temp_encoded = pd.get_dummies(df_temp, drop_first=True)
    df_temp_encoded = df_temp_encoded.reindex(columns=df_encoded.drop('AQI', axis=1).columns, fill_value=0)

    input_scaled = scaler.transform(df_temp_encoded.tail(1))
    prediction = model.predict(input_scaled)
    return round(prediction[0], 2)

inputs = [
    gr.Number(label="PM2.5"),
    gr.Number(label="PM10"),
    gr.Number(label="NO2"),
    gr.Number(label="CO"),
    gr.Number(label="O3"),
]

output = gr.Number(label="Predicted AQI")

gr.Interface(fn=predict_aqi, inputs=inputs, outputs=output, title="Air Quality Predictor").launch()
```

```
Collecting gradio
  Downloading gradio-5.29.0-py3-none-any.whl.metadata (16 kB)
Collecting aiofiles<25.0,>=22.0 (from gradio)
  Downloading aiofiles-24.1.0-py3-none-any.whl.metadata (10 kB)
Requirement already satisfied: anyio<5.0,>=3.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (4.9.0)
Collecting fastapi<1.0,>=0.115.2 (from gradio)
  Downloading fastapi-0.115.12-py3-none-any.whl.metadata (27 kB)
Collecting ffmpy (from gradio)
  Downloading ffmpy-0.5.0-py3-none-any.whl.metadata (3.0 kB)
Collecting gradio-client==1.10.0 (from gradio)
  Downloading gradio_client-1.10.0-py3-none-any.whl.metadata (7.1 kB)
Collecting groovy~=0.1 (from gradio)
  Downloading groovy-0.1.2-py3-none-any.whl.metadata (6.1 kB)
Requirement already satisfied: httpx>=0.24.1 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.28.1)
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Requirement already satisfied: jinja2<4.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (3.1.6)
Requirement already satisfied: markupsafe<4.0,>=2.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (3.0.2)
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Requirement already satisfied: packaging in /usr/local/lib/python3.11/dist-packages (from gradio) (24.2)
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  Downloading pydub-0.25.1-py2.py3-none-any.whl.metadata (1.4 kB)
Collecting python-multipart>=0.0.18 (from gradio)
  Downloading python_multipart-0.0.20-py3-none-any.whl.metadata (1.8 kB)
Requirement already satisfied: pyyaml<7.0,>=5.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (6.0.2)
Collecting ruff>=0.9.3 (from gradio)
  Downloading ruff-0.11.8-py3-none-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (25 kB)
Collecting safehttpx<0.2.0,>=0.1.6 (from gradio)
  Downloading safehttpx-0.1.6-py3-none-any.whl.metadata (4.2 kB)
Collecting semantic-version~=2.0 (from gradio)
  Downloading semantic_version-2.10.0-py2.py3-none-any.whl.metadata (9.7 kB)
Collecting starlette<1.0,>=0.40.0 (from gradio)
  Downloading starlette-0.46.2-py3-none-any.whl.metadata (6.2 kB)
Collecting tomlkit<0.14.0,>=0.12.0 (from gradio)
  Downloading tomlkit-0.13.2-py3-none-any.whl.metadata (2.7 kB)
Requirement already satisfied: typer<1.0,>=0.12 in /usr/local/lib/python3.11/dist-packages (from gradio) (0.15.3)
Requirement already satisfied: typing-extensions~=4.0 in /usr/local/lib/python3.11/dist-packages (from gradio) (4.13.2)
Collecting uvicorn>=0.14.0 (from gradio)
  Downloading uvicorn-0.34.2-py3-none-any.whl.metadata (6.5 kB)
Requirement already satisfied: fsspec in /usr/local/lib/python3.11/dist-packages (from gradio-client==1.10.0->gradio) (2025.3.2)
Requirement already satisfied: websockets<16.0,>=10.0 in /usr/local/lib/python3.11/dist-packages (from gradio-client==1.10.0->gradio) (15.0.
Requirement already satisfied: idna>=2.8 in /usr/local/lib/python3.11/dist-packages (from anyio<5.0,>=3.0->gradio) (3.10)
Requirement already satisfied: sniffio>=1.1 in /usr/local/lib/python3.11/dist-packages (from anyio<5.0,>=3.0->gradio) (1.3.1)

Requirement already satisfied: certifi in /usr/local/lib/python3.11/dist-packages (from httpx>=0.24.1->gradio) (2025.4.26)
Requirement already satisfied: httpcore==1.* in /usr/local/lib/python3.11/dist-packages (from httpx>=0.24.1->gradio) (1.0.9)
Requirement already satisfied: h11>=0.16 in /usr/local/lib/python3.11/dist-packages (from httpcore==1.*->httpx>=0.24.1->gradio) (0.16.0)
Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-packages (from huggingface-hub>=0.28.1->gradio) (3.18.0)
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Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.11/dist-packages (from pandas<3.0,>=1.0->gradio) (2.9.0.post0
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas<3.0,>=1.0->gradio) (2025.2)
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Requirement already satisfied: pygments<3.0.0,>=2.13.0 in /usr/local/lib/python3.11/dist-packages (from rich>=10.11.0->typer<1.0,>=0.12->grad
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests->huggingface-hub>=0.28.1->g
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests->huggingface-hub>=0.28.1->gradio)
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Installing collected packages: pydub, uvicorn, tomlkit, semantic-version, ruff, python-multipart, groovy, ffmpy, aiofiles, starlette, safehtt
Successfully installed aiofiles-24.1.0 fastapi-0.115.12 ffmpy-0.5.0 gradio-5.29.0 gradio-client-1.10.0 groovy-0.1.2 pydub-0.25.1 python-multi
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```

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