ADD IMAGE DATA SET DIRECTIY FROM KAGGLEHUB TO GOOGLE COLLAB

```
import kagglehub
saroz014_plant_diseases_path = kagglehub.dataset_download('saroz014/plant-diseases')
print('Data source import complete.')
```

```
Using Colab cache for faster access to the 'plant-diseases' dataset.
Data source import complete.
```

```
!pip install lime
```

```
Collecting lime
  Downloading lime-0.2.0.1.tar.gz (275 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 275.7/275.7 kB 22.1 MB/s eta 0:00:00
  Preparing metadata (setup.py) ... done
Requirement already satisfied: matplotlib in /usr/local/lib/python3.12/dist-packages (from lime) (3.10.0)
Requirement already satisfied: numpy in /usr/local/lib/python3.12/dist-packages (from lime) (2.0.2)
Requirement already satisfied: scipy in /usr/local/lib/python3.12/dist-packages (from lime) (1.16.2)
Requirement already satisfied: tqdm in /usr/local/lib/python3.12/dist-packages (from lime) (4.67.1)
Requirement already satisfied: scikit-learn>=0.18 in /usr/local/lib/python3.12/dist-packages (from lime) (1.6.1)
Requirement already satisfied: scikit-image>=0.12 in /usr/local/lib/python3.12/dist-packages (from lime) (0.25.2)
Requirement already satisfied: networkx>=3.0 in /usr/local/lib/python3.12/dist-packages (from scikit-image>=0.12->lime) (3.5)
Requirement already satisfied: pillow>=10.1 in /usr/local/lib/python3.12/dist-packages (from scikit-image>=0.12->lime) (11.3.0)
Requirement already satisfied: imageio!=2.35.0,>=2.33 in /usr/local/lib/python3.12/dist-packages (from scikit-image>=0.12->lime) (2.37.0)
Requirement already satisfied: tifffile>=2022.8.12 in /usr/local/lib/python3.12/dist-packages (from scikit-image>=0.12->lime) (2025.10.16)
Requirement already satisfied: packaging>=21 in /usr/local/lib/python3.12/dist-packages (from scikit-image>=0.12->lime) (25.0)
Requirement already satisfied: lazy-loader>=0.4 in /usr/local/lib/python3.12/dist-packages (from scikit-image>=0.12->lime) (0.4)
Requirement already satisfied: joblib>=1.2.0 in /usr/local/lib/python3.12/dist-packages (from scikit-learn>=0.18->lime) (1.5.2)
Requirement already satisfied: threadpoolctl>=3.1.0 in /usr/local/lib/python3.12/dist-packages (from scikit-learn>=0.18->lime) (3.6.0)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.12/dist-packages (from matplotlib->lime) (1.3.3)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.12/dist-packages (from matplotlib->lime) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.12/dist-packages (from matplotlib->lime) (4.60.1)
Requirement already satisfied: kiwisolver>=1.3.1 in /usr/local/lib/python3.12/dist-packages (from matplotlib->lime) (1.4.9)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.12/dist-packages (from matplotlib->lime) (3.2.5)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.12/dist-packages (from matplotlib->lime) (2.9.0.post0)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.12/dist-packages (from python-dateutil>=2.7->matplotlib->lime) (1.17.0)
Building wheels for collected packages: lime
  Building wheel for lime (setup.py) ... done
  Created wheel for lime: filename=lime-0.2.0.1-py3-none-any.whl size=283834 sha256=8ef62d079a3f76f2a734d7dd925ed591db815dd3499dc4a6a2265ae4e4314d63
  Stored in directory: /root/.cache/pip/wheels/e7/5d/0e/4b4fff9a47468fed5633211fb3b76d1db43fe806a17fb7486a
Successfully built lime
Installing collected packages: lime
Successfully installed lime-0.2.0.1
```

```
#data reading and plotting libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from glob import glob
import keras
```

data reading and plotting libraries

```
dir = glob('/kaggle/input/plant-diseases/dataset_itr2/train/*')
dir
```

```
['/kaggle/input/plant-diseases/dataset_itr2/train/Tomato___Late_blight',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Tomato___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Grape___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Orange___Haunglongbing_(Citrus_greening)',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Soybean___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Squash___Powdery_mildew',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Potato___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Corn_(maize)___Northern_Leaf_Blight',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Tomato___Early_blight',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Tomato___Septoria_leaf_spot',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Corn_(maize)___Cercospora_leaf_spot Gray_leaf_spot',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Strawberry___Leaf_scorch',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Peach___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Apple___Apple_scab',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Tomato___Tomato_Yellow_Leaf_Curl_Virus',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Tomato___Bacterial_spot',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Apple___Black_rot',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Blueberry___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Cherry_(including_sour)___Powdery_mildew',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Peach___Bacterial_spot',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Apple___Cedar_apple_rust',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Tomato___Target_Spot',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Pepper,_bell___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Grape___Leaf_blight_(Isariopsis_Leaf_Spot)',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Potato___Late_blight',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Tomato___Tomato_mosaic_virus',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Strawberry___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Apple___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Grape___Black_rot',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Potato___Early_blight',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Cherry_(including_sour)___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Corn_(maize)___Common_rust_',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Grape___Esca_(Black_Measles)',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Raspberry___healthy',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Tomato___Leaf_Mold',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Tomato___Spider_mites Two-spotted_spider_mite',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Pepper,_bell___Bacterial_spot',
 '/kaggle/input/plant-diseases/dataset_itr2/train/Corn_(maize)___healthy']
```

```
import kagglehub
path = kagglehub.dataset_download('saroz014/plant-diseases')
print('Data source import complete:', path)

# Core libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from glob import glob
import os
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, roc_auc_score, confusion_matrix, classification_report
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier, GradientBoostingClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
import xgboost as xgb

# Deep Learning
import keras
from keras.models import Sequential
from keras.layers import Dense, Dropout
```

```
# XAI
import shap
from sklearn.inspection import PartialDependenceDisplay
```

```
Data source import complete: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1
```

```
import glob
import os

# List all CSV files in the downloaded dataset directory
csv_files = glob.glob(os.path.join(path, '*.csv'))
print("Found CSV files in the dataset directory:")
for csv_file in csv_files:
    print(csv_file)
```

```
Found CSV files in the dataset directory:
```

shows you all the files and their full paths inside your dataset folder.

```
import os

print("Dataset path:", path)
for root, dirs, files in os.walk(path):
    for file in files:
        print(os.path.join(root, file))
```

```
Streaming output truncated to the last 5000 lines.
/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/6e4dfd43-4d68-4c5e-8580-8caa165107a8___FAM_B.Rot 0398.JPG
/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/0cf5d61f-fb1a-4533-b0aa-f174d2acdc82___FAM_B.Rot 0721_90degFli
/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/3b840038-8831-4158-ab4a-8eeee954d136___FAM_B.Rot 3307_90degFli
/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/0e143d33-adc0-41af-92e2-d0bb712d7b72___FAM_B.Rot 5047_90degFli
/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/2e875c76-45f3-48f9-b678-f2282da11408___FAM_B.Rot 3101.JPG
/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/0baabe1e-b188-4c55-8f61-0f484f90c73b___FAM_B.Rot 3532_90degFli
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/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/0e143d33-adc0-41af-92e2-d0bb712d7b72___FAM_B.Rot 5047_90degFli
/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/4b0efd47-1736-40e8-844f-077a0cf12294___FAM_B.Rot 5104_FlipTB.J
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/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/1e24a20d-3dbf-42fe-b3ee-0a1281a92159___FAM_B.Rot 0636_FlipTB.J
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/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/3f82a8c0-b79d-48a1-971e-8ae69f34dc0e___FAM_B.Rot 3012_FlipTB.J
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/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/4e9dc57c-9d1e-4e31-bb7e-a744a67d98ed___FAM_B.Rot 3263_90degFli
/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/2a0ee669-62f0-4f4a-8edc-c37e2bbe461d___FAM_B.Rot 3578.JPG
/root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/dataset_itr2/test/Grape___Black_rot/1a081ae3-fab7-4a12-8ba4-2e46cabf5f44___FAM_B.Rot 5059.JPG
```

Deletes any corrupted or unreadable image files

```
import os
from PIL import Image

for root, dirs, files in os.walk(path):
    for file in files:
        fpath = os.path.join(root, file)
        try:
            with Image.open(fpath) as img:
                img.verify()
        except Exception:
            print("🗑️ Removing corrupted file:", fpath)
            os.remove(fpath)
```

```
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/train/Pepper,_bell___Bacterial_spot/.directory
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/train/Tomato___Late_blight/.directory
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/train/Pepper,_bell___healthy/.directory
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/train/Tomato___healthy/.directory
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/train/Apple___Apple_scab/.directory
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/3b54aef1-a072-4573-b081
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/6e6f7ac5-c6dd-40d8-b02b
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/6fd294ef-7fd5-4a8b-ade0
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/1c85b964-5938-4697-88ef
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/4b9ea976-2e8e-440b-b637
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/2bb9b733-61f3-45c1-a456
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/3c43caa6-a520-425e-92f1
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/6b27e8ce-ab53-427a-85c7
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/2f71bea1-93fa-4e87-80dd
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/5fe5044a-c2c2-4c8b-b14e
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/4b829642-fdcd-4e9b-b981
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/2a09ee4c-327b-4c3a-843c
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/2cba74b9-b924-4791-87fa
🗑️ Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/6e1646b4-4366-42c2-b781
```

```
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/1acd61a0-cded-4377-aaf1
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/2fafa290-5f6f-4b17-af2b
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/6da65077-20da-4372-a5c7
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/3badd648-c38a-4f84-b5ea
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/7a0f96cc-72a2-426f-9d48
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/4b8cb423-6b37-45c7-9e5e
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/3c862cab-574f-4fd5-a94e
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/4b4574ff-8e5d-48a6-b993
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/2f6367b2-d10a-4c58-8a6e
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/1e8e3277-ade5-42dd-b7d5
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/3c43caa6-a520-425e-92f1
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/2c5614e2-6d97-4259-8cd9
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/4f6f2114-24ea-421d-bb23
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/6aec29ed-a0a1-4ec5-99f6
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/1ab10a20-8a1e-4d49-8bc6
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/1a3a5d93-5025-473f-9ac2
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/1e5b0554-a8e5-468e-b86e
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/2cc12edf-603b-452e-bde5
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/3f2a8efd-c025-44fc-836f
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/0fa3fd36-b09e-4297-b5d0
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/0f3d1946-dcde-4466-9907
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/6f7ec5c0-f936-456c-bbf2
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/5b0fd44e-41d8-49c0-92b4
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/5bc61f9a-047b-4bc6-85f6
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/7e6ee51c-ac00-459c-bcd4
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/1be5a2f2-8cc5-4e7f-ac0c
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/6d2c3614-af3e-4565-bc83
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/3bf34ac8-0953-4586-888f
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/5a623871-630f-4917-ab1e
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/5c5fbafd-80f4-4389-b2d9
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/2ad33bef-7d92-4375-8457
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/1ca24b53-4c1c-4ea1-b185
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/2a232a54-a387-44ab-9018
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/1db036cc-e72f-45d3-a351
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/3fb99094-5e52-42f0-b66d
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/7dbdb991-c516-436e-80df
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/1db985a3-b296-49c2-bf3e
Removing corrupted file: /root/.cache/kagglehub/datasets/saroz014/plant-diseases/versions/1/dataset_itr2/test/Orange___Haunglongbing_(Citrus_greening)/4e51832d-9ca7-4ba3-8c97
```

Loads all your images

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator

datagen = ImageDataGenerator(rescale=1./255, validation_split=0.2)

train_gen = datagen.flow_from_directory(
    path,
    target_size=(128, 128),
    batch_size=32,
    class_mode='categorical',
    subset='training'
)

val_gen = datagen.flow_from_directory(
    path,
    target_size=(128, 128),
    batch_size=32,
    class_mode='categorical',
    subset='validation'
)
```

```
Found 344676 images belonging to 1 classes.
Found 86168 images belonging to 1 classes.
```

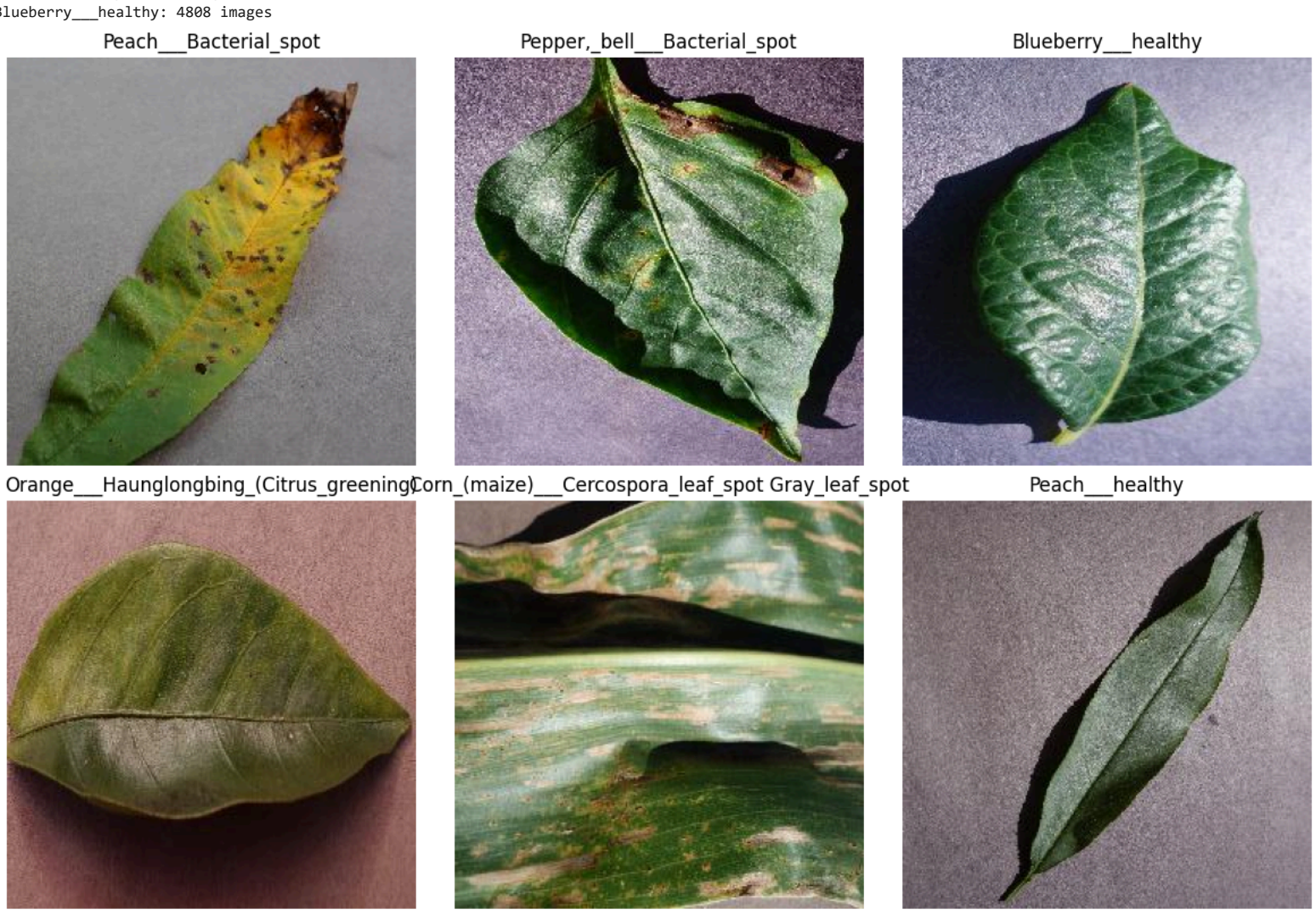
Count number of images per class

```
import os

# Update the path to list directories within the train directory
train_dir = os.path.join(path, 'dataset_itr2/train/')
classes = [d for d in os.listdir(train_dir) if os.path.isdir(os.path.join(train_dir, d))]
print(f"Total classes: {len(classes)}")
# Print counts for all classes
for c in classes:
    print(f"{c}: {len(os.listdir(os.path.join(train_dir, c)))} images")

# Display sample images
import random
plt.figure(figsize=(12, 8))
# Ensure we don't sample more classes than exist
num_samples = min(6, len(classes))
for i, cls in enumerate(random.sample(classes, num_samples)):
    cls_path = os.path.join(train_dir, cls)
    img_file = random.choice(os.listdir(cls_path))
    img = plt.imread(os.path.join(cls_path, img_file))
    plt.subplot(2, 3, i+1)
    plt.imshow(img)
    plt.title(cls)
    plt.axis("off")
plt.tight_layout()
plt.show()
```

```
Total classes: 38
Tomato___Spider_mites Two-spotted_spider_mite: 5364 images
Corn_(maize)___Common_rust_: 3816 images
Tomato___Early_blight: 3200 images
Pepper,_bell___Bacterial_spot: 3192 images
Tomato___Late_blight: 6108 images
Orange___Haunglongbing_(Citrus_greening): 17624 images
Peach___Bacterial_spot: 7352 images
Pepper,_bell___healthy: 4724 images
Grape___Esca_(Black_Measles): 4428 images
Tomato___Tomato_mosaic_virus: 1196 images
Potato___Early_blight: 3200 images
Corn_(maize)___healthy: 3720 images
Tomato___Bacterial_spot: 6808 images
Squash___Powdery_mildew: 5872 images
Apple___Black_rot: 1988 images
Strawberry___Leaf_scorch: 3552 images
Peach___healthy: 1152 images
Raspberry___healthy: 1188 images
Tomato___Tomato_Yellow_Leaf_Curl_Virus: 17144 images
Soybean___healthy: 16288 images
Strawberry___healthy: 1460 images
Tomato___Leaf_Mold: 3048 images
Corn_(maize)___Northern_Leaf_Blight: 3152 images
Tomato___Septoria_leaf_spot: 5668 images
Apple___Cedar_apple_rust: 880 images
Potato___Late_blight: 3200 images
Potato___healthy: 488 images
Tomato___healthy: 5088 images
Grape___healthy: 1356 images
Grape___Leaf_blight_(Isariopsis_Leaf_Spot): 3444 images
Cherry_(including_sour)___Powdery_mildew: 3368 images
Tomato___Target_Spot: 4496 images
Grape___Black_rot: 3776 images
Apple___Apple_scab: 2016 images
Cherry_(including_sour)___healthy: 2736 images
Corn_(maize)___Cercospora_leaf_spot Gray_leaf_spot: 1644 images
Apple___healthy: 5264 images
Blueberry___healthy: 4808 images
```



1.Reads all your images from folders.

2.Resizes them to 128×128 pixels.

3.Normalizes pixel values to 0–1.

4.Automatically splits them: 80% for training, 20% for validation.

5.Prepares them in batches of 32 for your CNN model to train efficiently.

```
IMG_SIZE = (128, 128)
BATCH_SIZE = 32

datagen = ImageDataGenerator(
    rescale=1./255,
    validation_split=0.2
)

train_gen = datagen.flow_from_directory(
    path,
    target_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='training'
)

val_gen = datagen.flow_from_directory(
    path,
    target_size=IMG_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='validation'
)
```

```
Found 344676 images belonging to 1 classes.
Found 86168 images belonging to 1 classes.
```

loads, resizes, and normalizes images

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator

datagen = ImageDataGenerator(rescale=1./255, validation_split=0.2)
train_gen = datagen.flow_from_directory(path, target_size=(128,128),
                                        batch_size=32, class_mode='categorical',
                                        subset='training')
```

```
Found 344676 images belonging to 1 classes.
```

loads, resizes, and prepares images from two folders

```
train_gen = datagen.flow_from_directory(
    path,
    target_size=(128,128),
    batch_size=32,
    class_mode='binary',
    subset='training'
)

val_gen = datagen.flow_from_directory(
    path,
    target_size=(128,128),
    batch_size=32,
    class_mode='binary',
    subset='validation'
)
```

```
Found 344676 images belonging to 1 classes.
Found 86168 images belonging to 1 classes.
```

Deep learenig model (CNN)

```
from tensorflow.keras import models, layers
from tensorflow.keras.optimizers import Adam

cnn = models.Sequential([
    layers.Conv2D(32, (3,3), activation='relu', input_shape=(128,128,3)),
    layers.MaxPooling2D(2,2),

    layers.Conv2D(64, (3,3), activation='relu'),
    layers.MaxPooling2D(2,2),

    layers.Conv2D(128, (3,3), activation='relu'),
    layers.MaxPooling2D(2,2),

    layers.Flatten(),
    layers.Dense(128, activation='relu'),
    layers.Dropout(0.3),


    layers.Dense(len(classes), activation='softmax') # Changed to len(classes) units and softmax activation
])

cnn.compile(optimizer=Adam(learning_rate=0.001),
            loss='categorical_crossentropy', # Changed loss to categorical_crossentropy
            metrics=['accuracy'])
cnn.summary()
```

```
/usr/local/lib/python3.12/dist-packages/keras/src/layers/convolutional/base_conv.py:113: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequ
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 126, 126, 32)	896
max_pooling2d (MaxPooling2D)	(None, 63, 63, 32)	0
conv2d_1 (Conv2D)	(None, 61, 61, 64)	18,496
max_pooling2d_1 (MaxPooling2D)	(None, 30, 30, 64)	0
conv2d_2 (Conv2D)	(None, 28, 28, 128)	73,856
max_pooling2d_2 (MaxPooling2D)	(None, 14, 14, 128)	0
flatten (Flatten)	(None, 25088)	0
dense (Dense)	(None, 128)	3,211,392
dropout (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 38)	4,902

Total params: 3,309,542 (12.62 MB)
Trainable params: 3,309,542 (12.62 MB)
Non-trainable params: 0 (0.00 B)

Explainable AI (XAI)

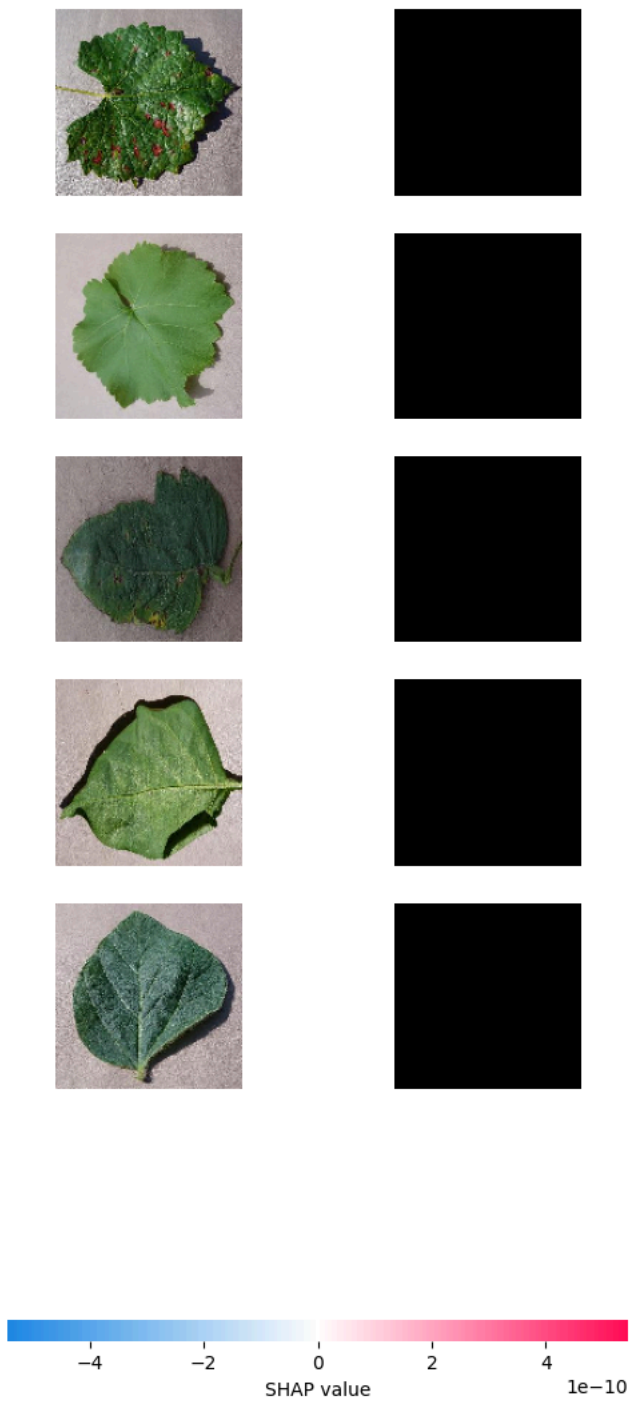
SHAP

```
import shap

background = next(iter(train_gen))[0][:30]
explainer = shap.DeepExplainer(cnn, background)
shap_values = explainer.shap_values(background[:5])

# plot SHAP explanations
shap.image_plot(shap_values, background[:5])
```

```
/usr/local/lib/python3.12/dist-packages/shap/explainers/_deep/deep_tf.py:94: UserWarning: Your TensorFlow version is newer than 2.4.0 and so graph support has been removed in eag
  warnings.warn(
/usr/local/lib/python3.12/dist-packages/keras/src/models/functional.py:241: UserWarning: The structure of `inputs` doesn't match the expected structure.
Expected: keras_tensor
Received: inputs=['Tensor(shape=(30, 128, 128, 3))']
  warnings.warn(msg)
/usr/local/lib/python3.12/dist-packages/keras/src/models/functional.py:241: UserWarning: The structure of `inputs` doesn't match the expected structure.
Expected: keras_tensor
Received: inputs=['Tensor(shape=(60, 128, 128, 3))']
  warnings.warn(msg)
/usr/local/lib/python3.12/dist-packages/keras/src/models/functional.py:241: UserWarning: The structure of `inputs` doesn't match the expected structure.
Expected: keras_tensor
Received: inputs=['Tensor(shape=(5, 128, 128, 3))']
  warnings.warn(msg)
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers). Got range [-3.559534889063798e-10..5.337881
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers). Got range [-1.002263161353767e-09..1.115040
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers). Got range [-5.991296347929165e-10..6.357367
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers). Got range [-6.107683248046669e-10..7.654676
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers). Got range [-9.781615517567843e-10..1.076841
```



LIME

```
from lime import lime_image
from skimage.segmentation import mark_boundaries
import matplotlib.pyplot as plt
import numpy as np

# Get a batch of images from the validation generator
img_batch, _ = next(val_gen)
img_array = img_batch[:1] # Take the first image

explainer = lime_image.LimeImageExplainer()
explanation = explainer.explain_instance(
    image=img_array[0].astype('double'),
    classifier_fn=lambda x: cnn.predict(x),
    top_labels=1,
    hide_color=0,
    num_samples=1000
)

temp, mask = explanation.get_image_and_mask(
    label=explanation.top_labels[0],
    positive_only=True,
    num_features=5,
    hide_rest=False
)

plt.imshow(mark_boundaries(temp / 2 + 0.5, mask))
plt.title("LIME Explanation")
plt.axis("off")
plt.show()
```

```
100%                                                 1000/1000 [00:25<00:00, 61.59it/s]
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 534ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 314ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 481ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 338ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 525ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 308ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 160ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 307ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 278ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 207ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 203ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 184ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 245ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 94ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 95ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 97ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 116ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 102ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 95ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 114ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 116ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 101ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 99ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 97ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 105ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 118ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 101ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 101ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 101ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 100ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 108ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 94ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 100ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 95ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 106ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 100ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 95ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 102ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 105ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 170ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 223ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 202ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 364ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 142ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 179ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 173ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 165ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 163ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 167ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 164ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 168ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 101ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 109ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 98ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 101ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 98ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 103ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 97ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 116ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 103ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 94ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 103ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 99ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 113ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 101ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 102ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 97ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 101ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 114ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 100ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 113ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 102ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 103ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 98ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 123ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 97ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 97ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 105ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 100ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
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1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 98ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 96ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 103ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 95ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 99ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 120ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 101ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 98ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 102ms/step
```
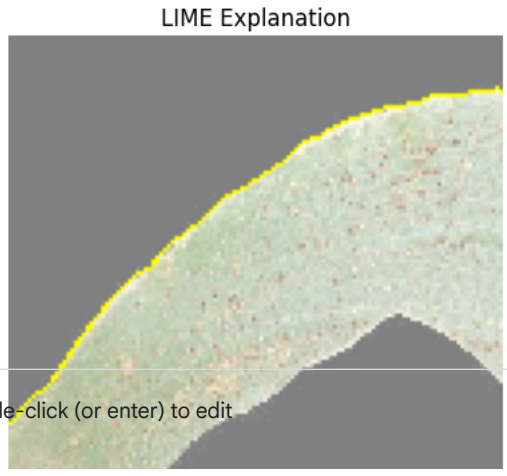

LIME Explanation



Double-click (or enter) to edit