```
# Set seeds for reproducibility
import random
random.seed(0)

import numpy as np
np.random.seed(0)

import tensorflow as tf
tf.random.set_seed(0)
```

Importing Dependencies

```
import os
import json
from zipfile import ZipFile
from PIL import Image

import numpy as np
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras import layers, models
```

Data Curation

Upload the kaggle.json file

```
!pip install kaggle
```

```
    Requirement already satisfied: kaggle in /usr/local/lib/python3.10/dist-packages (1.5.16)
    Requirement already satisfied: six>=1.10 in /usr/local/lib/python3.10/dist-packages (from kaggle) (1.16.0)
    Requirement already satisfied: certifi in /usr/local/lib/python3.10/dist-packages (from kaggle) (2024.2.2)
    Requirement already satisfied: python-dateutil in /usr/local/lib/python3.10/dist-packages (from kaggle) (2.8.2)
    Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-packages (from kaggle) (2.31.0)
    Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (from kaggle) (4.66.2)
    Requirement already satisfied: python-slugify in /usr/local/lib/python3.10/dist-packages (from kaggle) (8.0.4)
    Requirement already satisfied: urllib3 in /usr/local/lib/python3.10/dist-packages (from kaggle) (2.0.7)
    Requirement already satisfied: bleach in /usr/local/lib/python3.10/dist-packages (from kaggle) (6.1.0)
    Requirement already satisfied: webencodings in /usr/local/lib/python3.10/dist-packages (from bleach->kaggle) (0.5.1)
    Requirement already satisfied: text-unidecode>=1.3 in /usr/local/lib/python3.10/dist-packages (from python-slugify->kaggle) (1.3)
    Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests->kaggle) (3.3.2)
    Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests->kaggle) (3.7)
```

```
kaggle_credentails = json.load(open("kaggle.json"))
```

```
# setup Kaggle API key as environment variables
os.environ['KAGGLE_USERNAME'] = kaggle_credentails["username"]
os.environ['KAGGLE_KEY'] = kaggle_credentails["key"]
```

```
!kaggle datasets download -d abdallahalidev/plantvillage-dataset
```

```
    Downloading plantvillage-dataset.zip to /content
    100% 2.04G/2.04G [00:20<00:00, 183MB/s]
    100% 2.04G/2.04G [00:20<00:00, 105MB/s]
```

```
!ls
```

```
    drive  kaggle.json  plantvillage-dataset.zip  sample_data
```

```
with ZipFile("plantvillage-dataset.zip", 'r') as zip_ref:
    zip_ref.extractall()
```

```
print(os.listdir("plantvillage dataset"))


print(len(os.listdir("plantvillage dataset/segmented")))
print(os.listdir("plantvillage dataset/segmented")[:5])

print(len(os.listdir("plantvillage dataset/color")))
print(os.listdir("plantvillage dataset/color")[:5])

print(len(os.listdir("plantvillage dataset/grayscale")))
print(os.listdir("plantvillage dataset/grayscale")[:5])
```

```
['color', 'segmented', 'grayscale']
38
['Blueberry___healthy', 'Pepper,_bell___Bacterial_spot', 'Tomato___Bacterial_spot', 'Grape___Esca_(Black_Measles)', 'Cherry_(including_s
38
['Blueberry___healthy', 'Pepper,_bell___Bacterial_spot', 'Tomato___Bacterial_spot', 'Grape___Esca_(Black_Measles)', 'Cherry_(including_s
38
['Blueberry___healthy', 'Pepper,_bell___Bacterial_spot', 'Tomato___Bacterial_spot', 'Grape___Esca_(Black_Measles)', 'Cherry_(including_s
```

Number of Classes = 38

```
print(len(os.listdir("plantvillage dataset/color/Grape___healthy")))
print(os.listdir("plantvillage dataset/color/Grape___healthy")[:5])
```

```
423
['93f13053-88c2-4e0e-af52-b8057795b060___Mt.N.V_HL 8955.JPG', '789501fb-f627-40eb-bb6d-ffc25e179ad0___Mt.N.V_HL 8908.JPG', 'da73a76d-506
```

Data Preprocessing

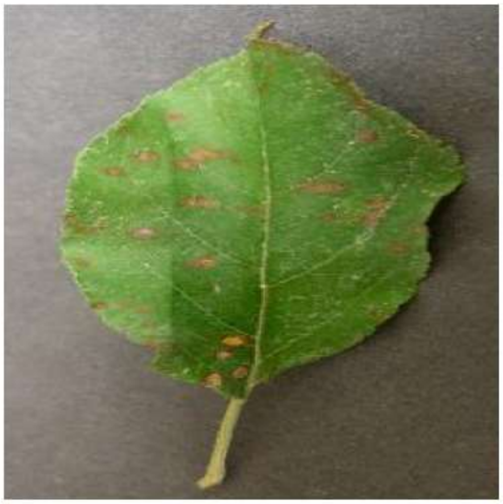
```
# Dataset Path
base_dir = 'plantvillage dataset/color'
```

```
image_path = '/content/plantvillage dataset/color/Apple___Cedar_apple_rust/025b2b9a-0ec4-4132-96ac-7f2832d0db4a___FREC_C.Rust 3655.JPG'

# Read the image
img = mpimg.imread(image_path)

print(img.shape)
# Display the image
plt.imshow(img)
plt.axis('off')  # Turn off axis numbers
plt.show()
```

```
(256, 256, 3)
```



```
image_path = '/content/plantvillage dataset/color/Apple___Cedar_apple_rust/025b2b9a-0ec4-4132-96ac-7f2832d0db4a___FREC_C.Rust 3655.JPG'

# Read the image
img = mpimg.imread(image_path)

print(img)
```

```
[[[179 175 176]
  [181 177 178]
  [184 180 181]
  ...
  [115 112 105]
  [108 105  98]
  [101  98  91]]

 [[176 172 173]
  [177 173 174]
  [178 174 175]
  ...
  [113 110 103]
  [111 108 101]
  [109 106  99]]

 [[180 176 177]
  [180 176 177]
  [180 176 177]
  ...
  [108 105  98]
  [111 108 101]
  [114 111 104]]

 ...

 [[137 128 119]
  [131 122 113]
  [125 116 107]
  ...
  [ 74  65  48]
  [ 74  65  48]
  [ 73  64  47]]

 [[136 127 118]
  [132 123 114]
  [128 119 110]
  ...
  [ 77  69  50]
  [ 75  67  48]
  [ 75  67  48]]

 [[133 124 115]
  [133 124 115]
  [132 123 114]
  ...
  [ 81  73  54]
  [ 80  72  53]
  [ 79  71  52]]]
```

```
# Image Parameters
img_size = 224
batch_size = 32
```

Train Test Split

```
# Image Data Generators
data_gen = ImageDataGenerator(
    rescale=1./255,
    validation_split=0.2  # Use 20% of data for validation
)
```

```
# Train Generator
train_generator = data_gen.flow_from_directory(
    base_dir,
    target_size=(img_size, img_size),
    batch_size=batch_size,
    subset='training',
    class_mode='categorical'
)
```

```
Found 43456 images belonging to 38 classes.
```

```
# Validation Generator
validation_generator = data_gen.flow_from_directory(
    base_dir,
    target_size=(img_size, img_size),
    batch_size=batch_size,
    subset='validation',
    class_mode='categorical'
)
```

```
Found 10849 images belonging to 38 classes.
```

Convolutional Neural Network

```
# Model Definition
model = models.Sequential()

model.add(layers.Conv2D(32, (3, 3), activation='relu', input_shape=(img_size, img_size, 3)))
model.add(layers.MaxPooling2D(2, 2))

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


model.add(layers.Flatten())
model.add(layers.Dense(256, activation='relu'))
model.add(layers.Dense(train_generator.num_classes, activation='softmax'))
```

```
# model summary
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 conv2d (Conv2D)             (None, 222, 222, 32)      896       
                                                                 
 max_pooling2d (MaxPooling2  (None, 111, 111, 32)      0         
 D)                                                              
                                                                 
 conv2d_1 (Conv2D)           (None, 109, 109, 64)      18496     
                                                                 
 max_pooling2d_1 (MaxPoolin  (None, 54, 54, 64)        0         
 g2D)                                                            
                                                                 
 flatten (Flatten)           (None, 186624)            0         
                                                                 
 dense (Dense)               (None, 256)               47776000  
                                                                 
 dense_1 (Dense)             (None, 38)                9766      
                                                                 
=================================================================
Total params: 47805158 (182.36 MB)
Trainable params: 47805158 (182.36 MB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

```
# Compile the Model
model.compile(optimizer='adam',
              loss='categorical_crossentropy',
              metrics=['accuracy'])
```

Model training

```
# Training the Model
history = model.fit(
    train_generator,
    steps_per_epoch=train_generator.samples // batch_size,  # Number of steps per epoch
    epochs=5,  # Number of epochs
    validation_data=validation_generator,
    validation_steps=validation_generator.samples // batch_size  # Validation steps
)
```

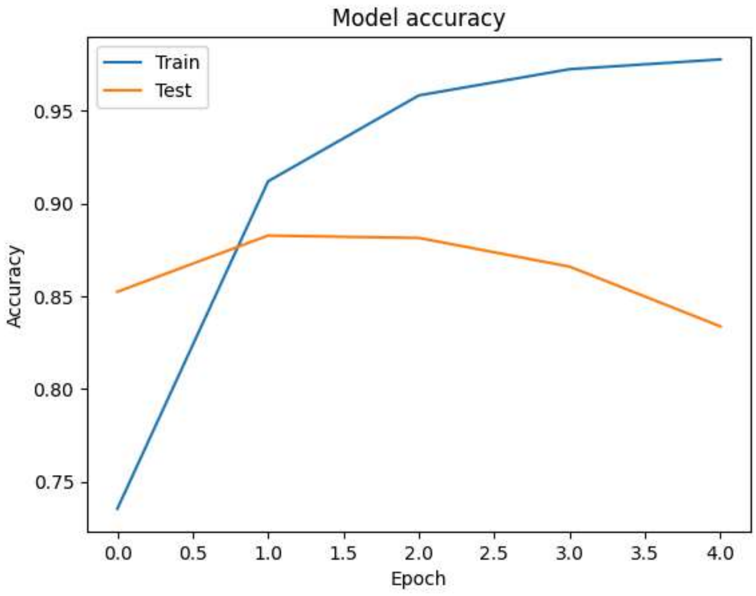
```
Epoch 1/5
1358/1358 [==============================] - 114s 79ms/step - loss: 0.9734 - accuracy: 0.7353 - val_loss: 0.4678 - val_accuracy: 0.8524
Epoch 2/5
1358/1358 [==============================] - 103s 76ms/step - loss: 0.2775 - accuracy: 0.9120 - val_loss: 0.3725 - val_accuracy: 0.8827
Epoch 3/5
1358/1358 [==============================] - 101s 75ms/step - loss: 0.1263 - accuracy: 0.9584 - val_loss: 0.4702 - val_accuracy: 0.8815
Epoch 4/5
1358/1358 [==============================] - 104s 76ms/step - loss: 0.0864 - accuracy: 0.9725 - val_loss: 0.5648 - val_accuracy: 0.8660
Epoch 5/5
1358/1358 [==============================] - 106s 78ms/step - loss: 0.0683 - accuracy: 0.9778 - val_loss: 0.7403 - val_accuracy: 0.8337
```

Model Evaluation

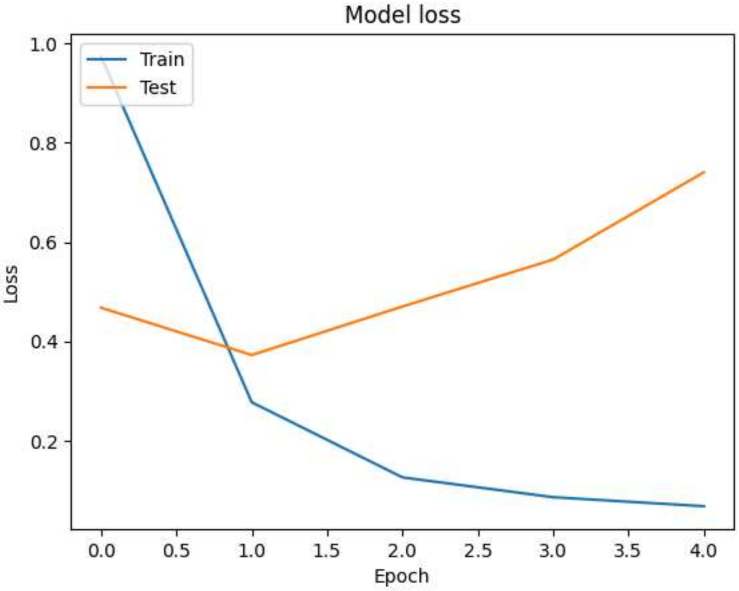
```
# Model Evaluation
print("Evaluating model...")
val_loss, val_accuracy = model.evaluate(validation_generator, steps=validation_generator.samples // batch_size)
print(f"Validation Accuracy: {val_accuracy * 100:.2f}%")
```

```
Evaluating model...
339/339 [==============================] - 20s 59ms/step - loss: 0.7403 - accuracy: 0.8337
Validation Accuracy: 83.37%
```

```
# Plot training & validation accuracy values
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('Model accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train', 'Test'], loc='upper left')
plt.show()
```



```
# Plot training & validation loss values
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('Model loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Train', 'Test'], loc='upper left')
plt.show()
```



Building a Predictive System

```
# Function to Load and Preprocess the Image using Pillow
def load_and_preprocess_image(image_path, target_size=(224, 224)):
    # Load the image
    img = Image.open(image_path)
    # Resize the image
    img = img.resize(target_size)
    # Convert the image to a numpy array
    img_array = np.array(img)
    # Add batch dimension
    img_array = np.expand_dims(img_array, axis=0)
    # Scale the image values to [0, 1]
    img_array = img_array.astype('float32') / 255.
    return img_array

# Function to Predict the Class of an Image
def predict_image_class(model, image_path, class_indices):
    preprocessed_img = load_and_preprocess_image(image_path)
    predictions = model.predict(preprocessed_img)
    predicted_class_index = np.argmax(predictions, axis=1)[0]
    predicted_class_name = class_indices[predicted_class_index]
    return predicted_class_name
```

```
# Create a mapping from class indices to class names
class_indices = {v: k for k, v in train_generator.class_indices.items()}
```

```
class_indices
```

```
{0: 'Apple___Apple_scab',
 1: 'Apple___Black_rot',
 2: 'Apple___Cedar_apple_rust',
 3: 'Apple___healthy',
 4: 'Blueberry___healthy',
 5: 'Cherry_(including_sour)___Powdery_mildew',
 6: 'Cherry_(including_sour)___healthy',
 7: 'Corn_(maize)___Cercospora_leaf_spot Gray_leaf_spot',
 8: 'Corn_(maize)___Common_rust_',
 9: 'Corn_(maize)___Northern_Leaf_Blight',
     10: 'Corn_(maize)___healthy',
     11: 'Grape___Black_rot',
     12: 'Grape___Esca_(Black_Measles)',
     13: 'Grape___Leaf_blight_(Isariopsis_Leaf_Spot)',
     14: 'Grape___healthy',
     15: 'Orange___Haunglongbing_(Citrus_greening)',
     16: 'Peach___Bacterial_spot',
     17: 'Peach___healthy',
     18: 'Pepper,_bell___Bacterial_spot',
     19: 'Pepper,_bell___healthy',
     20: 'Potato___Early_blight',
     21: 'Potato___Late_blight',
     22: 'Potato___healthy',
     23: 'Raspberry___healthy',
     24: 'Soybean___healthy',
     25: 'Squash___Powdery_mildew',
     26: 'Strawberry___Leaf_scorch',
     27: 'Strawberry___healthy',
     28: 'Tomato___Bacterial_spot',
     29: 'Tomato___Early_blight',
     30: 'Tomato___Late_blight',
     31: 'Tomato___Leaf_Mold',
     32: 'Tomato___Septoria_leaf_spot',
     33: 'Tomato___Spider_mites Two-spotted_spider_mite',
     34: 'Tomato___Target_Spot',
     35: 'Tomato___Tomato_Yellow_Leaf_Curl_Virus',
     36: 'Tomato___Tomato_mosaic_virus',
     37: 'Tomato___healthy'}
```

```
# saving the class names as json file
json.dump(class_indices, open('class_indices.json', 'w'))
```

```
# Example Usage
image_path = '/content/test_apple_black_rot.JPG'
#image_path = '/content/test_blueberry_healthy.jpg'
#image_path = '/content/test_potato_early_blight.jpg'
predicted_class_name = predict_image_class(model, image_path, class_indices)

# Output the result
print("Predicted Class Name:", predicted_class_name)
```

```
    1/1 [==============================] - 0s 312ms/step
    Predicted Class Name: Apple___Black_rot
```

Save the model to Google drive or local

```
model.save('drive/MyDrive/Potato-Disease-Detection-cnn/trained_models/plant_disease_prediction_model.h5')
```

```
model.save('plant_disease_prediction_model.h5')
```

Start coding or generate with AI.