

```
!pip install kagglehub --quiet

import kagglehub
import tensorflow as tf
import matplotlib.pyplot as plt
import os
from tensorflow.keras.preprocessing.image import ImageDataGenerator

# Download dataset from KaggleHub
path = kagglehub.dataset_download("vipooooool/new-plant-diseases-dataset")

# Define base directory
base_dir = os.path.join(
    path,
    "New Plant Diseases Dataset(Augmented)",
    "New Plant Diseases Dataset(Augmented)"
)

# Check structure
print("Base directory:", base_dir)

Using Colab cache for faster access to the 'new-plant-diseases-dataset' dataset.
Base directory: /kaggle/input/new-plant-diseases-dataset/New Plant Diseases Dataset(Augmented)/New Plant Diseases

TARGET_SIZE = (96, 96)    # Smaller for faster training
BATCH_SIZE = 32

train_datagen = ImageDataGenerator(
    rescale=1./255,
    rotation_range=10,
    zoom_range=0.1,
    horizontal_flip=True
)

val_datagen = ImageDataGenerator(rescale=1./255)

train_generator = train_datagen.flow_from_directory(
    os.path.join(base_dir, 'train'),
    target_size=TARGET_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical'
)

val_generator = val_datagen.flow_from_directory(
    os.path.join(base_dir, 'valid'),
    target_size=TARGET_SIZE,
    batch_size=BATCH_SIZE,
    class_mode='categorical'
)

Found 70295 images belonging to 38 classes.
Found 17572 images belonging to 38 classes.

base_model = tf.keras.applications.MobileNetV2(
    input_shape=(TARGET_SIZE[0], TARGET_SIZE[1], 3),
    include_top=False,
    weights='imagenet'
)
base_model.trainable = False  # Freeze base model layers

model = tf.keras.Sequential([
    base_model,
    tf.keras.layers.GlobalAveragePooling2D(),
    tf.keras.layers.Dense(512, activation='relu'),
    tf.keras.layers.Dropout(0.3),
    tf.keras.layers.Dense(train_generator.num_classes, activation='softmax')
])

model.compile(
    optimizer=tf.keras.optimizers.Adam(learning_rate=1e-4),
    loss='categorical_crossentropy',
    metrics=['accuracy'])
```

)

model.summary()

Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/mobilenet_v2/mobilenet_v2_weights_tf_dim_ordering_tf_keras.h5
 9406464/9406464 2s 0us/step

Model: "sequential"

Layer (type)	Output Shape	Param #
mobilenetv2_1.00_96 (Functional)	(None, 3, 3, 1280)	2,257,984
global_average_pooling2d (GlobalAveragePooling2D)	(None, 1280)	0
dense (Dense)	(None, 512)	655,872
dropout (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 38)	19,494

Total params: 2,933,350 (11.19 MB)

Trainable params: 675,366 (2.58 MB)

Non-trainable params: 2,257,984 (8.61 MB)

```
callbacks = [
    tf.keras.callbacks.EarlyStopping(monitor='val_loss', patience=5, restore_best_weights=True),
    tf.keras.callbacks.ReduceLROnPlateau(monitor='val_loss', factor=0.2, patience=3, min_lr=1e-5)
]

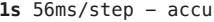
history = model.fit(
    train_generator,
    validation_data=val_generator,
    epochs=50,
    callbacks=callbacks,
)
```

```
/usr/local/lib/python3.12/dist-packages/keras/src/trainers/data_adapters/py_dataset_adapter.py:121: UserWarning:
  self._warn_if_super_not_called()
Epoch 1/50
2197/2197 873s 389ms/step - accuracy: 0.6078 - loss: 1.4391 - val_accuracy: 0.8598 - val_loss: 1.4391
Epoch 2/50
2197/2197 328s 149ms/step - accuracy: 0.8814 - loss: 0.3803 - val_accuracy: 0.8780 - val_loss: 0.3803
Epoch 3/50
2197/2197 340s 155ms/step - accuracy: 0.9072 - loss: 0.2871 - val_accuracy: 0.8856 - val_loss: 0.2871
Epoch 4/50
2197/2197 335s 153ms/step - accuracy: 0.9234 - loss: 0.2345 - val_accuracy: 0.8916 - val_loss: 0.2345
Epoch 5/50
2197/2197 341s 155ms/step - accuracy: 0.9325 - loss: 0.2055 - val_accuracy: 0.8913 - val_loss: 0.2055
Epoch 6/50
2197/2197 345s 157ms/step - accuracy: 0.9397 - loss: 0.1833 - val_accuracy: 0.9083 - val_loss: 0.1833
Epoch 7/50
2197/2197 341s 155ms/step - accuracy: 0.9447 - loss: 0.1703 - val_accuracy: 0.9084 - val_loss: 0.1703
Epoch 8/50
2197/2197 342s 156ms/step - accuracy: 0.9469 - loss: 0.1587 - val_accuracy: 0.9017 - val_loss: 0.1587
Epoch 9/50
2197/2197 350s 159ms/step - accuracy: 0.9536 - loss: 0.1418 - val_accuracy: 0.9097 - val_loss: 0.1418
Epoch 10/50
2197/2197 341s 155ms/step - accuracy: 0.9540 - loss: 0.1364 - val_accuracy: 0.9150 - val_loss: 0.1364
Epoch 11/50
2197/2197 335s 152ms/step - accuracy: 0.9581 - loss: 0.1271 - val_accuracy: 0.9123 - val_loss: 0.1271
Epoch 12/50
2197/2197 337s 153ms/step - accuracy: 0.9592 - loss: 0.1221 - val_accuracy: 0.9159 - val_loss: 0.1221
Epoch 13/50
2197/2197 337s 153ms/step - accuracy: 0.9614 - loss: 0.1146 - val_accuracy: 0.9125 - val_loss: 0.1146
Epoch 14/50
2197/2197 336s 153ms/step - accuracy: 0.9635 - loss: 0.1086 - val_accuracy: 0.9140 - val_loss: 0.1086
Epoch 15/50
2197/2197 335s 152ms/step - accuracy: 0.9664 - loss: 0.1015 - val_accuracy: 0.9082 - val_loss: 0.1015
Epoch 16/50
2197/2197 334s 152ms/step - accuracy: 0.9701 - loss: 0.0894 - val_accuracy: 0.9171 - val_loss: 0.0894
Epoch 17/50
2197/2197 324s 148ms/step - accuracy: 0.9716 - loss: 0.0873 - val_accuracy: 0.9166 - val_loss: 0.0873
Epoch 18/50
2197/2197 321s 146ms/step - accuracy: 0.9734 - loss: 0.0812 - val_accuracy: 0.9170 - val_loss: 0.0812
Epoch 19/50
2197/2197 322s 147ms/step - accuracy: 0.9725 - loss: 0.0819 - val_accuracy: 0.9173 - val_loss: 0.0819
Epoch 20/50
2197/2197 322s 147ms/step - accuracy: 0.9712 - loss: 0.0843 - val_accuracy: 0.9160 - val_loss: 0.0843
Epoch 21/50
2197/2197 326s 148ms/step - accuracy: 0.9724 - loss: 0.0821 - val_accuracy: 0.9156 - val_loss: 0.0821
Epoch 22/50
2197/2197 321s 146ms/step - accuracy: 0.9732 - loss: 0.0789 - val_accuracy: 0.9151 - val_loss: 0.0789
Epoch 23/50
2197/2197 324s 147ms/step - accuracy: 0.9737 - loss: 0.0802 - val_accuracy: 0.9155 - val_loss: 0.0802
```

Epoch 24/50

2197/2197  327s 149ms/step - accuracy: 0.9728 - loss: 0.0806 - val_accuracy: 0.9159 - val_loss:

```
val_loss, val_acc = model.evaluate(val_generator)
print(f"\n\checkmark Validation Accuracy: {val_acc*100:.2f}%")
print(f"\t\tValidation Loss: {val_loss:.4f}")
```

550/550  31s 56ms/step - accuracy: 0.9164 - loss: 0.2432

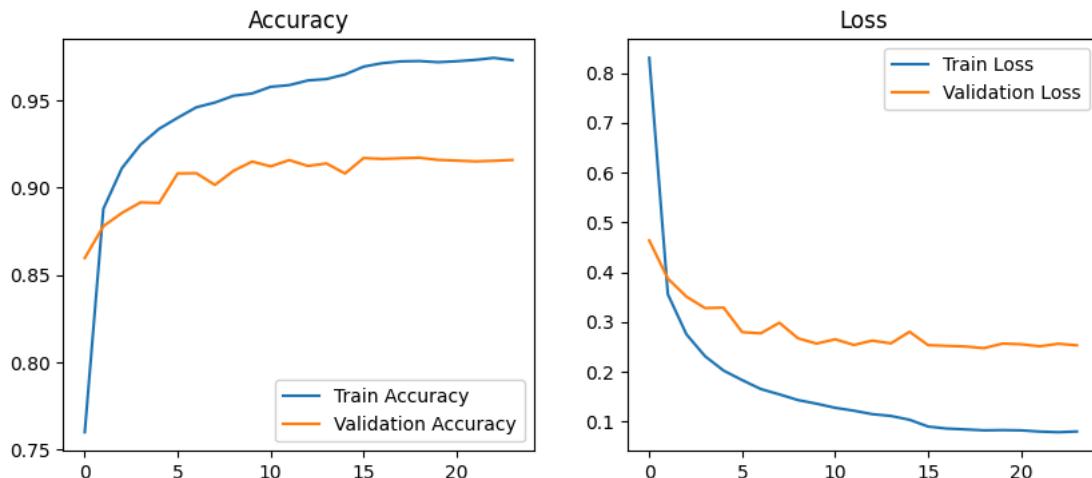
```
\checkmark Validation Accuracy: 91.73%
\t\tValidation Loss: 0.2475
```

```
plt.figure(figsize=(10, 4))

plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Train Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.legend(); plt.title('Accuracy')

plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.legend(); plt.title('Loss')

plt.show()
```



test_datagen = ImageDataGenerator(rescale=1./255)

```
# Corrected path to the test directory
test_dir = '/kaggle/input/new-plant-diseases-dataset/test'

test_generator = test_datagen.flow_from_directory(
    test_dir,
    target_size=TARGET_SIZE,
    batch_size=32,
    class_mode='categorical',
    shuffle=False # Keep order to match predictions later
)
```

Found 33 images belonging to 1 classes.

```
test_loss, test_acc = model.evaluate(test_generator)
print(f"\n\checkmark Test Accuracy: {test_acc*1000:.2f}%")
print(f"\t\tTest Loss: {test_loss/1000:.4f}")
```

2/2  14s 9s/step - accuracy: 0.0919 - loss: 681.0745

```
\checkmark Test Accuracy: 90.91%
\t\tTest Loss: 0.6830
```

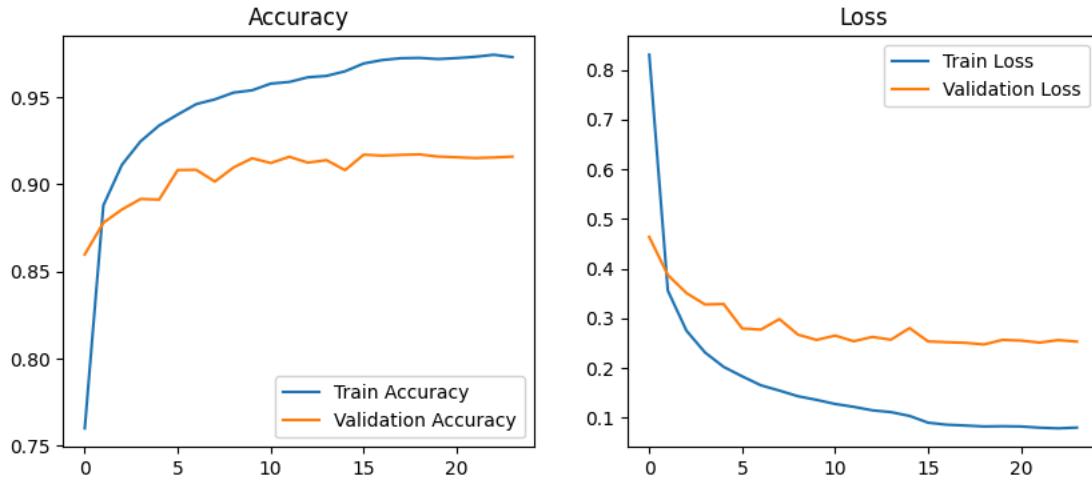
```
# --- Plot Training History ---
plt.figure(figsize=(10, 4))

plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='Train Accuracy')
```

```
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.legend(); plt.title('Accuracy')

plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.legend(); plt.title('Loss')

plt.show()
```



```
# --- Generate All Test Predictions (Dataframe Output) ---
import numpy as np # Import numpy
import pandas as pd # Import pandas

print("Generating all test predictions...")
predictions = model.predict(test_generator, verbose=1)

predicted_classes_indices = np.argmax(predictions, axis=1)
filenames = test_generator.filenames

# Map the indices back to class names
class_labels = dict((v, k) for k, v in train_generator.class_indices.items())
predicted_class_names = [class_labels[k] for k in predicted_classes_indices]

# Use a placeholder for True Class since the test directory structure only showed 1 class
true_class_placeholder = list(test_generator.class_indices.keys())[0]
true_label_text = 'Undefined/Test Folder' if true_class_placeholder == 'test' else true_class_placeholder
true_class_names = [true_label_text] * len(filenames)

# Create a DataFrame for results
results_df = pd.DataFrame({
    'Filename': filenames,
    'True_Class': true_class_names,
    'Predicted_Class': predicted_class_names
})

print("\n--- Sample Predictions (DataFrame) ---")
print(results_df.head())

results_df.to_csv('plant_disease_predictions.csv', index=False)
print("\nResults saved to plant_disease_predictions.csv")

Generating all test predictions...
2/2  0s 12ms/step

--- Sample Predictions (DataFrame) ---
   Filename      True_Class     Predicted_Class
0  test/AppleCedarRust1.JPG  Undefined/Test Folder  Apple__Cedar_apple_rust
1  test/AppleCedarRust2.JPG  Undefined/Test Folder  Apple__Cedar_apple_rust
2  test/AppleCedarRust3.JPG  Undefined/Test Folder  Apple__Cedar_apple_rust
3  test/AppleCedarRust4.JPG  Undefined/Test Folder  Apple__Cedar_apple_rust
4  test/AppleScab1.JPG  Undefined/Test Folder  Apple__Apple_scab

Results saved to plant_disease_predictions.csv
```

```
# Generate All Test Predictions (Dataframe Output)
print("Generating all test predictions...")
# Predict probabilities for all test images
predictions = model.predict(test_generator, verbose=1)

# Get the index with the highest probability
predicted_classes_indices = np.argmax(predictions, axis=1)

# Get the list of filenames
filenames = test_generator.filenames

# Map the indices back to class names (from the training generator)
class_labels = dict((v, k) for k, v in train_generator.class_indices.items())
predicted_class_names = [class_labels[k] for k in predicted_classes_indices]

# Use a placeholder for True Class since the test directory structure only showed 1 class
true_class_placeholder = list(test_generator.class_indices.keys())[0]
true_label_text = 'Undefined/Test Folder' if true_class_placeholder == 'test' else true_class_placeholder
true_class_names = [true_label_text] * len(filenames)

# Create a DataFrame for results
results_df = pd.DataFrame({
    'Filename': filenames,
    'True_Class': true_class_names,
    'Predicted_Class': predicted_class_names
})

# Print a sample
print("\n--- Sample Predictions (DataFrame) ---")
print(results_df.head())

# Save all results to CSV
results_df.to_csv('plant_disease_predictions.csv', index=False)
print("\nResults saved to plant_disease_predictions.csv")

Generating all test predictions...
2/2 0s 13ms/step

--- Sample Predictions (DataFrame) ---
   Filename      True_Class      Predicted_Class
0  test/AppleCedarRust1.JPG  Undefined/Test Folder  Apple__Cedar_apple_rust
1  test/AppleCedarRust2.JPG  Undefined/Test Folder  Apple__Cedar_apple_rust
2  test/AppleCedarRust3.JPG  Undefined/Test Folder  Apple__Cedar_apple_rust
3  test/AppleCedarRust4.JPG  Undefined/Test Folder  Apple__Cedar_apple_rust
4  test/AppleScab1.JPG  Undefined/Test Folder  Apple__Apple_scab

Results saved to plant_disease_predictions.csv
```

```
import os
import random
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.preprocessing.image import load_img, img_to_array

# Define test directory
TEST_DIR_ROOT = os.path.join(path, 'test')
print("TEST_DIR_ROOT:", TEST_DIR_ROOT)

# Class labels
class_labels = {v: k for k, v in train_generator.class_indices.items()}

# Get test filenames and their true labels
sample_filenames = test_generator.filenames
true_labels = test_generator.classes
sample_paths = [os.path.join(TEST_DIR_ROOT, f) for f in sample_filenames]

# Randomly select up to 10 samples
num_samples = min(10, len(sample_paths))
indices = random.sample(range(len(sample_paths)), num_samples)
sample_files = [sample_paths[i] for i in indices]
sample_true_labels = [true_labels[i] for i in indices]

# Plot predictions vs truth
plt.figure(figsize=(20, 4))
plt.suptitle("True (T) vs Predicted (P)", fontsize=16)
```

```
for i, img_path in enumerate(sample_files):
    img = load_img(img_path, target_size=TARGET_SIZE)
    img_array = img_to_array(img) / 255.0
    img_tensor = np.expand_dims(img_array, axis=0)

    # Predict
    pred = model.predict(img_tensor, verbose=0)
    predicted_class = class_labels[np.argmax(pred[0])]
    true_class = class_labels[sample_true_labels[i]]

    # Display image and labels
    plt.subplot(1, num_samples, i + 1)
    plt.imshow(img)
    plt.title(f"T: {true_class}\nP: {predicted_class}", fontsize=10)
    plt.axis('off')

plt.tight_layout(rect=[0, 0.03, 1, 0.95])
plt.show()
```

TEST_DIR_ROOT: /kaggle/input/new-plant-diseases-dataset/test
True (T) vs Predicted (P)

