```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib.image import imread
```

```
C:\Users\saket\anaconda3\lib\site-packages\pandas\core\computation\
expressions.py:21: UserWarning: Pandas requires version '2.8.0' or
newer of 'numexpr' (version '2.7.3' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
C:\Users\saket\anaconda3\lib\site-packages\pandas\core\arrays\
masked.py:62: UserWarning: Pandas requires version '1.3.4' or newer of
'bottleneck' (version '1.3.2' currently installed).
  from pandas.core import (
```

```
import cv2
import os

# Path to the main directory containing the disease folders
data_dir = "D:\plant_images_dataset"  # Replace with your actual path
class_names = sorted(os.listdir(data_dir))  # List of folders (disease
types)

# Loop through each folder (class) and read images
for class_name in class_names:
    folder_path = os.path.join(data_dir, class_name)  # Path to each
class folder
    if os.path.isdir(folder_path):  # Check if it's a directory
        print(f"Reading images from folder: {class_name}")
        for file_name in os.listdir(folder_path):
            file_path = os.path.join(folder_path, file_name)

            # Read and display image
            image = cv2.imread(file_path)
            if image is not None:
                print(f"Loaded image: {file_name}")
            else:
                print(f"Failed to load image: {file_name}")
```

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Reading images from folder: Corn_(maize)___Common_rust_
Loaded image: RS_Rust 2469.JPG
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3780.JPG
```

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5911.JPG
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```

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3041.JPG
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```

```
3241.JPG
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```

```
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2959.JPG
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```

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6341.JPG
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Leaf 1164.JPG
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Leaf 1108.JPG
Loaded image: ffcf0c9e-f932-4836-b160-47277fbe124c___GCREC_Bact.Sp
3776.JPG
['Corn_(maize)___Common_rust_', 'Potato___Early_blight',
'Tomato___Bacterial_spot']
```

```python
import cv2
import os

# Path to the main directory containing the disease folders
data_dir = "D:/plant_images_dataset"  # Replace with your actual path
class_names = sorted(os.listdir(data_dir))  # List of folders (disease
types)

# Loop through each folder (class) and count images
for class_name in class_names:
    folder_path = os.path.join(data_dir, class_name)  # Path to each
class folder
    if os.path.isdir(folder_path):  # Check if it's a directory
        image_count = 0
        print(f"Reading images from folder: {class_name}")

        for file_name in os.listdir(folder_path):
            file_path = os.path.join(folder_path, file_name)

            # Check if file is an image (you can add more extensions
if necessary)
            if file_name.lower().endswith(('.jpg', '.jpeg', '.png',
'.bmp')):
                image = cv2.imread(file_path)

                if image is not None:
```

```
                    image_count += 1  # Increment the count for each
valid image
                else:
                    print(f"Failed to load image: {file_name}")

        # Print the count of images in the current folder
        print(f"Total images in {class_name}: {image_count}")
```

```
Reading images from folder: Corn_(maize)___Common_rust_
Total images in Corn_(maize)___Common_rust_: 300
Reading images from folder: Potato___Early_blight
Total images in Potato___Early_blight: 300
Reading images from folder: Tomato___Bacterial_spot
Total images in Tomato___Bacterial_spot: 300
```

```
import cv2
import os
from sklearn.model_selection import train_test_split
import numpy as np

# Path to the main directory containing the disease folders
data_dir = "D:/plant_images_dataset"  # Replace with your actual path
class_names = sorted(os.listdir(data_dir))  # List of folders (disease
types)

# Lists to store image data and labels
X = []  # Images
y = []  # Labels

# Loop through each folder (class) and read images
for class_idx, class_name in enumerate(class_names):
    folder_path = os.path.join(data_dir, class_name)  # Path to each
class folder
    if os.path.isdir(folder_path):  # Check if it's a directory
        print(f"Reading images from folder: {class_name}")

        for file_name in os.listdir(folder_path):
            file_path = os.path.join(folder_path, file_name)

            # Check if file is an image (you can add more extensions
if necessary)
            if file_name.lower().endswith(('.jpg', '.jpeg', '.png',
'.bmp')):
                image = cv2.imread(file_path)

                if image is not None:
                    image = cv2.resize(image, (128, 128))  # Resize
image to fixed size
                    X.append(image)  # Append image to X
                    y.append(class_idx)  # Append corresponding label
```

```
(class index)
                else:
                    print(f"Failed to load image: {file_name}")

# Convert to numpy arrays
X = np.array(X, dtype='float32') / 255.0  # Normalize images to range
[0, 1]
y = np.array(y)

# Split the dataset into train and test sets (80% train, 20% test)
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)

# Print the size of the train and test sets
print(f"Training set size: {X_train.shape[0]} images")
print(f"Test set size: {X_test.shape[0]} images")
```

```
C:\Users\saket\anaconda3\lib\site-packages\scipy\__init__.py:146:
UserWarning: A NumPy version >=1.16.5 and <1.23.0 is required for this
version of SciPy (detected version 1.26.2
  warnings.warn(f"A NumPy version >={np_minversion} and
<{np_maxversion}"

Reading images from folder: Corn_(maize)___Common_rust_
Reading images from folder: Potato___Early_blight
Reading images from folder: Tomato___Bacterial_spot
Training set size: 720 images
Test set size: 180 images
```

```
# Basic libraries
import os
import numpy as np
import matplotlib.pyplot as plt
import cv2

# TensorFlow and Keras libraries
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten,
Dense
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator

# For train-test split (if not already split)
from sklearn.model_selection import train_test_split
```

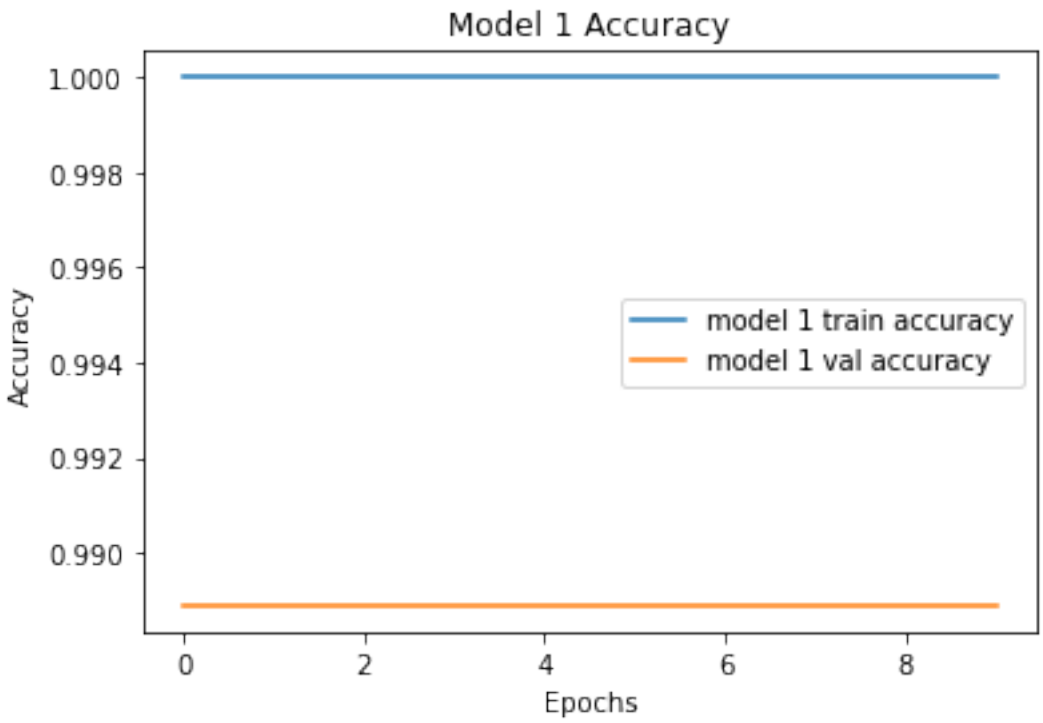
CNN

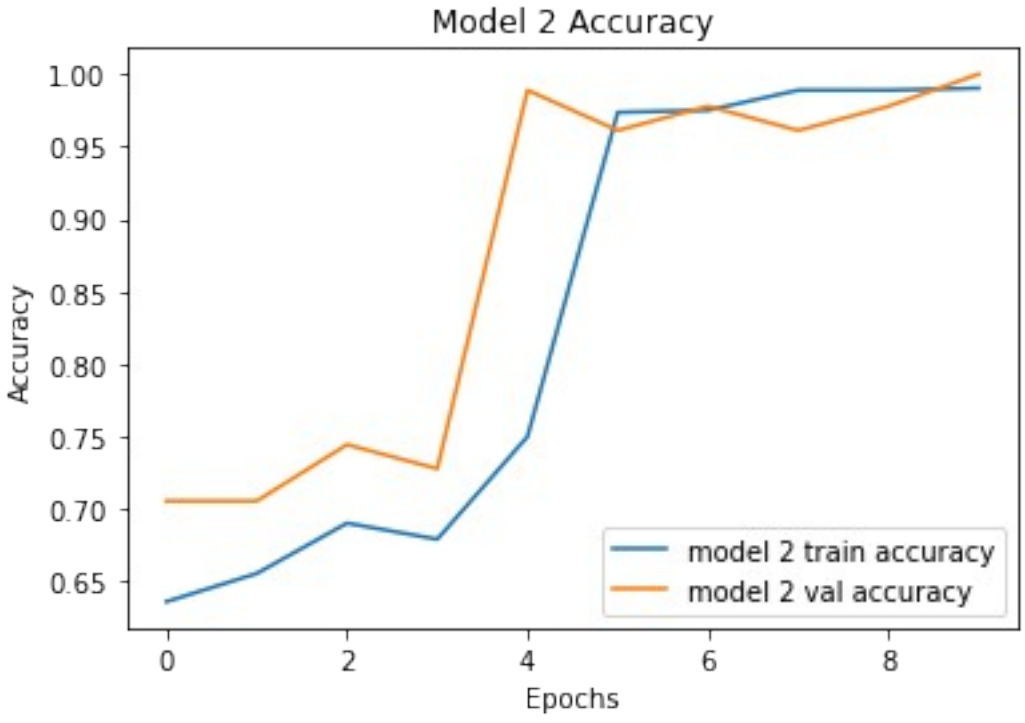
```
import tensorflow as tf
from tensorflow.keras import layers, models
```

```
model_1 = models.Sequential()
model_1.add(Conv2D(32, (3, 3), padding="same", input_shape=(128, 128,
3), activation="relu"))
model_1.add(MaxPooling2D(pool_size=(2, 2)))
model_1.add(Conv2D(64, (3, 3), padding="same", activation="relu"))
model_1.add(MaxPooling2D(pool_size=(2, 2)))
model_1.add(Conv2D(128, (3, 3), padding="same", activation="relu"))
model_1.add(MaxPooling2D(pool_size=(2, 2)))
model_1.add(Flatten())
model_1.add(Dense(128, activation="relu"))
model_1.add(Dense(3, activation="softmax"))

model_1.compile(optimizer='adam',
loss='sparse_categorical_crossentropy', metrics=['accuracy'])

# New model
model_2 = models.Sequential()
model_2.add(Conv2D(32, (3, 3), padding="same", input_shape=(128,128,
3), activation="relu"))
model_2.add(MaxPooling2D(pool_size=(3, 3)))
model_2.add(Conv2D(16, (3, 3), padding="same", activation="relu"))
model_2.add(MaxPooling2D(pool_size=(2, 2)))
model_2.add(Flatten())
model_2.add(Dense(8, activation="relu"))
model_2.add(Dense(3, activation="softmax"))

model_2.compile(optimizer='adam',
loss='sparse_categorical_crossentropy', metrics=['accuracy'])



# Train Model 1
history_1 = model_1.fit(X_train, y_train, epochs=10,
validation_data=(X_test, y_test), batch_size=32)

# Train Model 2
history_2 = model_2.fit(X_train, y_train, epochs=10,
validation_data=(X_test, y_test), batch_size=32)

Epoch 1/10
23/23 [==============================] - 10s 436ms/step - loss:
2.6118e-05 - accuracy: 1.0000 - val_loss: 0.0210 - val_accuracy:
0.9889
Epoch 2/10
23/23 [==============================] - 12s 549ms/step - loss:
2.3244e-05 - accuracy: 1.0000 - val_loss: 0.0235 - val_accuracy:
0.9889
Epoch 3/10
23/23 [==============================] - 11s 497ms/step - loss:
```

```
2.1355e-05 - accuracy: 1.0000 - val_loss: 0.0244 - val_accuracy:
0.9889
Epoch 4/10
23/23 [==============================] - 11s 495ms/step - loss:
2.0913e-05 - accuracy: 1.0000 - val_loss: 0.0207 - val_accuracy:
0.9889
Epoch 5/10
23/23 [==============================] - 11s 484ms/step - loss:
1.9607e-05 - accuracy: 1.0000 - val_loss: 0.0246 - val_accuracy:
0.9889
Epoch 6/10
23/23 [==============================] - 12s 501ms/step - loss:
1.7758e-05 - accuracy: 1.0000 - val_loss: 0.0224 - val_accuracy:
0.9889
Epoch 7/10
23/23 [==============================] - 12s 524ms/step - loss:
1.6957e-05 - accuracy: 1.0000 - val_loss: 0.0225 - val_accuracy:
0.9889
Epoch 8/10
23/23 [==============================] - 13s 546ms/step - loss:
1.5954e-05 - accuracy: 1.0000 - val_loss: 0.0224 - val_accuracy:
0.9889
Epoch 9/10
23/23 [==============================] - 13s 561ms/step - loss:
1.4858e-05 - accuracy: 1.0000 - val_loss: 0.0214 - val_accuracy:
0.9889
Epoch 10/10
23/23 [==============================] - 13s 571ms/step - loss:
1.3694e-05 - accuracy: 1.0000 - val_loss: 0.0237 - val_accuracy:
0.9889
Epoch 1/10
23/23 [==============================] - 5s 180ms/step - loss: 0.7825
- accuracy: 0.6361 - val_loss: 0.5473 - val_accuracy: 0.7056
Epoch 2/10
23/23 [==============================] - 4s 177ms/step - loss: 0.5553
- accuracy: 0.6556 - val_loss: 0.4894 - val_accuracy: 0.7056
Epoch 3/10
23/23 [==============================] - 4s 185ms/step - loss: 0.4684
- accuracy: 0.6903 - val_loss: 0.3560 - val_accuracy: 0.7444
Epoch 4/10
23/23 [==============================] - 4s 180ms/step - loss: 0.3805
- accuracy: 0.6792 - val_loss: 0.2983 - val_accuracy: 0.7278
Epoch 5/10
23/23 [==============================] - 4s 178ms/step - loss: 0.3159
- accuracy: 0.7500 - val_loss: 0.2260 - val_accuracy: 0.9889
Epoch 6/10
23/23 [==============================] - 4s 165ms/step - loss: 0.2004
- accuracy: 0.9736 - val_loss: 0.0947 - val_accuracy: 0.9611
Epoch 7/10
```

```
23/23 [==============================] - 4s 167ms/step - loss: 0.1211
- accuracy: 0.9750 - val_loss: 0.0667 - val_accuracy: 0.9778
Epoch 8/10
23/23 [==============================] - 4s 166ms/step - loss: 0.0549
- accuracy: 0.9889 - val_loss: 0.0913 - val_accuracy: 0.9611
Epoch 9/10
23/23 [==============================] - 4s 170ms/step - loss: 0.0391
- accuracy: 0.9889 - val_loss: 0.0416 - val_accuracy: 0.9778
Epoch 10/10
23/23 [==============================] - 4s 171ms/step - loss: 0.0334
- accuracy: 0.9903 - val_loss: 0.0203 - val_accuracy: 1.0000

# Plot training and validation accuracy for Model 1
plt.plot(history_1.history['accuracy'], label='model 1 train
accuracy')
plt.plot(history_1.history['val_accuracy'], label='model 1 val
accuracy')
plt.title('Model 1 Accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.show()

# Plot training and validation accuracy for Model 2
plt.plot(history_2.history['accuracy'], label='model 2 train
accuracy')
plt.plot(history_2.history['val_accuracy'], label='model 2 val
accuracy')
plt.title('Model 2 Accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.show()
```






```
import tensorflow as tf
from tensorflow.keras import layers, models

# Build the CNN model
model = models.Sequential()
```

```python
# First convolutional layer
model.add(layers.Conv2D(32, (3, 3), activation='relu',
input_shape=(128, 128, 3)))
model.add(layers.MaxPooling2D((2, 2)))

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

# Third convolutional layer
model.add(layers.Conv2D(128, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))

# Flatten the 3D outputs to 1D
model.add(layers.Flatten())

# Fully connected layer
model.add(layers.Dense(128, activation='relu'))

# Output layer (softmax for multi-class classification)
model.add(layers.Dense(len(class_names), activation='softmax'))

# Compile the model
model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',  # Use
sparse_categorical_crossentropy for integer labels
              metrics=['accuracy'])

# Print the model summary
model.summary()
```

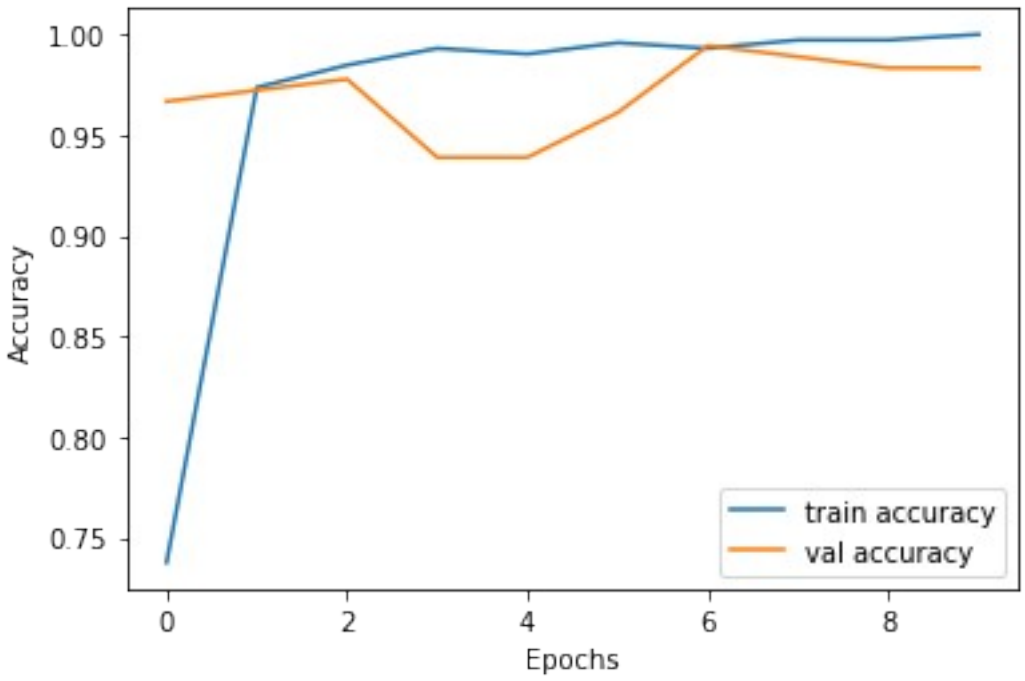
```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 126, 126, 32)      896

 max_pooling2d (MaxPooling2D  (None, 63, 63, 32)       0
 )

 conv2d_1 (Conv2D)           (None, 61, 61, 64)        18496

 max_pooling2d_1 (MaxPooling  (None, 30, 30, 64)       0
 2D)

 conv2d_2 (Conv2D)           (None, 28, 28, 128)       73856

 max_pooling2d_2 (MaxPooling  (None, 14, 14, 128)      0
 2D)
```

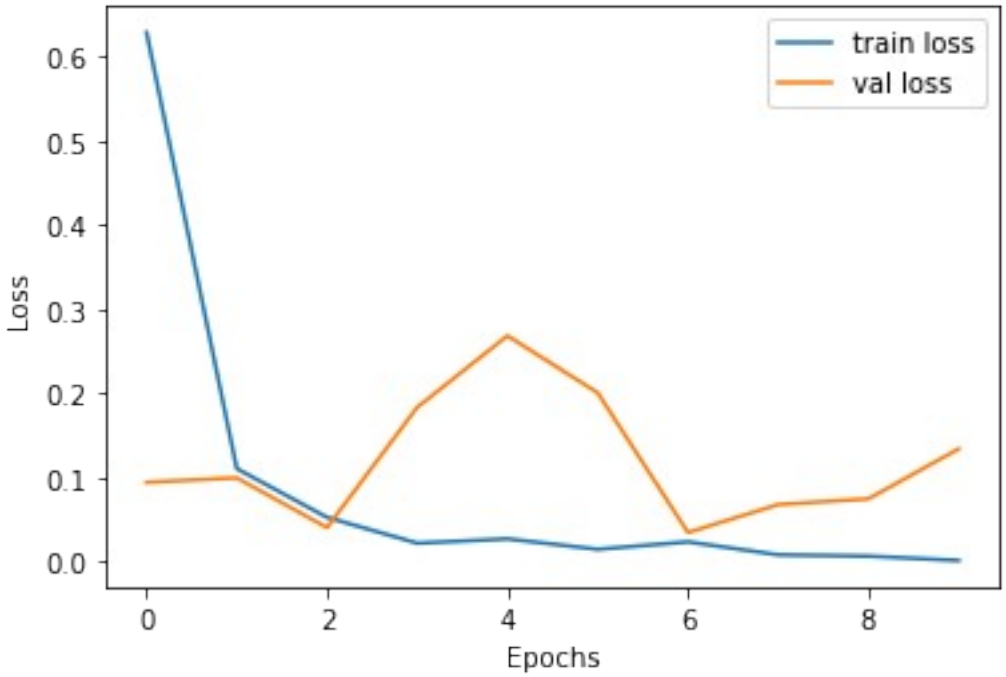
```
 flatten (Flatten)           (None, 25088)             0

 dense (Dense)               (None, 128)               3211392

 dense_1 (Dense)             (None, 3)                 387

=================================================================
Total params: 3,305,027
Trainable params: 3,305,027
Non-trainable params: 0
_________________________________________________________________

# Train the model
history = model.fit(X_train, y_train, epochs=10,
validation_data=(X_test, y_test), batch_size=32)

Epoch 1/10
23/23 [==============================] - 12s 475ms/step - loss: 0.6283
- accuracy: 0.7375 - val_loss: 0.0939 - val_accuracy: 0.9667
Epoch 2/10
23/23 [==============================] - 11s 459ms/step - loss: 0.1102
- accuracy: 0.9736 - val_loss: 0.0992 - val_accuracy: 0.9722
Epoch 3/10
23/23 [==============================] - 11s 470ms/step - loss: 0.0523
- accuracy: 0.9847 - val_loss: 0.0402 - val_accuracy: 0.9778
Epoch 4/10
23/23 [==============================] - 10s 429ms/step - loss: 0.0216
- accuracy: 0.9931 - val_loss: 0.1830 - val_accuracy: 0.9389
Epoch 5/10
23/23 [==============================] - 9s 414ms/step - loss: 0.0267
- accuracy: 0.9903 - val_loss: 0.2680 - val_accuracy: 0.9389
Epoch 6/10
23/23 [==============================] - 11s 469ms/step - loss: 0.0143
- accuracy: 0.9958 - val_loss: 0.2002 - val_accuracy: 0.9611
Epoch 7/10
23/23 [==============================] - 10s 420ms/step - loss: 0.0231
- accuracy: 0.9931 - val_loss: 0.0343 - val_accuracy: 0.9944
Epoch 8/10
23/23 [==============================] - 10s 430ms/step - loss: 0.0078
- accuracy: 0.9972 - val_loss: 0.0675 - val_accuracy: 0.9889
Epoch 9/10
23/23 [==============================] - 9s 414ms/step - loss: 0.0062
- accuracy: 0.9972 - val_loss: 0.0743 - val_accuracy: 0.9833
Epoch 10/10
23/23 [==============================] - 10s 416ms/step - loss: 0.0010
- accuracy: 1.0000 - val_loss: 0.1337 - val_accuracy: 0.9833
```

```python
# Evaluate the model on the test data
test_loss, test_acc = model.evaluate(X_test, y_test, verbose=2)
print(f"Test accuracy: {test_acc:.4f}")
```

```
6/6 - 0s - loss: 0.1337 - accuracy: 0.9833 - 455ms/epoch - 76ms/step
Test accuracy: 0.9833
```

```python
import matplotlib.pyplot as plt

# Plot training and validation accuracy
plt.plot(history.history['accuracy'], label='train accuracy')
plt.plot(history.history['val_accuracy'], label='val accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.show()

# Plot training and validation loss
plt.plot(history.history['loss'], label='train loss')
plt.plot(history.history['val_loss'], label='val loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.show()
```





ResNet50

```
import tensorflow as tf
from tensorflow.keras.applications import ResNet50
from tensorflow.keras.layers import GlobalAveragePooling2D, Dense,
Dropout
from tensorflow.keras.models import Model
from tensorflow.keras.optimizers import Adam

# Load the pretrained ResNet50 base
base_model = ResNet50(include_top=False, weights='imagenet',
input_shape=(128, 128, 3))

# Freeze base model layers
base_model.trainable = False

# Add custom classification head
x = base_model.output
x = GlobalAveragePooling2D()(x)
x = Dropout(0.5)(x)
x = Dense(64, activation='relu')(x)
x = Dropout(0.3)(x)
predictions = Dense(3, activation='softmax')(x)

# Final model
resnet_model = Model(inputs=base_model.input, outputs=predictions)

# Compile the model
resnet_model.compile(optimizer=Adam(learning_rate=0.0001),
```

```
                    loss='categorical_crossentropy',
                    metrics=['accuracy'])

# Summary
resnet_model.summary()
```

```
Model: "model_1"
__________________________________________________________________________________________________
 Layer (type)                   Output Shape         Param #     Connected to
==================================================================================================
 input_2 (InputLayer)           [(None, 128, 128, 3  0           []
                                )]

 conv1_pad (ZeroPadding2D)      (None, 134, 134, 3)  0           ['input_2[0][0]']

 conv1_conv (Conv2D)            (None, 64, 64, 64)   9472        ['conv1_pad[0][0]']

 conv1_bn (BatchNormalization)  (None, 64, 64, 64)   256         ['conv1_conv[0][0]']

 conv1_relu (Activation)        (None, 64, 64, 64)   0           ['conv1_bn[0][0]']

 pool1_pad (ZeroPadding2D)      (None, 66, 66, 64)   0           ['conv1_relu[0][0]']

 pool1_pool (MaxPooling2D)      (None, 32, 32, 64)   0           ['pool1_pad[0][0]']

 conv2_block1_1_conv (Conv2D)   (None, 32, 32, 64)   4160        ['pool1_pool[0][0]']

 conv2_block1_1_bn (BatchNormal  (None, 32, 32, 64)  256         ['conv2_block1_1_conv[0][0]']
 ization)
```

```
 conv2_block1_1_relu (Activatio  (None, 32, 32, 64)  0
['conv2_block1_1_bn[0][0]']
 n)


 conv2_block1_2_conv (Conv2D)   (None, 32, 32, 64)   36928
['conv2_block1_1_relu[0][0]']


 conv2_block1_2_bn (BatchNormal  (None, 32, 32, 64)  256
['conv2_block1_2_conv[0][0]']
 ization)


 conv2_block1_2_relu (Activatio  (None, 32, 32, 64)  0
['conv2_block1_2_bn[0][0]']
 n)


 conv2_block1_0_conv (Conv2D)   (None, 32, 32, 256)  16640
['pool1_pool[0][0]']


 conv2_block1_3_conv (Conv2D)   (None, 32, 32, 256)  16640
['conv2_block1_2_relu[0][0]']


 conv2_block1_0_bn (BatchNormal  (None, 32, 32, 256)  1024
['conv2_block1_0_conv[0][0]']
 ization)


 conv2_block1_3_bn (BatchNormal  (None, 32, 32, 256)  1024
['conv2_block1_3_conv[0][0]']
 ization)


 conv2_block1_add (Add)         (None, 32, 32, 256)  0
['conv2_block1_0_bn[0][0]',

'conv2_block1_3_bn[0][0]']


 conv2_block1_out (Activation)  (None, 32, 32, 256)  0
```

```
['conv2_block1_add[0][0]']


 conv2_block2_1_conv (Conv2D)   (None, 32, 32, 64)   16448
['conv2_block1_out[0][0]']


 conv2_block2_1_bn (BatchNormal  (None, 32, 32, 64)  256
['conv2_block2_1_conv[0][0]']
 ization)



 conv2_block2_1_relu (Activatio  (None, 32, 32, 64)  0
['conv2_block2_1_bn[0][0]']
 n)



 conv2_block2_2_conv (Conv2D)   (None, 32, 32, 64)   36928
['conv2_block2_1_relu[0][0]']


 conv2_block2_2_bn (BatchNormal  (None, 32, 32, 64)  256
['conv2_block2_2_conv[0][0]']
 ization)



 conv2_block2_2_relu (Activatio  (None, 32, 32, 64)  0
['conv2_block2_2_bn[0][0]']
 n)



 conv2_block2_3_conv (Conv2D)   (None, 32, 32, 256)  16640
['conv2_block2_2_relu[0][0]']


 conv2_block2_3_bn (BatchNormal  (None, 32, 32, 256)  1024
['conv2_block2_3_conv[0][0]']
 ization)



 conv2_block2_add (Add)         (None, 32, 32, 256)  0
['conv2_block1_out[0][0]',

'conv2_block2_3_bn[0][0]']
```

```
 conv2_block2_out (Activation)  (None, 32, 32, 256)  0
['conv2_block2_add[0][0]']


 conv2_block3_1_conv (Conv2D)   (None, 32, 32, 64)   16448
['conv2_block2_out[0][0]']


 conv2_block3_1_bn (BatchNormal  (None, 32, 32, 64)  256
['conv2_block3_1_conv[0][0]']
 ization)



 conv2_block3_1_relu (Activatio  (None, 32, 32, 64)  0
['conv2_block3_1_bn[0][0]']
 n)



 conv2_block3_2_conv (Conv2D)   (None, 32, 32, 64)   36928
['conv2_block3_1_relu[0][0]']


 conv2_block3_2_bn (BatchNormal  (None, 32, 32, 64)  256
['conv2_block3_2_conv[0][0]']
 ization)



 conv2_block3_2_relu (Activatio  (None, 32, 32, 64)  0
['conv2_block3_2_bn[0][0]']
 n)



 conv2_block3_3_conv (Conv2D)   (None, 32, 32, 256)  16640
['conv2_block3_2_relu[0][0]']


 conv2_block3_3_bn (BatchNormal  (None, 32, 32, 256)  1024
['conv2_block3_3_conv[0][0]']
 ization)



 conv2_block3_add (Add)         (None, 32, 32, 256)  0
['conv2_block2_out[0][0]',

'conv2_block3_3_bn[0][0]']
```

```
 conv2_block3_out (Activation)  (None, 32, 32, 256)  0
['conv2_block3_add[0][0]']


 conv3_block1_1_conv (Conv2D)   (None, 16, 16, 128)  32896
['conv2_block3_out[0][0]']


 conv3_block1_1_bn (BatchNormal  (None, 16, 16, 128)  512
['conv3_block1_1_conv[0][0]']
 ization)



 conv3_block1_1_relu (Activatio  (None, 16, 16, 128)  0
['conv3_block1_1_bn[0][0]']
 n)



 conv3_block1_2_conv (Conv2D)   (None, 16, 16, 128)  147584
['conv3_block1_1_relu[0][0]']


 conv3_block1_2_bn (BatchNormal  (None, 16, 16, 128)  512
['conv3_block1_2_conv[0][0]']
 ization)



 conv3_block1_2_relu (Activatio  (None, 16, 16, 128)  0
['conv3_block1_2_bn[0][0]']
 n)



 conv3_block1_0_conv (Conv2D)   (None, 16, 16, 512)  131584
['conv2_block3_out[0][0]']


 conv3_block1_3_conv (Conv2D)   (None, 16, 16, 512)  66048
['conv3_block1_2_relu[0][0]']


 conv3_block1_0_bn (BatchNormal  (None, 16, 16, 512)  2048
['conv3_block1_0_conv[0][0]']
 ization)
```

```
 conv3_block1_3_bn (BatchNormal  (None, 16, 16, 512)  2048
['conv3_block1_3_conv[0][0]']
 ization)



 conv3_block1_add (Add)         (None, 16, 16, 512)  0
['conv3_block1_0_bn[0][0]',

'conv3_block1_3_bn[0][0]']


 conv3_block1_out (Activation)  (None, 16, 16, 512)  0
['conv3_block1_add[0][0]']


 conv3_block2_1_conv (Conv2D)   (None, 16, 16, 128)  65664
['conv3_block1_out[0][0]']


 conv3_block2_1_bn (BatchNormal  (None, 16, 16, 128)  512
['conv3_block2_1_conv[0][0]']
 ization)



 conv3_block2_1_relu (Activatio  (None, 16, 16, 128)  0
['conv3_block2_1_bn[0][0]']
 n)



 conv3_block2_2_conv (Conv2D)   (None, 16, 16, 128)  147584
['conv3_block2_1_relu[0][0]']


 conv3_block2_2_bn (BatchNormal  (None, 16, 16, 128)  512
['conv3_block2_2_conv[0][0]']
 ization)



 conv3_block2_2_relu (Activatio  (None, 16, 16, 128)  0
['conv3_block2_2_bn[0][0]']
 n)



 conv3_block2_3_conv (Conv2D)   (None, 16, 16, 512)  66048
['conv3_block2_2_relu[0][0]']
```

```
 conv3_block2_3_bn (BatchNormal  (None, 16, 16, 512)  2048
['conv3_block2_3_conv[0][0]']
 ization)



 conv3_block2_add (Add)         (None, 16, 16, 512)  0
['conv3_block1_out[0][0]',

'conv3_block2_3_bn[0][0]']


 conv3_block2_out (Activation)  (None, 16, 16, 512)  0
['conv3_block2_add[0][0]']


 conv3_block3_1_conv (Conv2D)   (None, 16, 16, 128)  65664
['conv3_block2_out[0][0]']


 conv3_block3_1_bn (BatchNormal  (None, 16, 16, 128)  512
['conv3_block3_1_conv[0][0]']
 ization)



 conv3_block3_1_relu (Activatio  (None, 16, 16, 128)  0
['conv3_block3_1_bn[0][0]']
 n)



 conv3_block3_2_conv (Conv2D)   (None, 16, 16, 128)  147584
['conv3_block3_1_relu[0][0]']


 conv3_block3_2_bn (BatchNormal  (None, 16, 16, 128)  512
['conv3_block3_2_conv[0][0]']
 ization)



 conv3_block3_2_relu (Activatio  (None, 16, 16, 128)  0
['conv3_block3_2_bn[0][0]']
 n)



 conv3_block3_3_conv (Conv2D)   (None, 16, 16, 512)  66048
['conv3_block3_2_relu[0][0]']
```

```
 conv3_block3_3_bn (BatchNormal  (None, 16, 16, 512)  2048
['conv3_block3_3_conv[0][0]']
 ization)


 conv3_block3_add (Add)         (None, 16, 16, 512)  0
['conv3_block2_out[0][0]',

'conv3_block3_3_bn[0][0]']


 conv3_block3_out (Activation)  (None, 16, 16, 512)  0
['conv3_block3_add[0][0]']


 conv3_block4_1_conv (Conv2D)   (None, 16, 16, 128)  65664
['conv3_block3_out[0][0]']


 conv3_block4_1_bn (BatchNormal  (None, 16, 16, 128)  512
['conv3_block4_1_conv[0][0]']
 ization)


 conv3_block4_1_relu (Activatio  (None, 16, 16, 128)  0
['conv3_block4_1_bn[0][0]']
 n)


 conv3_block4_2_conv (Conv2D)   (None, 16, 16, 128)  147584
['conv3_block4_1_relu[0][0]']


 conv3_block4_2_bn (BatchNormal  (None, 16, 16, 128)  512
['conv3_block4_2_conv[0][0]']
 ization)


 conv3_block4_2_relu (Activatio  (None, 16, 16, 128)  0
['conv3_block4_2_bn[0][0]']
 n)


 conv3_block4_3_conv (Conv2D)   (None, 16, 16, 512)  66048
```

```
['conv3_block4_2_relu[0][0]']


 conv3_block4_3_bn (BatchNormal  (None, 16, 16, 512)  2048
['conv3_block4_3_conv[0][0]']
 ization)



 conv3_block4_add (Add)         (None, 16, 16, 512)  0
['conv3_block3_out[0][0]',

'conv3_block4_3_bn[0][0]']


 conv3_block4_out (Activation)  (None, 16, 16, 512)  0
['conv3_block4_add[0][0]']


 conv4_block1_1_conv (Conv2D)   (None, 8, 8, 256)    131328
['conv3_block4_out[0][0]']


 conv4_block1_1_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block1_1_conv[0][0]']
 ization)



 conv4_block1_1_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block1_1_bn[0][0]']
 n)



 conv4_block1_2_conv (Conv2D)   (None, 8, 8, 256)    590080
['conv4_block1_1_relu[0][0]']


 conv4_block1_2_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block1_2_conv[0][0]']
 ization)



 conv4_block1_2_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block1_2_bn[0][0]']
 n)
```

```
 conv4_block1_0_conv (Conv2D)   (None, 8, 8, 1024)   525312
['conv3_block4_out[0][0]']


 conv4_block1_3_conv (Conv2D)   (None, 8, 8, 1024)   263168
['conv4_block1_2_relu[0][0]']


 conv4_block1_0_bn (BatchNormal  (None, 8, 8, 1024)  4096
['conv4_block1_0_conv[0][0]']
 ization)



 conv4_block1_3_bn (BatchNormal  (None, 8, 8, 1024)  4096
['conv4_block1_3_conv[0][0]']
 ization)



 conv4_block1_add (Add)         (None, 8, 8, 1024)   0
['conv4_block1_0_bn[0][0]',

'conv4_block1_3_bn[0][0]']


 conv4_block1_out (Activation)  (None, 8, 8, 1024)   0
['conv4_block1_add[0][0]']


 conv4_block2_1_conv (Conv2D)   (None, 8, 8, 256)    262400
['conv4_block1_out[0][0]']


 conv4_block2_1_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block2_1_conv[0][0]']
 ization)



 conv4_block2_1_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block2_1_bn[0][0]']
 n)



 conv4_block2_2_conv (Conv2D)   (None, 8, 8, 256)    590080
['conv4_block2_1_relu[0][0]']


 conv4_block2_2_bn (BatchNormal  (None, 8, 8, 256)   1024
```

```
['conv4_block2_2_conv[0][0]']
 ization)



 conv4_block2_2_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block2_2_bn[0][0]']
 n)



 conv4_block2_3_conv (Conv2D)   (None, 8, 8, 1024)   263168
['conv4_block2_2_relu[0][0]']


 conv4_block2_3_bn (BatchNormal  (None, 8, 8, 1024)  4096
['conv4_block2_3_conv[0][0]']
 ization)



 conv4_block2_add (Add)         (None, 8, 8, 1024)   0
['conv4_block1_out[0][0]',

'conv4_block2_3_bn[0][0]']


 conv4_block2_out (Activation)  (None, 8, 8, 1024)   0
['conv4_block2_add[0][0]']


 conv4_block3_1_conv (Conv2D)   (None, 8, 8, 256)    262400
['conv4_block2_out[0][0]']


 conv4_block3_1_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block3_1_conv[0][0]']
 ization)



 conv4_block3_1_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block3_1_bn[0][0]']
 n)



 conv4_block3_2_conv (Conv2D)   (None, 8, 8, 256)    590080
['conv4_block3_1_relu[0][0]']
```

```
 conv4_block3_2_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block3_2_conv[0][0]']
 ization)



 conv4_block3_2_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block3_2_bn[0][0]']
 n)



 conv4_block3_3_conv (Conv2D)   (None, 8, 8, 1024)   263168
['conv4_block3_2_relu[0][0]']


 conv4_block3_3_bn (BatchNormal  (None, 8, 8, 1024)  4096
['conv4_block3_3_conv[0][0]']
 ization)



 conv4_block3_add (Add)         (None, 8, 8, 1024)   0
['conv4_block2_out[0][0]',

'conv4_block3_3_bn[0][0]']


 conv4_block3_out (Activation)  (None, 8, 8, 1024)   0
['conv4_block3_add[0][0]']


 conv4_block4_1_conv (Conv2D)   (None, 8, 8, 256)    262400
['conv4_block3_out[0][0]']


 conv4_block4_1_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block4_1_conv[0][0]']
 ization)



 conv4_block4_1_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block4_1_bn[0][0]']
 n)



 conv4_block4_2_conv (Conv2D)   (None, 8, 8, 256)    590080
['conv4_block4_1_relu[0][0]']
```

```
 conv4_block4_2_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block4_2_conv[0][0]']
 ization)


 conv4_block4_2_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block4_2_bn[0][0]']
 n)


 conv4_block4_3_conv (Conv2D)   (None, 8, 8, 1024)   263168
['conv4_block4_2_relu[0][0]']


 conv4_block4_3_bn (BatchNormal  (None, 8, 8, 1024)  4096
['conv4_block4_3_conv[0][0]']
 ization)


 conv4_block4_add (Add)         (None, 8, 8, 1024)   0
['conv4_block3_out[0][0]',

'conv4_block4_3_bn[0][0]']


 conv4_block4_out (Activation)  (None, 8, 8, 1024)   0
['conv4_block4_add[0][0]']


 conv4_block5_1_conv (Conv2D)   (None, 8, 8, 256)    262400
['conv4_block4_out[0][0]']


 conv4_block5_1_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block5_1_conv[0][0]']
 ization)


 conv4_block5_1_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block5_1_bn[0][0]']
 n)


 conv4_block5_2_conv (Conv2D)   (None, 8, 8, 256)    590080
['conv4_block5_1_relu[0][0]']
```

```
 conv4_block5_2_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block5_2_conv[0][0]']
 ization)


 conv4_block5_2_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block5_2_bn[0][0]']
 n)


 conv4_block5_3_conv (Conv2D)   (None, 8, 8, 1024)   263168
['conv4_block5_2_relu[0][0]']


 conv4_block5_3_bn (BatchNormal  (None, 8, 8, 1024)  4096
['conv4_block5_3_conv[0][0]']
 ization)


 conv4_block5_add (Add)         (None, 8, 8, 1024)   0
['conv4_block4_out[0][0]',

'conv4_block5_3_bn[0][0]']


 conv4_block5_out (Activation)  (None, 8, 8, 1024)   0
['conv4_block5_add[0][0]']


 conv4_block6_1_conv (Conv2D)   (None, 8, 8, 256)    262400
['conv4_block5_out[0][0]']


 conv4_block6_1_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block6_1_conv[0][0]']
 ization)


 conv4_block6_1_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block6_1_bn[0][0]']
 n)


 conv4_block6_2_conv (Conv2D)   (None, 8, 8, 256)    590080
```

```
['conv4_block6_1_relu[0][0]']


 conv4_block6_2_bn (BatchNormal  (None, 8, 8, 256)   1024
['conv4_block6_2_conv[0][0]']
 ization)



 conv4_block6_2_relu (Activatio  (None, 8, 8, 256)   0
['conv4_block6_2_bn[0][0]']
 n)



 conv4_block6_3_conv (Conv2D)   (None, 8, 8, 1024)   263168
['conv4_block6_2_relu[0][0]']


 conv4_block6_3_bn (BatchNormal  (None, 8, 8, 1024)  4096
['conv4_block6_3_conv[0][0]']
 ization)



 conv4_block6_add (Add)         (None, 8, 8, 1024)   0
['conv4_block5_out[0][0]',

'conv4_block6_3_bn[0][0]']


 conv4_block6_out (Activation)  (None, 8, 8, 1024)   0
['conv4_block6_add[0][0]']


 conv5_block1_1_conv (Conv2D)   (None, 4, 4, 512)    524800
['conv4_block6_out[0][0]']


 conv5_block1_1_bn (BatchNormal  (None, 4, 4, 512)   2048
['conv5_block1_1_conv[0][0]']
 ization)



 conv5_block1_1_relu (Activatio  (None, 4, 4, 512)   0
['conv5_block1_1_bn[0][0]']
 n)
```

```
 conv5_block1_2_conv (Conv2D)   (None, 4, 4, 512)    2359808
['conv5_block1_1_relu[0][0]']


 conv5_block1_2_bn (BatchNormal  (None, 4, 4, 512)   2048
['conv5_block1_2_conv[0][0]']
 ization)



 conv5_block1_2_relu (Activatio  (None, 4, 4, 512)   0
['conv5_block1_2_bn[0][0]']
 n)



 conv5_block1_0_conv (Conv2D)   (None, 4, 4, 2048)   2099200
['conv4_block6_out[0][0]']


 conv5_block1_3_conv (Conv2D)   (None, 4, 4, 2048)   1050624
['conv5_block1_2_relu[0][0]']


 conv5_block1_0_bn (BatchNormal  (None, 4, 4, 2048)  8192
['conv5_block1_0_conv[0][0]']
 ization)



 conv5_block1_3_bn (BatchNormal  (None, 4, 4, 2048)  8192
['conv5_block1_3_conv[0][0]']
 ization)



 conv5_block1_add (Add)         (None, 4, 4, 2048)   0
['conv5_block1_0_bn[0][0]',

'conv5_block1_3_bn[0][0]']


 conv5_block1_out (Activation)  (None, 4, 4, 2048)   0
['conv5_block1_add[0][0]']


 conv5_block2_1_conv (Conv2D)   (None, 4, 4, 512)    1049088
['conv5_block1_out[0][0]']


 conv5_block2_1_bn (BatchNormal  (None, 4, 4, 512)   2048
```

```
['conv5_block2_1_conv[0][0]']
 ization)



 conv5_block2_1_relu (Activatio  (None, 4, 4, 512)   0
['conv5_block2_1_bn[0][0]']
 n)



 conv5_block2_2_conv (Conv2D)   (None, 4, 4, 512)    2359808
['conv5_block2_1_relu[0][0]']


 conv5_block2_2_bn (BatchNormal  (None, 4, 4, 512)   2048
['conv5_block2_2_conv[0][0]']
 ization)



 conv5_block2_2_relu (Activatio  (None, 4, 4, 512)   0
['conv5_block2_2_bn[0][0]']
 n)



 conv5_block2_3_conv (Conv2D)   (None, 4, 4, 2048)   1050624
['conv5_block2_2_relu[0][0]']


 conv5_block2_3_bn (BatchNormal  (None, 4, 4, 2048)  8192
['conv5_block2_3_conv[0][0]']
 ization)



 conv5_block2_add (Add)         (None, 4, 4, 2048)   0
['conv5_block1_out[0][0]',

'conv5_block2_3_bn[0][0]']


 conv5_block2_out (Activation)  (None, 4, 4, 2048)   0
['conv5_block2_add[0][0]']


 conv5_block3_1_conv (Conv2D)   (None, 4, 4, 512)    1049088
['conv5_block2_out[0][0]']
```

```
 conv5_block3_1_bn (BatchNormal  (None, 4, 4, 512)   2048
['conv5_block3_1_conv[0][0]']
 ization)



 conv5_block3_1_relu (Activatio  (None, 4, 4, 512)   0
['conv5_block3_1_bn[0][0]']
 n)



 conv5_block3_2_conv (Conv2D)   (None, 4, 4, 512)    2359808
['conv5_block3_1_relu[0][0]']


 conv5_block3_2_bn (BatchNormal  (None, 4, 4, 512)   2048
['conv5_block3_2_conv[0][0]']
 ization)



 conv5_block3_2_relu (Activatio  (None, 4, 4, 512)   0
['conv5_block3_2_bn[0][0]']
 n)



 conv5_block3_3_conv (Conv2D)   (None, 4, 4, 2048)   1050624
['conv5_block3_2_relu[0][0]']


 conv5_block3_3_bn (BatchNormal  (None, 4, 4, 2048)  8192
['conv5_block3_3_conv[0][0]']
 ization)



 conv5_block3_add (Add)         (None, 4, 4, 2048)   0
['conv5_block2_out[0][0]',

'conv5_block3_3_bn[0][0]']


 conv5_block3_out (Activation)  (None, 4, 4, 2048)   0
['conv5_block3_add[0][0]']


 global_average_pooling2d_1 (Gl  (None, 2048)        0
['conv5_block3_out[0][0]']
 obalAveragePooling2D)
```

```
 dropout_2 (Dropout)            (None, 2048)         0
['global_average_pooling2d_1[0][0
                                                                 ']']


 dense_18 (Dense)               (None, 64)           131136
['dropout_2[0][0]']

 dropout_3 (Dropout)            (None, 64)           0
['dense_18[0][0]']

 dense_19 (Dense)               (None, 3)            195
['dropout_3[0][0]']

==================================================================================
Total params: 23,719,043
Trainable params: 131,331
Non-trainable params: 23,587,712
__________________________________________________________________________________
```

```python
from tensorflow.keras.applications import ResNet50
from tensorflow.keras.models import Model
from tensorflow.keras.layers import Dense, GlobalAveragePooling2D,
Input
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.utils import to_categorical

# Convert labels to one-hot
y_train_cat = to_categorical(y_train, num_classes=3)
y_test_cat = to_categorical(y_test, num_classes=3)

# Input shape must match your resized image shape
input_tensor = Input(shape=(128, 128, 3))

# Load ResNet50 base (without top)
base_model = ResNet50(include_top=False, weights='imagenet',
input_tensor=input_tensor)
base_model.trainable = False  # freeze base

# Add custom classification layers
x = base_model.output
x = GlobalAveragePooling2D()(x)
```

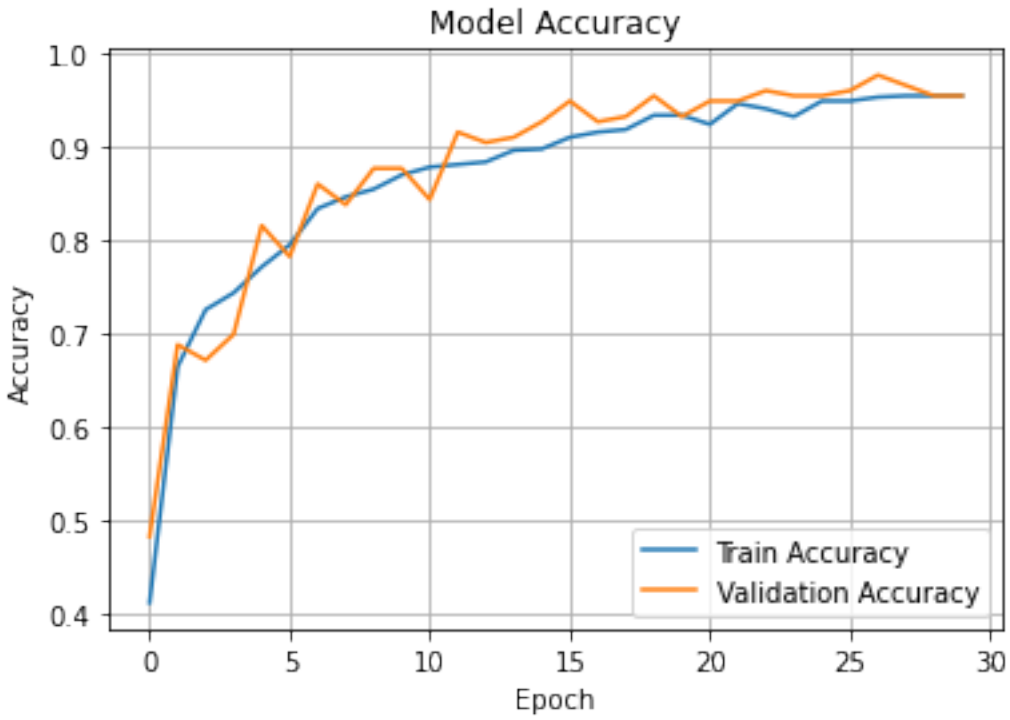
```
x = Dense(128, activation='relu')(x)
output = Dense(3, activation='softmax')(x)

resnet_model = Model(inputs=base_model.input, outputs=output)

# Compile
resnet_model.compile(optimizer=Adam(),
                     loss='categorical_crossentropy',
                     metrics=['accuracy'])

# Fit
history_resnet = resnet_model.fit(X_train, y_train_cat,
                                  epochs=30,
                                  batch_size=32,
                                  validation_data=(X_test,
y_test_cat))
```

```
Epoch 1/30
23/23 [==============================] - 22s 887ms/step - loss: 1.0753
- accuracy: 0.4125 - val_loss: 1.0142 - val_accuracy: 0.4833
Epoch 2/30
23/23 [==============================] - 20s 856ms/step - loss: 0.9475
- accuracy: 0.6653 - val_loss: 0.8941 - val_accuracy: 0.6889
Epoch 3/30
23/23 [==============================] - 20s 857ms/step - loss: 0.8529
- accuracy: 0.7264 - val_loss: 0.8078 - val_accuracy: 0.6722
Epoch 4/30
23/23 [==============================] - 20s 861ms/step - loss: 0.7663
- accuracy: 0.7444 - val_loss: 0.7323 - val_accuracy: 0.7000
Epoch 5/30
23/23 [==============================] - 19s 853ms/step - loss: 0.6941
- accuracy: 0.7722 - val_loss: 0.6507 - val_accuracy: 0.8167
Epoch 6/30
23/23 [==============================] - 19s 851ms/step - loss: 0.6380
- accuracy: 0.7958 - val_loss: 0.6089 - val_accuracy: 0.7833
Epoch 7/30
23/23 [==============================] - 19s 852ms/step - loss: 0.5754
- accuracy: 0.8347 - val_loss: 0.5514 - val_accuracy: 0.8611
Epoch 8/30
23/23 [==============================] - 20s 873ms/step - loss: 0.5289
- accuracy: 0.8472 - val_loss: 0.5090 - val_accuracy: 0.8389
Epoch 9/30
23/23 [==============================] - 20s 860ms/step - loss: 0.4923
- accuracy: 0.8556 - val_loss: 0.4736 - val_accuracy: 0.8778
Epoch 10/30
23/23 [==============================] - 20s 887ms/step - loss: 0.4553
- accuracy: 0.8708 - val_loss: 0.4504 - val_accuracy: 0.8778
Epoch 11/30
23/23 [==============================] - 20s 882ms/step - loss: 0.4283
- accuracy: 0.8792 - val_loss: 0.4223 - val_accuracy: 0.8444
```

```
Epoch 12/30
23/23 [==============================] - 21s 904ms/step - loss: 0.4029
- accuracy: 0.8819 - val_loss: 0.3986 - val_accuracy: 0.9167
Epoch 13/30
23/23 [==============================] - 27s 1s/step - loss: 0.3834 -
accuracy: 0.8847 - val_loss: 0.3728 - val_accuracy: 0.9056
Epoch 14/30
23/23 [==============================] - 25s 1s/step - loss: 0.3501 -
accuracy: 0.8972 - val_loss: 0.3408 - val_accuracy: 0.9111
Epoch 15/30
23/23 [==============================] - 25s 1s/step - loss: 0.3288 -
accuracy: 0.8986 - val_loss: 0.3485 - val_accuracy: 0.9278
Epoch 16/30
23/23 [==============================] - 25s 1s/step - loss: 0.3100 -
accuracy: 0.9111 - val_loss: 0.3198 - val_accuracy: 0.9500
Epoch 17/30
23/23 [==============================] - 26s 1s/step - loss: 0.2970 -
accuracy: 0.9167 - val_loss: 0.3030 - val_accuracy: 0.9278
Epoch 18/30
23/23 [==============================] - 26s 1s/step - loss: 0.2862 -
accuracy: 0.9194 - val_loss: 0.2872 - val_accuracy: 0.9333
Epoch 19/30
23/23 [==============================] - 27s 1s/step - loss: 0.2647 -
accuracy: 0.9347 - val_loss: 0.2553 - val_accuracy: 0.9556
Epoch 20/30
23/23 [==============================] - 28s 1s/step - loss: 0.2448 -
accuracy: 0.9347 - val_loss: 0.2533 - val_accuracy: 0.9333
Epoch 21/30
23/23 [==============================] - 24s 1s/step - loss: 0.2491 -
accuracy: 0.9250 - val_loss: 0.2377 - val_accuracy: 0.9500
Epoch 22/30
23/23 [==============================] - 23s 1s/step - loss: 0.2232 -
accuracy: 0.9472 - val_loss: 0.2212 - val_accuracy: 0.9500
Epoch 23/30
23/23 [==============================] - 27s 1s/step - loss: 0.2195 -
accuracy: 0.9417 - val_loss: 0.2142 - val_accuracy: 0.9611
Epoch 24/30
23/23 [==============================] - 26s 1s/step - loss: 0.2162 -
accuracy: 0.9333 - val_loss: 0.2169 - val_accuracy: 0.9556
Epoch 25/30
23/23 [==============================] - 26s 1s/step - loss: 0.2027 -
accuracy: 0.9500 - val_loss: 0.1952 - val_accuracy: 0.9556
Epoch 26/30
23/23 [==============================] - 27s 1s/step - loss: 0.1912 -
accuracy: 0.9500 - val_loss: 0.1939 - val_accuracy: 0.9611
Epoch 27/30
23/23 [==============================] - 26s 1s/step - loss: 0.1792 -
accuracy: 0.9542 - val_loss: 0.1801 - val_accuracy: 0.9778
Epoch 28/30
```

```
23/23 [==============================] - 26s 1s/step - loss: 0.1732 -
accuracy: 0.9556 - val_loss: 0.1726 - val_accuracy: 0.9667
Epoch 29/30
23/23 [==============================] - 26s 1s/step - loss: 0.1693 -
accuracy: 0.9556 - val_loss: 0.1723 - val_accuracy: 0.9556
Epoch 30/30
23/23 [==============================] - 27s 1s/step - loss: 0.1660 -
accuracy: 0.9556 - val_loss: 0.1783 - val_accuracy: 0.9556
```

```
# Plot training & validation accuracy
plt.plot(history_resnet.history['accuracy'], label='Train Accuracy')
plt.plot(history_resnet.history['val_accuracy'], label='Validation
Accuracy')
plt.title('Model Accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()
plt.grid(True)
plt.show()
```




```
resnet_model.save("resnet_model.h5")
```