```
In [1]: !pip install tensorflow
```

```
Requirement already satisfied: tensorflow in /usr/local/lib/python3.10/dist-packages (2.
15.0)
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-packages
(from tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.10/dist-packa
ges (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=23.5.26 in /usr/local/lib/python3.10/dist-pa
ckages (from tensorflow) (24.3.25)
Requirement already satisfied: gast!=0.5.0,!=0.5.1,!=0.5.2,>=0.2.1 in /usr/local/lib/pyt
hon3.10/dist-packages (from tensorflow) (0.6.0)
Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.10/dist-pac
kages (from tensorflow) (0.2.0)
Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.10/dist-packages (f
rom tensorflow) (3.11.0)
Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.10/dist-packag
es (from tensorflow) (18.1.1)
Requirement already satisfied: ml-dtypes~=0.2.0 in /usr/local/lib/python3.10/dist-packag
es (from tensorflow) (0.2.0)
Requirement already satisfied: numpy<2.0.0,>=1.23.5 in /usr/local/lib/python3.10/dist-pa
ckages (from tensorflow) (1.26.4)
Requirement already satisfied: opt-einsum>=2.3.2 in /usr/local/lib/python3.10/dist-packa
ges (from tensorflow) (3.3.0)
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (fro
m tensorflow) (24.1)
Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.21.4,!=4.
21.5,<5.0.0dev,>=3.20.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.
20.3)
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (fr
om tensorflow) (71.0.4)
Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.10/dist-packages (f
rom tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.10/dist-packag
es (from tensorflow) (2.4.0)
Requirement already satisfied: typing-extensions>=3.6.6 in /usr/local/lib/python3.10/dis
t-packages (from tensorflow) (4.12.2)
Requirement already satisfied: wrapt<1.15,>=1.11.0 in /usr/local/lib/python3.10/dist-pac
kages (from tensorflow) (1.14.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /usr/local/lib/py
thon3.10/dist-packages (from tensorflow) (0.37.1)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.10/dist-pac
kages (from tensorflow) (1.64.1)
Requirement already satisfied: tensorboard<2.16,>=2.15 in /usr/local/lib/python3.10/dist
-packages (from tensorflow) (2.15.2)
Requirement already satisfied: tensorflow-estimator<2.16,>=2.15.0 in /usr/local/lib/pyth
on3.10/dist-packages (from tensorflow) (2.15.0)
Requirement already satisfied: keras<2.16,>=2.15.0 in /usr/local/lib/python3.10/dist-pac
kages (from tensorflow) (2.15.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in /usr/local/lib/python3.10/dist-pack
ages (from astunparse>=1.6.0->tensorflow) (0.43.0)
Requirement already satisfied: google-auth<3,>=1.6.3 in /usr/local/lib/python3.10/dist-p
ackages (from tensorboard<2.16,>=2.15->tensorflow) (2.27.0)
Requirement already satisfied: google-auth-oauthlib<2,>=0.5 in /usr/local/lib/python3.1
0/dist-packages (from tensorboard<2.16,>=2.15->tensorflow) (1.2.1)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.10/dist-package
s (from tensorboard<2.16,>=2.15->tensorflow) (3.6)
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.10/dist-pac
kages (from tensorboard<2.16,>=2.15->tensorflow) (2.31.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /usr/local/lib/p
ython3.10/dist-packages (from tensorboard<2.16,>=2.15->tensorflow) (0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in /usr/local/lib/python3.10/dist-package
s (from tensorboard<2.16,>=2.15->tensorflow) (3.0.3)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in /usr/local/lib/python3.10/dist-
```

In [6]:
```python
from tensorflow.compat.v1 import ConfigProto
from tensorflow.compat.v1 import InteractiveSession

config = ConfigProto()
config.gpu_options.per_process_gpu_memory_fraction = 0.5
config.gpu_options.allow_growth = True
session = InteractiveSession(config=config)
# import the libraries as shown below

from tensorflow.keras.layers import Input, Lambda, Dense, Flatten
from tensorflow.keras.models import Model
from tensorflow.keras.applications.inception_v3 import InceptionV3
#from keras.applications.vgg16 import VGG16
from tensorflow.keras.applications.inception_v3 import preprocess_input
from tensorflow.keras.preprocessing import image
from tensorflow.keras.preprocessing.image import ImageDataGenerator,load_img
from tensorflow.keras.models import Sequential
import numpy as np
from glob import glob
```

/usr/local/lib/python3.10/dist-packages/tensorflow/python/client/session.py:1793: UserWa
rning: An interactive session is already active. This can cause out-of-memory errors in
some cases. You must explicitly call `InteractiveSession.close()` to release resources h
eld by the other session(s).
  warnings.warn('An interactive session is already active. This can '

In [4]:
```python
IMAGE_SIZE = [224, 224]

train_path = '/content/drive/MyDrive/Datasets/train'
valid_path = '/content/drive/MyDrive/Datasets/test'
```

In [7]:
```python
inception = InceptionV3(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top=Fa
```

Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/incep
tion_v3/inception_v3_weights_tf_dim_ordering_tf_kernels_notop.h5
87910968/87910968 [==============================] - 1s 0us/step

In [9]:
```python
for layer in inception.layers:
    layer.trainable = False
```

```
In [13]:  # useful for getting number of output classes
          folders = glob('/content/drive/MyDrive/Datasets/train/*')
          folders
```

Out[13]: ['/content/drive/MyDrive/Datasets/train/diseased cotton leaf',
           '/content/drive/MyDrive/Datasets/train/fresh cotton plant',
           '/content/drive/MyDrive/Datasets/train/diseased cotton plant',
           '/content/drive/MyDrive/Datasets/train/fresh cotton leaf']

```
In [14]:  # our layers - you can add more if you want
          x = Flatten()(inception.output)
```

```
In [15]:  prediction = Dense(len(folders), activation='softmax')(x)

          # create a model object
          model = Model(inputs=inception.input, outputs=prediction)
```

```
In [16]:  model.summary()
```

Model: "model"
_____

_____
 Layer (type)   Output Shape   Param #   Connected to

===
==========
 input_1 (InputLayer)   [(None, 224, 224, 3)]   0   []

 conv2d (Conv2D)   (None, 111, 111, 32)   864   ['input_1[0][0]']

 batch_normalization (Batch   (None, 111, 111, 32)   96   ['conv2d[0][0]']

 Normalization)

 activation (Activation)   (None, 111, 111, 32)   0   ['batch_normalizatio
 n[0][0]']

 conv2d_1 (Conv2D)   (None, 109, 109, 32)   9216   ['activation[0][0]']

 batch_normalization_1 (Bat   (None, 109, 109, 32)   96   ['conv2d_1[0][0]']

 chNormalization)

 activation_1 (Activation)   (None, 109, 109, 32)   0   ['batch_normalizatio
 n_1[0][0]'
                                                                   ]

 conv2d_2 (Conv2D)   (None, 109, 109, 64)   18432   ['activation_1[0]
 [0]']

 batch_normalization_2 (Bat   (None, 109, 109, 64)   192   ['conv2d_2[0][0]']
```

chNormalization)

| activation_2 (Activation) | (None, 109, 109, 64) | 0 | ['batch_normalizatio n_2[0][0]' ] |
| max_pooling2d (MaxPooling2 D) | (None, 54, 54, 64) | 0 | ['activation_2[0] [0]'] |
| conv2d_3 (Conv2D) | (None, 54, 54, 80) | 5120 | ['max_pooling2d[0] [0]'] |
| batch_normalization_3 (Bat chNormalization) | (None, 54, 54, 80) | 240 | ['conv2d_3[0][0]'] |
| activation_3 (Activation) | (None, 54, 54, 80) | 0 | ['batch_normalizatio n_3[0][0]' ] |
| conv2d_4 (Conv2D) | (None, 52, 52, 192) | 138240 | ['activation_3[0] [0]'] |
| batch_normalization_4 (Bat chNormalization) | (None, 52, 52, 192) | 576 | ['conv2d_4[0][0]'] |
| activation_4 (Activation) | (None, 52, 52, 192) | 0 | ['batch_normalizatio n_4[0][0]' ] |
| max_pooling2d_1 (MaxPoolin g2D) | (None, 25, 25, 192) | 0 | ['activation_4[0] [0]'] |
| conv2d_8 (Conv2D) | (None, 25, 25, 64) | 12288 | ['max_pooling2d_1[0] [0]'] |
| batch_normalization_8 (Bat chNormalization) | (None, 25, 25, 64) | 192 | ['conv2d_8[0][0]'] |
| activation_8 (Activation) | (None, 25, 25, 64) | 0 | ['batch_normalizatio |

```
                                                                   n_8[0][0]'
                                                                                                    ]


 conv2d_6 (Conv2D)              (None, 25, 25, 48)      9216         ['max_pooling2d_1[0]
[0]']


 conv2d_9 (Conv2D)              (None, 25, 25, 96)      55296        ['activation_8[0]
[0]']


 batch_normalization_6 (Bat     (None, 25, 25, 48)      144          ['conv2d_6[0][0]']

 chNormalization)



 batch_normalization_9 (Bat     (None, 25, 25, 96)      288          ['conv2d_9[0][0]']

 chNormalization)



 activation_6 (Activation)      (None, 25, 25, 48)      0            ['batch_normalizatio
n_6[0][0]'
                                                                                                    ]


 activation_9 (Activation)      (None, 25, 25, 96)      0            ['batch_normalizatio
n_9[0][0]'
                                                                                                    ]



 average_pooling2d (Average     (None, 25, 25, 192)     0            ['max_pooling2d_1[0]
[0]']
 Pooling2D)



 conv2d_5 (Conv2D)              (None, 25, 25, 64)      12288        ['max_pooling2d_1[0]
[0]']


 conv2d_7 (Conv2D)              (None, 25, 25, 64)      76800        ['activation_6[0]
[0]']


 conv2d_10 (Conv2D)             (None, 25, 25, 96)      82944        ['activation_9[0]
[0]']


 conv2d_11 (Conv2D)             (None, 25, 25, 32)      6144         ['average_pooling2d
[0][0]']


 batch_normalization_5 (Bat     (None, 25, 25, 64)      192          ['conv2d_5[0][0]']

 chNormalization)



 batch_normalization_7 (Bat     (None, 25, 25, 64)      192          ['conv2d_7[0][0]']
```

chNormalization)

batch_normalization_10 (Ba   (None, 25, 25, 96)   288   ['conv2d_10[0][0]']
tchNormalization)

batch_normalization_11 (Ba   (None, 25, 25, 32)   96   ['conv2d_11[0][0]']
tchNormalization)

activation_5 (Activation)   (None, 25, 25, 64)   0   ['batch_normalizatio
n_5[0][0]'
                                                              ]

activation_7 (Activation)   (None, 25, 25, 64)   0   ['batch_normalizatio
n_7[0][0]'
                                                              ]

activation_10 (Activation)   (None, 25, 25, 96)   0   ['batch_normalizatio
n_10[0][0]
                                                              ']

activation_11 (Activation)   (None, 25, 25, 32)   0   ['batch_normalizatio
n_11[0][0]
                                                              ']

mixed0 (Concatenate)   (None, 25, 25, 256)   0   ['activation_5[0]
[0]',
                                                                'activation_7[0]
[0]',
                                                                'activation_10[0]
[0]',
                                                                'activation_11[0]
[0]']

conv2d_15 (Conv2D)   (None, 25, 25, 64)   16384   ['mixed0[0][0]']

batch_normalization_15 (Ba   (None, 25, 25, 64)   192   ['conv2d_15[0][0]']
tchNormalization)

activation_15 (Activation)   (None, 25, 25, 64)   0   ['batch_normalizatio
n_15[0][0]
                                                              ']

conv2d_13 (Conv2D)	(None, 25, 25, 48)	12288	['mixed0[0][0]']
conv2d_16 (Conv2D)	(None, 25, 25, 96)	55296	['activation_15[0][0]']
batch_normalization_13 (Ba tchNormalization)	(None, 25, 25, 48)	144	['conv2d_13[0][0]']
batch_normalization_16 (Ba tchNormalization)	(None, 25, 25, 96)	288	['conv2d_16[0][0]']
activation_13 (Activation)	(None, 25, 25, 48)	0	['batch_normalizatio n_13[0][0]']
activation_16 (Activation)	(None, 25, 25, 96)	0	['batch_normalizatio n_16[0][0]']
average_pooling2d_1 (Avera gePooling2D)	(None, 25, 25, 256)	0	['mixed0[0][0]']
conv2d_12 (Conv2D)	(None, 25, 25, 64)	16384	['mixed0[0][0]']
conv2d_14 (Conv2D)	(None, 25, 25, 64)	76800	['activation_13[0][0]']
conv2d_17 (Conv2D)	(None, 25, 25, 96)	82944	['activation_16[0][0]']
conv2d_18 (Conv2D)	(None, 25, 25, 64)	16384	['average_pooling2d_ 1[0][0]']
batch_normalization_12 (Ba tchNormalization)	(None, 25, 25, 64)	192	['conv2d_12[0][0]']
batch_normalization_14 (Ba tchNormalization)	(None, 25, 25, 64)	192	['conv2d_14[0][0]']

batch_normalization_17 (Ba tchNormalization)	(None, 25, 25, 96)	288	['conv2d_17[0][0]']
batch_normalization_18 (Ba tchNormalization)	(None, 25, 25, 64)	192	['conv2d_18[0][0]']
activation_12 (Activation)	(None, 25, 25, 64)	0	['batch_normalizatio n_12[0][0]']
activation_14 (Activation)	(None, 25, 25, 64)	0	['batch_normalizatio n_14[0][0]']
activation_17 (Activation)	(None, 25, 25, 96)	0	['batch_normalizatio n_17[0][0]']
activation_18 (Activation)	(None, 25, 25, 64)	0	['batch_normalizatio n_18[0][0]']
mixed1 (Concatenate)	(None, 25, 25, 288)	0	['activation_12[0] [0]', 'activation_14[0] [0]', 'activation_17[0] [0]', 'activation_18[0] [0]']
conv2d_22 (Conv2D)	(None, 25, 25, 64)	18432	['mixed1[0][0]']
batch_normalization_22 (Ba tchNormalization)	(None, 25, 25, 64)	192	['conv2d_22[0][0]']
activation_22 (Activation)	(None, 25, 25, 64)	0	['batch_normalizatio n_22[0][0]']
conv2d_20 (Conv2D)	(None, 25, 25, 48)	13824	['mixed1[0][0]']

Layer	Output Shape	Param #	Connected to
conv2d_23 (Conv2D)	(None, 25, 25, 96)	55296	['activation_22[0][0]']
batch_normalization_20 (Ba tchNormalization)	(None, 25, 25, 48)	144	['conv2d_20[0][0]']
batch_normalization_23 (Ba tchNormalization)	(None, 25, 25, 96)	288	['conv2d_23[0][0]']
activation_20 (Activation)	(None, 25, 25, 48)	0	['batch_normalizatio n_20[0][0]']
activation_23 (Activation)	(None, 25, 25, 96)	0	['batch_normalizatio n_23[0][0]']
average_pooling2d_2 (Avera gePooling2D)	(None, 25, 25, 288)	0	['mixed1[0][0]']
conv2d_19 (Conv2D)	(None, 25, 25, 64)	18432	['mixed1[0][0]']
conv2d_21 (Conv2D)	(None, 25, 25, 64)	76800	['activation_20[0][0]']
conv2d_24 (Conv2D)	(None, 25, 25, 96)	82944	['activation_23[0][0]']
conv2d_25 (Conv2D)	(None, 25, 25, 64)	18432	['average_pooling2d_ 2[0][0]']
batch_normalization_19 (Ba tchNormalization)	(None, 25, 25, 64)	192	['conv2d_19[0][0]']
batch_normalization_21 (Ba tchNormalization)	(None, 25, 25, 64)	192	['conv2d_21[0][0]']
batch_normalization_24 (Ba tchNormalization)	(None, 25, 25, 96)	288	['conv2d_24[0][0]']

batch_normalization_25 (Ba	(None, 25, 25, 64)	192	['conv2d_25[0][0]']
tchNormalization)			
activation_19 (Activation)	(None, 25, 25, 64)	0	['batch_normalizatio
n_19[0][0]			']
activation_21 (Activation)	(None, 25, 25, 64)	0	['batch_normalizatio
n_21[0][0]			']
activation_24 (Activation)	(None, 25, 25, 96)	0	['batch_normalizatio
n_24[0][0]			']
activation_25 (Activation)	(None, 25, 25, 64)	0	['batch_normalizatio
n_25[0][0]			']
mixed2 (Concatenate)	(None, 25, 25, 288)	0	['activation_19[0]
[0]',			'activation_21[0]
[0]',			'activation_24[0]
[0]',			'activation_25[0]
[0]']			
conv2d_27 (Conv2D)	(None, 25, 25, 64)	18432	['mixed2[0][0]']
batch_normalization_27 (Ba	(None, 25, 25, 64)	192	['conv2d_27[0][0]']
tchNormalization)			
activation_27 (Activation)	(None, 25, 25, 64)	0	['batch_normalizatio
n_27[0][0]			']
conv2d_28 (Conv2D)	(None, 25, 25, 96)	55296	['activation_27[0]
[0]']			
batch_normalization_28 (Ba	(None, 25, 25, 96)	288	['conv2d_28[0][0]']
tchNormalization)			

Layer (type)	Output Shape	Param #	Connected to
activation_28 (Activation)	(None, 25, 25, 96)	0	['batch_normalizatio n_28[0][0]']
conv2d_26 (Conv2D)	(None, 12, 12, 384)	995328	['mixed2[0][0]']
conv2d_29 (Conv2D)	(None, 12, 12, 96)	82944	['activation_28[0] [0]']
batch_normalization_26 (Ba tchNormalization)	(None, 12, 12, 384)	1152	['conv2d_26[0][0]']
batch_normalization_29 (Ba tchNormalization)	(None, 12, 12, 96)	288	['conv2d_29[0][0]']
activation_26 (Activation)	(None, 12, 12, 384)	0	['batch_normalizatio n_26[0][0]']
activation_29 (Activation)	(None, 12, 12, 96)	0	['batch_normalizatio n_29[0][0]']
max_pooling2d_2 (MaxPoolin g2D)	(None, 12, 12, 288)	0	['mixed2[0][0]']
mixed3 (Concatenate)	(None, 12, 12, 768)	0	['activation_26[0] [0]', 'activation_29[0] [0]', 'max_pooling2d_2[0] [0]']
conv2d_34 (Conv2D)	(None, 12, 12, 128)	98304	['mixed3[0][0]']
batch_normalization_34 (Ba tchNormalization)	(None, 12, 12, 128)	384	['conv2d_34[0][0]']
activation_34 (Activation)	(None, 12, 12, 128)	0	['batch_normalizatio

```
 n_34[0][0]

                                                                                    ']


 conv2d_35 (Conv2D)          (None, 12, 12, 128)     114688    ['activation_34[0]
 [0]']


 batch_normalization_35 (Ba  (None, 12, 12, 128)     384       ['conv2d_35[0][0]']

 tchNormalization)


 activation_35 (Activation)  (None, 12, 12, 128)     0         ['batch_normalizatio
 n_35[0][0]
                                                                                    ']


 conv2d_31 (Conv2D)          (None, 12, 12, 128)     98304     ['mixed3[0][0]']


 conv2d_36 (Conv2D)          (None, 12, 12, 128)     114688    ['activation_35[0]
 [0]']


 batch_normalization_31 (Ba  (None, 12, 12, 128)     384       ['conv2d_31[0][0]']

 tchNormalization)


 batch_normalization_36 (Ba  (None, 12, 12, 128)     384       ['conv2d_36[0][0]']

 tchNormalization)


 activation_31 (Activation)  (None, 12, 12, 128)     0         ['batch_normalizatio
 n_31[0][0]
                                                                                    ']


 activation_36 (Activation)  (None, 12, 12, 128)     0         ['batch_normalizatio
 n_36[0][0]
                                                                                    ']


 conv2d_32 (Conv2D)          (None, 12, 12, 128)     114688    ['activation_31[0]
 [0]']


 conv2d_37 (Conv2D)          (None, 12, 12, 128)     114688    ['activation_36[0]
 [0]']


 batch_normalization_32 (Ba  (None, 12, 12, 128)     384       ['conv2d_32[0][0]']

 tchNormalization)
```

batch_normalization_37 (Ba tchNormalization)	(None, 12, 12, 128)	384	['conv2d_37[0][0]']
activation_32 (Activation)	(None, 12, 12, 128)	0	['batch_normalizatio n_32[0][0] ']
activation_37 (Activation)	(None, 12, 12, 128)	0	['batch_normalizatio n_37[0][0] ']
average_pooling2d_3 (Avera gePooling2D)	(None, 12, 12, 768)	0	['mixed3[0][0]']
conv2d_30 (Conv2D)	(None, 12, 12, 192)	147456	['mixed3[0][0]']
conv2d_33 (Conv2D)	(None, 12, 12, 192)	172032	['activation_32[0] [0]']
conv2d_38 (Conv2D)	(None, 12, 12, 192)	172032	['activation_37[0] [0]']
conv2d_39 (Conv2D)	(None, 12, 12, 192)	147456	['average_pooling2d_ 3[0][0]']
batch_normalization_30 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_30[0][0]']
batch_normalization_33 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_33[0][0]']
batch_normalization_38 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_38[0][0]']
batch_normalization_39 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_39[0][0]']
activation_30 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio

```
                                                           n_30[0][0]

                                                           ']


 activation_33 (Activation)   (None, 12, 12, 192)      0        ['batch_normalizatio
                                                           n_33[0][0]

                                                           ']


 activation_38 (Activation)   (None, 12, 12, 192)      0        ['batch_normalizatio
                                                           n_38[0][0]

                                                           ']


 activation_39 (Activation)   (None, 12, 12, 192)      0        ['batch_normalizatio
                                                           n_39[0][0]

                                                           ']


 mixed4 (Concatenate)         (None, 12, 12, 768)      0        ['activation_30[0]
 [0]',
                                                                  'activation_33[0]
 [0]',
                                                                  'activation_38[0]
 [0]',
                                                                  'activation_39[0]
 [0]']

 conv2d_44 (Conv2D)           (None, 12, 12, 160)      122880   ['mixed4[0][0]']


 batch_normalization_44 (Ba   (None, 12, 12, 160)      480      ['conv2d_44[0][0]']

 tchNormalization)


 activation_44 (Activation)   (None, 12, 12, 160)      0        ['batch_normalizatio
                                                           n_44[0][0]

                                                           ']


 conv2d_45 (Conv2D)           (None, 12, 12, 160)      179200   ['activation_44[0]
 [0]']

 batch_normalization_45 (Ba   (None, 12, 12, 160)      480      ['conv2d_45[0][0]']

 tchNormalization)


 activation_45 (Activation)   (None, 12, 12, 160)      0        ['batch_normalizatio
                                                           n_45[0][0]

                                                           ']


 conv2d_41 (Conv2D)           (None, 12, 12, 160)      122880   ['mixed4[0][0]']
```

conv2d_46 (Conv2D)	(None, 12, 12, 160)	179200	['activation_45[0][0]']
batch_normalization_41 (Ba tchNormalization)	(None, 12, 12, 160)	480	['conv2d_41[0][0]']
batch_normalization_46 (Ba tchNormalization)	(None, 12, 12, 160)	480	['conv2d_46[0][0]']
activation_41 (Activation)	(None, 12, 12, 160)	0	['batch_normalizatio n_41[0][0]']
activation_46 (Activation)	(None, 12, 12, 160)	0	['batch_normalizatio n_46[0][0]']
conv2d_42 (Conv2D)	(None, 12, 12, 160)	179200	['activation_41[0][0]']
conv2d_47 (Conv2D)	(None, 12, 12, 160)	179200	['activation_46[0][0]']
batch_normalization_42 (Ba tchNormalization)	(None, 12, 12, 160)	480	['conv2d_42[0][0]']
batch_normalization_47 (Ba tchNormalization)	(None, 12, 12, 160)	480	['conv2d_47[0][0]']
activation_42 (Activation)	(None, 12, 12, 160)	0	['batch_normalizatio n_42[0][0]']
activation_47 (Activation)	(None, 12, 12, 160)	0	['batch_normalizatio n_47[0][0]']
average_pooling2d_4 (Avera gePooling2D)	(None, 12, 12, 768)	0	['mixed4[0][0]']

Layer	Output Shape	Param #	Connected to
conv2d_40 (Conv2D)	(None, 12, 12, 192)	147456	['mixed4[0][0]']
conv2d_43 (Conv2D)	(None, 12, 12, 192)	215040	['activation_42[0][0]']
conv2d_48 (Conv2D)	(None, 12, 12, 192)	215040	['activation_47[0][0]']
conv2d_49 (Conv2D)	(None, 12, 12, 192)	147456	['average_pooling2d_4[0][0]']
batch_normalization_40 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_40[0][0]']
batch_normalization_43 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_43[0][0]']
batch_normalization_48 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_48[0][0]']
batch_normalization_49 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_49[0][0]']
activation_40 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_40[0][0]']
activation_43 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_43[0][0]']
activation_48 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_48[0][0]']
activation_49 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_49[0][0]']

mixed5 (Concatenate)	(None, 12, 12, 768)	0	['activation_40[0] [0]',
			'activation_43[0] [0]',
			'activation_48[0] [0]',
			'activation_49[0] [0]']
conv2d_54 (Conv2D)	(None, 12, 12, 160)	122880	['mixed5[0][0]']
batch_normalization_54 (Ba tchNormalization)	(None, 12, 12, 160)	480	['conv2d_54[0][0]']
activation_54 (Activation)	(None, 12, 12, 160)	0	['batch_normalizatio n_54[0][0] ']
conv2d_55 (Conv2D)	(None, 12, 12, 160)	179200	['activation_54[0] [0]']
batch_normalization_55 (Ba tchNormalization)	(None, 12, 12, 160)	480	['conv2d_55[0][0]']
activation_55 (Activation)	(None, 12, 12, 160)	0	['batch_normalizatio n_55[0][0] ']
conv2d_51 (Conv2D)	(None, 12, 12, 160)	122880	['mixed5[0][0]']
conv2d_56 (Conv2D)	(None, 12, 12, 160)	179200	['activation_55[0] [0]']
batch_normalization_51 (Ba tchNormalization)	(None, 12, 12, 160)	480	['conv2d_51[0][0]']
batch_normalization_56 (Ba tchNormalization)	(None, 12, 12, 160)	480	['conv2d_56[0][0]']
activation_51 (Activation)	(None, 12, 12, 160)	0	['batch_normalizatio n_51[0][0] ']

activation_56 (Activation)	(None, 12, 12, 160)	0	['batch_normalizatio n_56[0][0] ']
conv2d_52 (Conv2D)	(None, 12, 12, 160)	179200	['activation_51[0] [0]']
conv2d_57 (Conv2D)	(None, 12, 12, 160)	179200	['activation_56[0] [0]']
batch_normalization_52 (Ba tchNormalization)	(None, 12, 12, 160)	480	['conv2d_52[0][0]']
batch_normalization_57 (Ba tchNormalization)	(None, 12, 12, 160)	480	['conv2d_57[0][0]']
activation_52 (Activation)	(None, 12, 12, 160)	0	['batch_normalizatio n_52[0][0] ']
activation_57 (Activation)	(None, 12, 12, 160)	0	['batch_normalizatio n_57[0][0] ']
average_pooling2d_5 (Avera gePooling2D)	(None, 12, 12, 768)	0	['mixed5[0][0]']
conv2d_50 (Conv2D)	(None, 12, 12, 192)	147456	['mixed5[0][0]']
conv2d_53 (Conv2D)	(None, 12, 12, 192)	215040	['activation_52[0] [0]']
conv2d_58 (Conv2D)	(None, 12, 12, 192)	215040	['activation_57[0] [0]']
conv2d_59 (Conv2D)	(None, 12, 12, 192)	147456	['average_pooling2d_ 5[0][0]']
batch_normalization_50 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_50[0][0]']

Layer (type)	Output Shape	Param #	Connected to
batch_normalization_53 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_53[0][0]']
batch_normalization_58 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_58[0][0]']
batch_normalization_59 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_59[0][0]']
activation_50 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_50[0][0] ']
activation_53 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_53[0][0] ']
activation_58 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_58[0][0] ']
activation_59 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_59[0][0] ']
mixed6 (Concatenate)	(None, 12, 12, 768)	0	['activation_50[0] [0]', 'activation_53[0] [0]', 'activation_58[0] [0]', 'activation_59[0] [0]']
conv2d_64 (Conv2D)	(None, 12, 12, 192)	147456	['mixed6[0][0]']
batch_normalization_64 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_64[0][0]']
activation_64 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio

```
                                                        ']

 conv2d_65 (Conv2D)          (None, 12, 12, 192)    258048    ['activation_64[0]
[0]']

 batch_normalization_65 (Ba  (None, 12, 12, 192)    576       ['conv2d_65[0][0]']

 tchNormalization)

 activation_65 (Activation)  (None, 12, 12, 192)    0         ['batch_normalizatio
n_65[0][0]

                                                        ']

 conv2d_61 (Conv2D)          (None, 12, 12, 192)    147456    ['mixed6[0][0]']

 conv2d_66 (Conv2D)          (None, 12, 12, 192)    258048    ['activation_65[0]
[0]']

 batch_normalization_61 (Ba  (None, 12, 12, 192)    576       ['conv2d_61[0][0]']

 tchNormalization)

 batch_normalization_66 (Ba  (None, 12, 12, 192)    576       ['conv2d_66[0][0]']

 tchNormalization)

 activation_61 (Activation)  (None, 12, 12, 192)    0         ['batch_normalizatio
n_61[0][0]

                                                        ']

 activation_66 (Activation)  (None, 12, 12, 192)    0         ['batch_normalizatio
n_66[0][0]

                                                        ']

 conv2d_62 (Conv2D)          (None, 12, 12, 192)    258048    ['activation_61[0]
[0]']

 conv2d_67 (Conv2D)          (None, 12, 12, 192)    258048    ['activation_66[0]
[0]']

 batch_normalization_62 (Ba  (None, 12, 12, 192)    576       ['conv2d_62[0][0]']

 tchNormalization)
```

batch_normalization_67 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_67[0][0]']
activation_62 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_62[0][0] ']
activation_67 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_67[0][0] ']
average_pooling2d_6 (Avera gePooling2D)	(None, 12, 12, 768)	0	['mixed6[0][0]']
conv2d_60 (Conv2D)	(None, 12, 12, 192)	147456	['mixed6[0][0]']
conv2d_63 (Conv2D)	(None, 12, 12, 192)	258048	['activation_62[0] [0]']
conv2d_68 (Conv2D)	(None, 12, 12, 192)	258048	['activation_67[0] [0]']
conv2d_69 (Conv2D)	(None, 12, 12, 192)	147456	['average_pooling2d_ 6[0][0]']
batch_normalization_60 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_60[0][0]']
batch_normalization_63 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_63[0][0]']
batch_normalization_68 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_68[0][0]']
batch_normalization_69 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_69[0][0]']
activation_60 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio

```
 activation_63 (Activation)    (None, 12, 12, 192)         0          ['batch_normalizatio
n_63[0][0]
                                                                       ']


 activation_68 (Activation)    (None, 12, 12, 192)         0          ['batch_normalizatio
n_68[0][0]
                                                                       ']


 activation_69 (Activation)    (None, 12, 12, 192)         0          ['batch_normalizatio
n_69[0][0]
                                                                       ']


 mixed7 (Concatenate)          (None, 12, 12, 768)         0          ['activation_60[0]
[0]',
                                                                        'activation_63[0]
[0]',
                                                                        'activation_68[0]
[0]',
                                                                        'activation_69[0]
[0]']

 conv2d_72 (Conv2D)            (None, 12, 12, 192)         147456     ['mixed7[0][0]']


 batch_normalization_72 (Ba    (None, 12, 12, 192)         576        ['conv2d_72[0][0]']

 tchNormalization)


 activation_72 (Activation)    (None, 12, 12, 192)         0          ['batch_normalizatio
n_72[0][0]
                                                                       ']


 conv2d_73 (Conv2D)            (None, 12, 12, 192)         258048     ['activation_72[0]
[0]']

 batch_normalization_73 (Ba    (None, 12, 12, 192)         576        ['conv2d_73[0][0]']

 tchNormalization)


 activation_73 (Activation)    (None, 12, 12, 192)         0          ['batch_normalizatio
n_73[0][0]
                                                                       ']


 conv2d_70 (Conv2D)            (None, 12, 12, 192)         147456     ['mixed7[0][0]']
```

conv2d_74 (Conv2D)	(None, 12, 12, 192)	258048	['activation_73[0][0]']
batch_normalization_70 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_70[0][0]']
batch_normalization_74 (Ba tchNormalization)	(None, 12, 12, 192)	576	['conv2d_74[0][0]']
activation_70 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_70[0][0]']
activation_74 (Activation)	(None, 12, 12, 192)	0	['batch_normalizatio n_74[0][0]']
conv2d_71 (Conv2D)	(None, 5, 5, 320)	552960	['activation_70[0][0]']
conv2d_75 (Conv2D)	(None, 5, 5, 192)	331776	['activation_74[0][0]']
batch_normalization_71 (Ba tchNormalization)	(None, 5, 5, 320)	960	['conv2d_71[0][0]']
batch_normalization_75 (Ba tchNormalization)	(None, 5, 5, 192)	576	['conv2d_75[0][0]']
activation_71 (Activation)	(None, 5, 5, 320)	0	['batch_normalizatio n_71[0][0]']
activation_75 (Activation)	(None, 5, 5, 192)	0	['batch_normalizatio n_75[0][0]']
max_pooling2d_3 (MaxPoolin g2D)	(None, 5, 5, 768)	0	['mixed7[0][0]']

mixed8 (Concatenate)	(None, 5, 5, 1280)	0	['activation_71[0][0]',
			'activation_75[0][0]',
			'max_pooling2d_3[0][0]']
conv2d_80 (Conv2D)	(None, 5, 5, 448)	573440	['mixed8[0][0]']
batch_normalization_80 (Ba tchNormalization)	(None, 5, 5, 448)	1344	['conv2d_80[0][0]']
activation_80 (Activation)	(None, 5, 5, 448)	0	['batch_normalizatio n_80[0][0]']
conv2d_77 (Conv2D)	(None, 5, 5, 384)	491520	['mixed8[0][0]']
conv2d_81 (Conv2D)	(None, 5, 5, 384)	1548288	['activation_80[0][0]']
batch_normalization_77 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_77[0][0]']
batch_normalization_81 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_81[0][0]']
activation_77 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_77[0][0]']
activation_81 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_81[0][0]']
conv2d_78 (Conv2D)	(None, 5, 5, 384)	442368	['activation_77[0][0]']
conv2d_79 (Conv2D)	(None, 5, 5, 384)	442368	['activation_77[0][0]']

Layer	Output Shape	Param #	Connected to
conv2d_82 (Conv2D)	(None, 5, 5, 384)	442368	['activation_81[0][0]']
conv2d_83 (Conv2D)	(None, 5, 5, 384)	442368	['activation_81[0][0]']
average_pooling2d_7 (Avera gePooling2D)	(None, 5, 5, 1280)	0	['mixed8[0][0]']
conv2d_76 (Conv2D)	(None, 5, 5, 320)	409600	['mixed8[0][0]']
batch_normalization_78 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_78[0][0]']
batch_normalization_79 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_79[0][0]']
batch_normalization_82 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_82[0][0]']
batch_normalization_83 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_83[0][0]']
conv2d_84 (Conv2D)	(None, 5, 5, 192)	245760	['average_pooling2d_ 7[0][0]']
batch_normalization_76 (Ba tchNormalization)	(None, 5, 5, 320)	960	['conv2d_76[0][0]']
activation_78 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_78[0][0] ']
activation_79 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_79[0][0] ']
activation_82 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio

			n_82[0][0] ']
activation_83 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_83[0][0] ']
batch_normalization_84 (Ba tchNormalization)	(None, 5, 5, 192)	576	['conv2d_84[0][0]']
activation_76 (Activation)	(None, 5, 5, 320)	0	['batch_normalizatio n_76[0][0] ']
mixed9_0 (Concatenate)	(None, 5, 5, 768)	0	['activation_78[0] [0]', 'activation_79[0] [0]']
concatenate (Concatenate)	(None, 5, 5, 768)	0	['activation_82[0] [0]', 'activation_83[0] [0]']
activation_84 (Activation)	(None, 5, 5, 192)	0	['batch_normalizatio n_84[0][0] ']
mixed9 (Concatenate)	(None, 5, 5, 2048)	0	['activation_76[0] [0]', 'mixed9_0[0][0]', 'concatenate[0] [0]', 'activation_84[0] [0]']
conv2d_89 (Conv2D)	(None, 5, 5, 448)	917504	['mixed9[0][0]']
batch_normalization_89 (Ba tchNormalization)	(None, 5, 5, 448)	1344	['conv2d_89[0][0]']
activation_89 (Activation)	(None, 5, 5, 448)	0	['batch_normalizatio n_89[0][0] ']

conv2d_86 (Conv2D)	(None, 5, 5, 384)	786432	['mixed9[0][0]']
conv2d_90 (Conv2D)	(None, 5, 5, 384)	1548288	['activation_89[0][0]']
batch_normalization_86 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_86[0][0]']
batch_normalization_90 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_90[0][0]']
activation_86 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_86[0][0]']
activation_90 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_90[0][0]']
conv2d_87 (Conv2D)	(None, 5, 5, 384)	442368	['activation_86[0][0]']
conv2d_88 (Conv2D)	(None, 5, 5, 384)	442368	['activation_86[0][0]']
conv2d_91 (Conv2D)	(None, 5, 5, 384)	442368	['activation_90[0][0]']
conv2d_92 (Conv2D)	(None, 5, 5, 384)	442368	['activation_90[0][0]']
average_pooling2d_8 (Avera gePooling2D)	(None, 5, 5, 2048)	0	['mixed9[0][0]']
conv2d_85 (Conv2D)	(None, 5, 5, 320)	655360	['mixed9[0][0]']
batch_normalization_87 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_87[0][0]']
batch_normalization_88 (Ba	(None, 5, 5, 384)	1152	['conv2d_88[0][0]']

tchNormalization)

batch_normalization_91 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_91[0][0]']
batch_normalization_92 (Ba tchNormalization)	(None, 5, 5, 384)	1152	['conv2d_92[0][0]']
conv2d_93 (Conv2D)	(None, 5, 5, 192)	393216	['average_pooling2d_ 8[0][0]']
batch_normalization_85 (Ba tchNormalization)	(None, 5, 5, 320)	960	['conv2d_85[0][0]']
activation_87 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_87[0][0] ']
activation_88 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_88[0][0] ']
activation_91 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_91[0][0] ']
activation_92 (Activation)	(None, 5, 5, 384)	0	['batch_normalizatio n_92[0][0] ']
batch_normalization_93 (Ba tchNormalization)	(None, 5, 5, 192)	576	['conv2d_93[0][0]']
activation_85 (Activation)	(None, 5, 5, 320)	0	['batch_normalizatio n_85[0][0] ']
mixed9_1 (Concatenate)	(None, 5, 5, 768)	0	['activation_87[0] [0]', 'activation_88[0]

```
[0]']
```

concatenate_1 (Concatenate) [0]'	(None, 5, 5, 768)	0	['activation_91[0] [0]', 'activation_92[0] [0]']
activation_93 (Activation)	(None, 5, 5, 192)	0	['batch_normalizatio n_93[0][0] ']
mixed10 (Concatenate) [0]',	(None, 5, 5, 2048)	0	['activation_85[0] 'mixed9_1[0][0]', 'concatenate_1[0] [0]', 'activation_93[0] [0]']
flatten_2 (Flatten)	(None, 51200)	0	['mixed10[0][0]']
dense (Dense)	(None, 4)	204804	['flatten_2[0][0]']

```
==============================================================================
==========
Total params: 22007588 (83.95 MB)
Trainable params: 204804 (800.02 KB)
Non-trainable params: 21802784 (83.17 MB)
_____
_____
```

In [17]:
```python
model.compile(
    loss='categorical_crossentropy',
    optimizer='adam',
    metrics=['accuracy']
)
```

In [18]:
```python
from tensorflow.keras.preprocessing.image import ImageDataGenerator

train_datagen = ImageDataGenerator(rescale = 1./255,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
                                   horizontal_flip = True)

test_datagen = ImageDataGenerator(rescale = 1./255)
```

In [20]:
```python
training_set = train_datagen.flow_from_directory('/content/drive/MyDrive/Datasets/train'
                                                 target_size = (224, 224),
                                                 batch_size = 32,
                                                 class_mode = 'categorical')
```

```
Found 1951 images belonging to 4 classes.
```

In [21]:
```python
test_set = test_datagen.flow_from_directory('/content/drive/MyDrive/Datasets/test',
                                            target_size = (224, 224),
```

```
                                                  batch_size = 32,
                                                  class_mode = 'categorical')
```

Found 18 images belonging to 4 classes.

In [22]:
```
r = model.fit_generator(
    training_set,
    validation_data=test_set,
    epochs=20,
    steps_per_epoch=len(training_set),
    validation_steps=len(test_set)
)
```

<ipython-input-22-dcaa1ca38143>:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit`, which supports generators.
  r = model.fit_generator(
Epoch 1/20
61/61 [==============================] - 508s 8s/step - loss: 1.7962 - accuracy: 0.7622 - val_loss: 0.8185 - val_accuracy: 0.8333
Epoch 2/20
61/61 [==============================] - 277s 5s/step - loss: 0.9023 - accuracy: 0.8596 - val_loss: 0.1151 - val_accuracy: 0.9444
Epoch 3/20
61/61 [==============================] - 276s 4s/step - loss: 0.6724 - accuracy: 0.8995 - val_loss: 0.3746 - val_accuracy: 0.8889
Epoch 4/20
61/61 [==============================] - 272s 4s/step - loss: 0.6372 - accuracy: 0.9036 - val_loss: 2.0711 - val_accuracy: 0.7778
Epoch 5/20
61/61 [==============================] - 274s 4s/step - loss: 0.4227 - accuracy: 0.9339 - val_loss: 0.0034 - val_accuracy: 1.0000
Epoch 6/20
61/61 [==============================] - 274s 4s/step - loss: 0.4071 - accuracy: 0.9364 - val_loss: 1.3184 - val_accuracy: 0.8333
Epoch 7/20
61/61 [==============================] - 272s 4s/step - loss: 0.4949 - accuracy: 0.9298 - val_loss: 0.1013 - val_accuracy: 0.9444
Epoch 8/20
61/61 [==============================] - 275s 4s/step - loss: 0.4864 - accuracy: 0.9344 - val_loss: 0.0048 - val_accuracy: 1.0000
Epoch 9/20
61/61 [==============================] - 277s 5s/step - loss: 0.2723 - accuracy: 0.9564 - val_loss: 0.2429 - val_accuracy: 0.9444
Epoch 10/20
61/61 [==============================] - 271s 4s/step - loss: 0.3815 - accuracy: 0.9457 - val_loss: 0.2780 - val_accuracy: 0.9444
Epoch 11/20
61/61 [==============================] - 274s 4s/step - loss: 0.4017 - accuracy: 0.9503 - val_loss: 0.0215 - val_accuracy: 1.0000
Epoch 12/20
61/61 [==============================] - 271s 4s/step - loss: 0.3135 - accuracy: 0.9569 - val_loss: 0.0021 - val_accuracy: 1.0000
Epoch 13/20
61/61 [==============================] - 276s 5s/step - loss: 0.4093 - accuracy: 0.9467 - val_loss: 5.6761e-04 - val_accuracy: 1.0000
Epoch 14/20
61/61 [==============================] - 271s 4s/step - loss: 0.5500 - accuracy: 0.9354 - val_loss: 0.0046 - val_accuracy: 1.0000
Epoch 15/20
61/61 [==============================] - 277s 5s/step - loss: 0.7507 - accuracy: 0.9267 - val_loss: 0.4010 - val_accuracy: 0.9444
Epoch 16/20
61/61 [==============================] - 276s 5s/step - loss: 0.4919 - accuracy: 0.9508 - val_loss: 2.2025e-05 - val_accuracy: 1.0000
Epoch 17/20
61/61 [==============================] - 277s 5s/step - loss: 0.3064 - accuracy: 0.9585
```

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                  - val_loss: 0.1559 - val_accuracy: 0.9444
         Epoch 18/20
         61/61 [==============================] - 270s 4s/step - loss: 0.2200 - accuracy: 0.9698
         - val_loss: 3.6814e-04 - val_accuracy: 1.0000
         Epoch 19/20
         61/61 [==============================] - 273s 4s/step - loss: 0.3123 - accuracy: 0.9687
         - val_loss: 2.0091e-04 - val_accuracy: 1.0000
         Epoch 20/20
         61/61 [==============================] - 272s 4s/step - loss: 0.2526 - accuracy: 0.9651
         - val_loss: 0.0098 - val_accuracy: 1.0000
```

In [ ]: