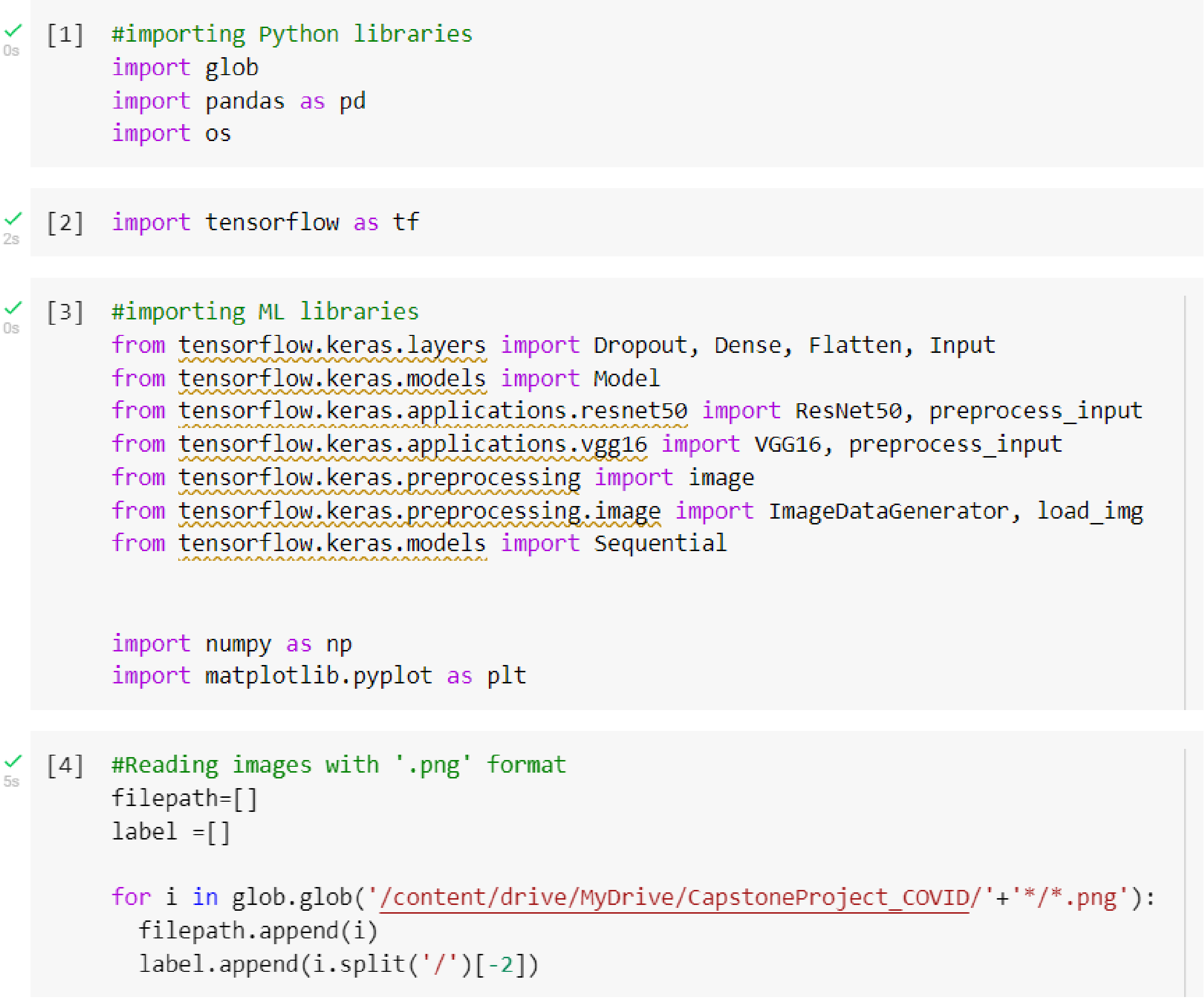
CapstoneProject_COVID

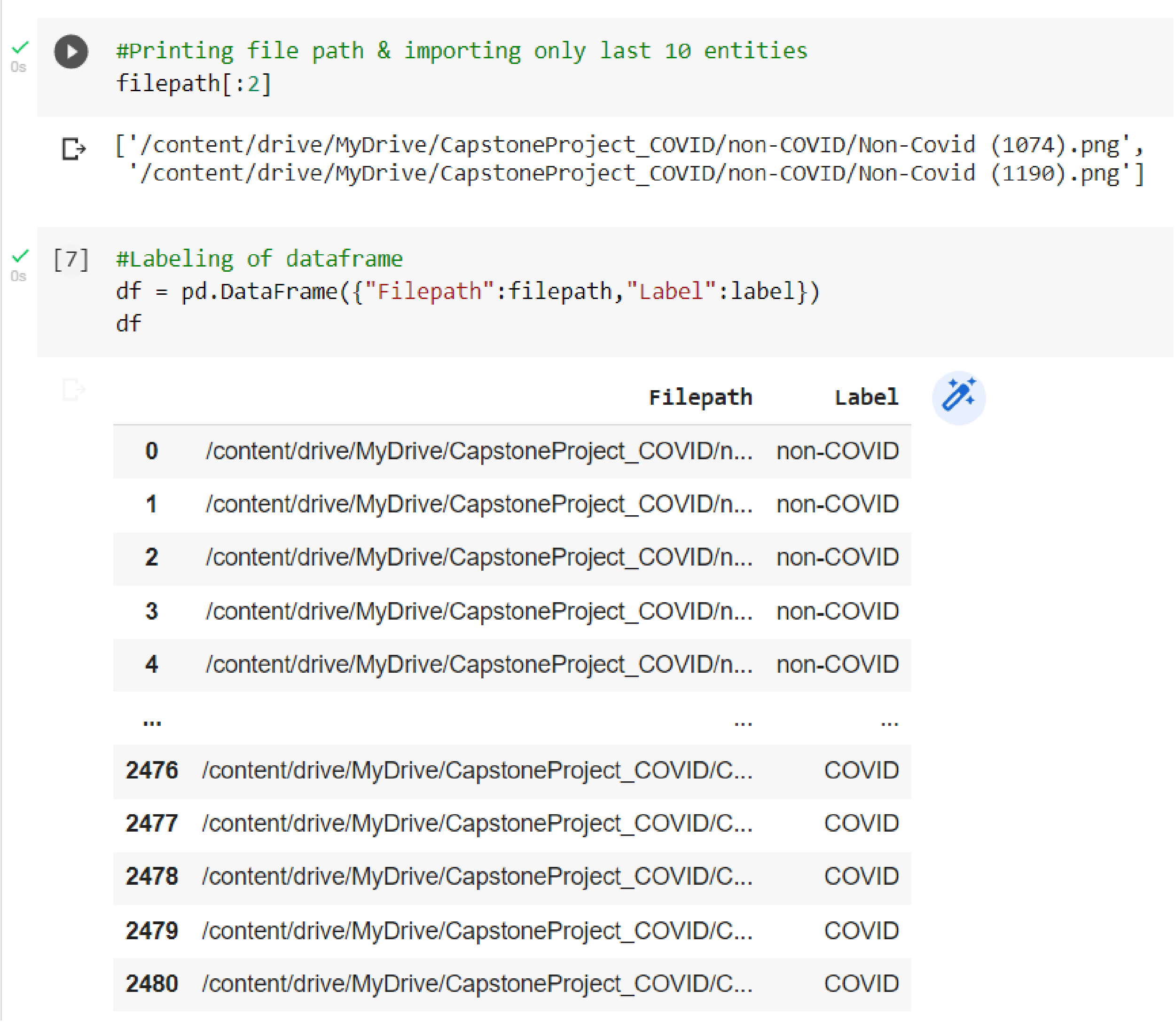


```
[1]  #importing Python libraries
     import glob
     import pandas as pd
     import os
```

```
[2]  import tensorflow as tf
```

```
[3]  #importing ML libraries
     from tensorflow.keras.layers import Dropout, Dense, Flatten, Input
     from tensorflow.keras.models import Model
     from tensorflow.keras.applications.resnet50 import ResNet50, preprocess_input
     from tensorflow.keras.applications.vgg16 import VGG16, 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
     import matplotlib.pyplot as plt
```

```
[4]  #Reading images with '.png' format
     filepath=[]
     label =[]

     for i in glob.glob('/content/drive/MyDrive/CapstoneProject_COVID/'+'*/*.png'):
       filepath.append(i)
       label.append(i.split('/')[-2])
```

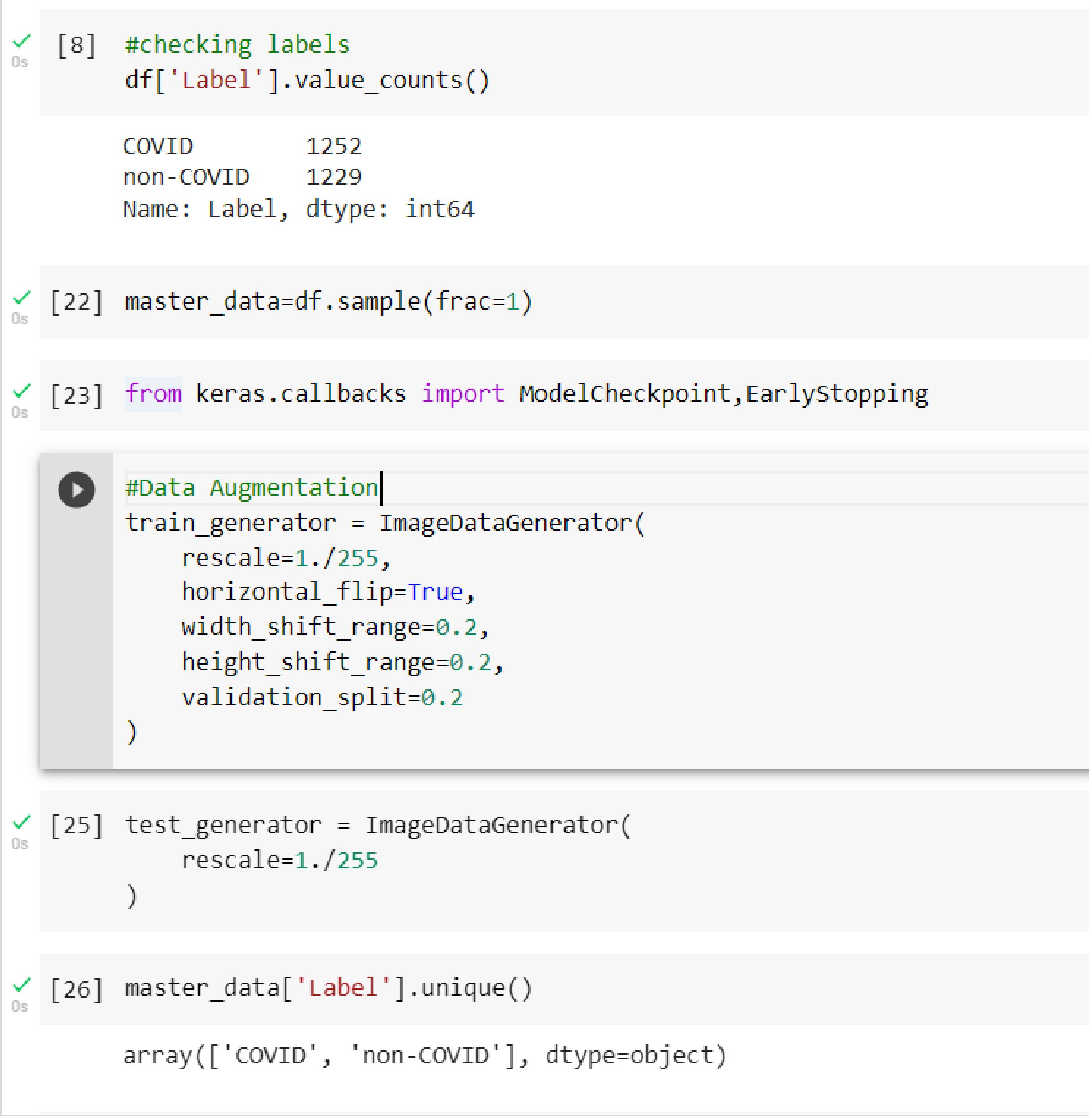


```
#Printing file path & importing only last 10 entities
filepath[:2]
```

```
['/content/drive/MyDrive/CapstoneProject_COVID/non-COVID/Non-Covid (1074).png',
 '/content/drive/MyDrive/CapstoneProject_COVID/non-COVID/Non-Covid (1190).png']
```

```
#Labeling of dataframe
df = pd.DataFrame({"Filepath":filepath,"Label":label})
df
```

	Filepath	Label
0	/content/drive/MyDrive/CapstoneProject_COVID/n...	non-COVID
1	/content/drive/MyDrive/CapstoneProject_COVID/n...	non-COVID
2	/content/drive/MyDrive/CapstoneProject_COVID/n...	non-COVID
3	/content/drive/MyDrive/CapstoneProject_COVID/n...	non-COVID
4	/content/drive/MyDrive/CapstoneProject_COVID/n...	non-COVID
...	...	...
2476	/content/drive/MyDrive/CapstoneProject_COVID/C...	COVID
2477	/content/drive/MyDrive/CapstoneProject_COVID/C...	COVID
2478	/content/drive/MyDrive/CapstoneProject_COVID/C...	COVID
2479	/content/drive/MyDrive/CapstoneProject_COVID/C...	COVID
2480	/content/drive/MyDrive/CapstoneProject_COVID/C...	COVID



✓ 0s [8]

```
#checking labels
df['Label'].value_counts()
```

```
COVID        1252
non-COVID    1229
Name: Label, dtype: int64
```

✓ 0s [22]

```
master_data=df.sample(frac=1)
```

✓ 0s [23]

```
from keras.callbacks import ModelCheckpoint,EarlyStopping
```

```
#Data Augmentation
train_generator = ImageDataGenerator(
    rescale=1./255,
    horizontal_flip=True,
    width_shift_range=0.2,
    height_shift_range=0.2,
    validation_split=0.2
)
```

✓ 0s [25]

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

✓ 0s [26]

```
master_data['Label'].unique()
```

```
array(['COVID', 'non-COVID'], dtype=object)
```

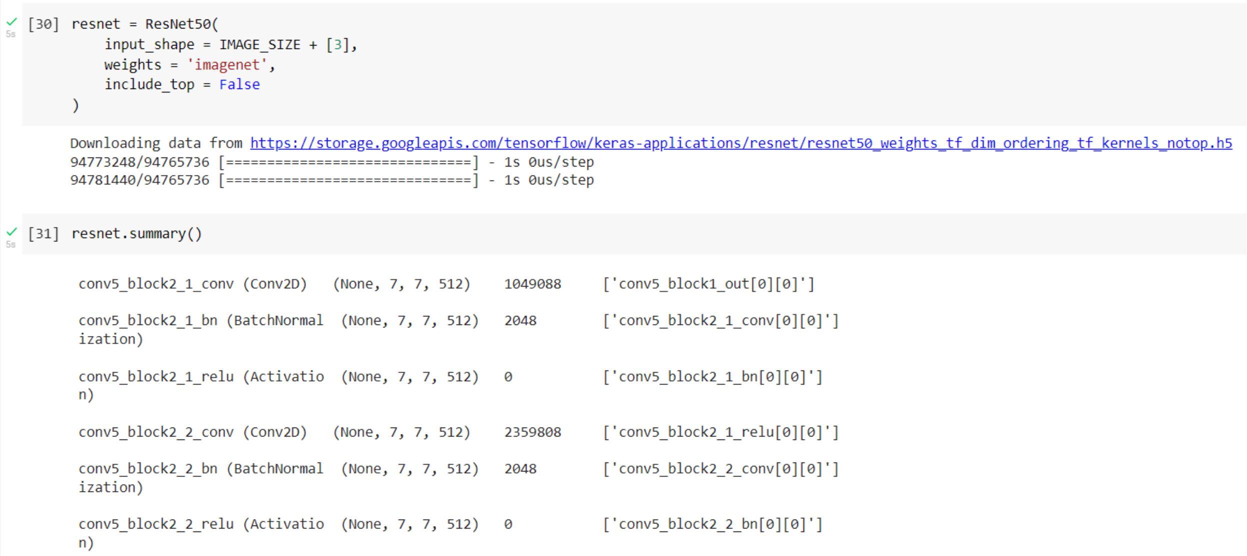
```
✓  [27] train_images = train_generator.flow_from_dataframe(
0s          dataframe=master_data,
            x_col='Filepath',
            y_col='Label',
            target_size=(224, 224),
            color_mode='rgb',
            class_mode='raw',
            batch_size=4,
            shuffle=True,
            subset='training'
        )
```

```
Found 1985 validated image filenames.
```

```
✓  [28] val_images = train_generator.flow_from_dataframe(
0s          dataframe=master_data,
            x_col='Filepath',
            y_col='Label',
            target_size=(224, 224),
            color_mode='rgb',
            class_mode='raw',
            batch_size=4,
            shuffle=True,
            subset='validation'
        )
```

```
Found 496 validated image filenames.
```

```
✓  [29] # Seting a size variable
0s      IMAGE_SIZE = [224, 224]
```

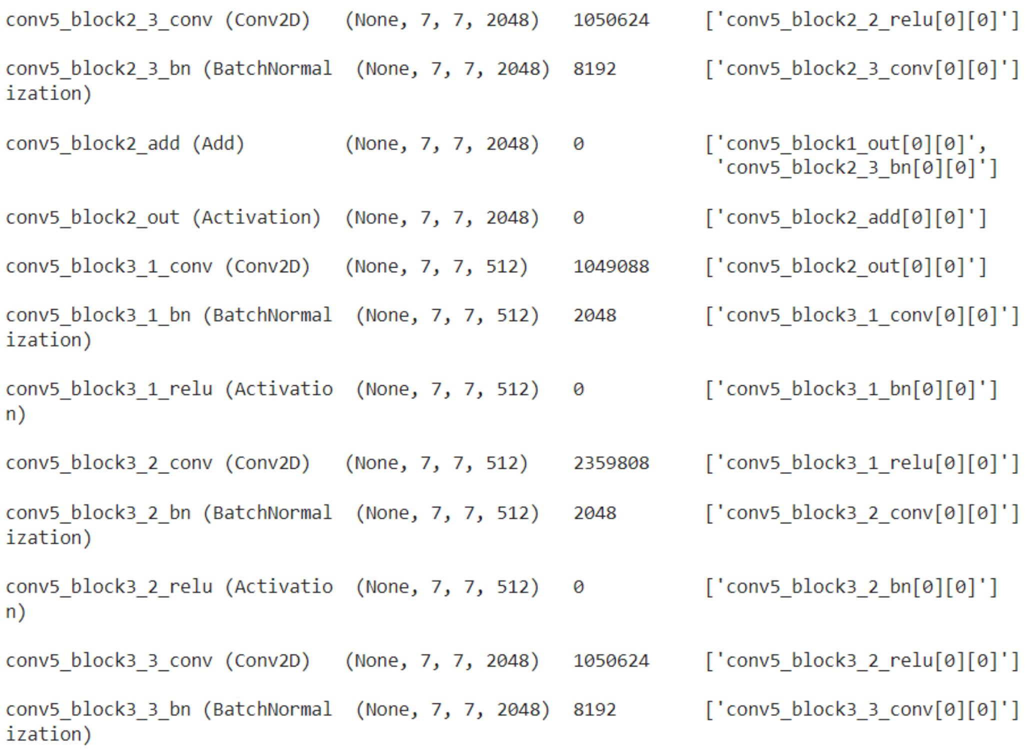


```
[30] resnet = ResNet50(
         input_shape = IMAGE_SIZE + [3],
         weights = 'imagenet',
         include_top = False
     )
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/resnet/resnet50_weights_tf_dim_ordering_tf_kernels_notop.h5
94773248/94765736 [==============================] - 1s 0us/step
94781440/94765736 [==============================] - 1s 0us/step
```

```
[31] resnet.summary()
```

```
 conv5_block2_1_conv (Conv2D)   (None, 7, 7, 512)    1049088     ['conv5_block1_out[0][0]']

 conv5_block2_1_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block2_1_conv[0][0]']
 ization)

 conv5_block2_1_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block2_1_bn[0][0]']
 n)

 conv5_block2_2_conv (Conv2D)   (None, 7, 7, 512)    2359808     ['conv5_block2_1_relu[0][0]']

 conv5_block2_2_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block2_2_conv[0][0]']
 ization)

 conv5_block2_2_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block2_2_bn[0][0]']
 n)
```



```
 conv5_block2_3_conv (Conv2D)   (None, 7, 7, 2048)   1050624     ['conv5_block2_2_relu[0][0]']

 conv5_block2_3_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block2_3_conv[0][0]']
 ization)

 conv5_block2_add (Add)         (None, 7, 7, 2048)   0           ['conv5_block1_out[0][0]',
                                                                  'conv5_block2_3_bn[0][0]']

 conv5_block2_out (Activation)  (None, 7, 7, 2048)   0           ['conv5_block2_add[0][0]']

 conv5_block3_1_conv (Conv2D)   (None, 7, 7, 512)    1049088     ['conv5_block2_out[0][0]']

 conv5_block3_1_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block3_1_conv[0][0]']
 ization)

 conv5_block3_1_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block3_1_bn[0][0]']
 n)

 conv5_block3_2_conv (Conv2D)   (None, 7, 7, 512)    2359808     ['conv5_block3_1_relu[0][0]']

 conv5_block3_2_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block3_2_conv[0][0]']
 ization)

 conv5_block3_2_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block3_2_bn[0][0]']
 n)

 conv5_block3_3_conv (Conv2D)   (None, 7, 7, 2048)   1050624     ['conv5_block3_2_relu[0][0]']

 conv5_block3_3_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block3_3_conv[0][0]']
 ization)
 conv5_block3_add (Add)         (None, 7, 7, 2048)   0           ['conv5_block2_out[0][0]',
                                                                  'conv5_block3_3_bn[0][0]']

 conv5_block3_out (Activation)  (None, 7, 7, 2048)   0           ['conv5_block3_add[0][0]']

==================================================================================================
Total params: 23,587,712
Trainable params: 23,534,592
Non-trainable params: 53,120
__________________________________________________________________________________________________
```

[32]

```python
for layer in resnet.layers:
    layer.trainable = True
```

[34]

```python
from glob import glob
```

[35]

```python
file = glob("/content/drive/MyDrive/CapstoneProject_COVID" + '/*')
file
```

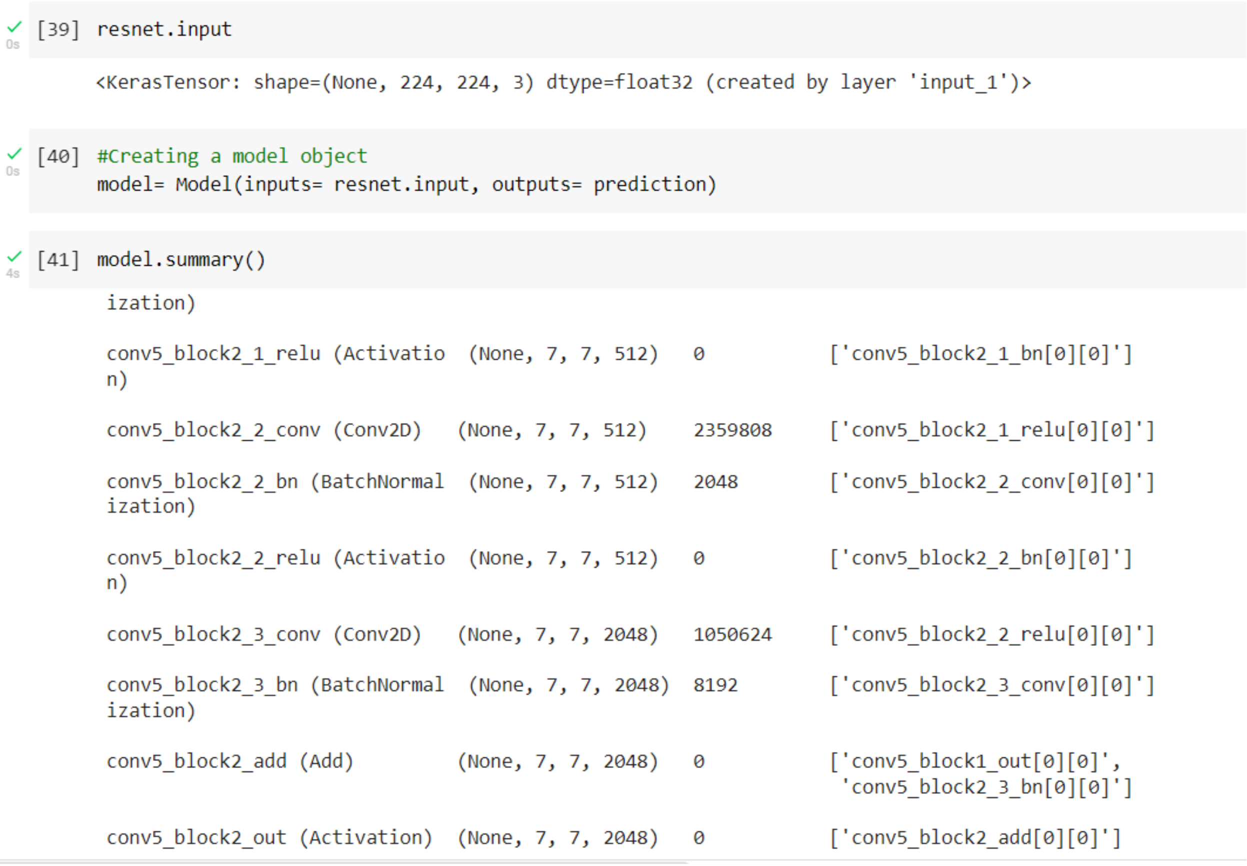
```
['/content/drive/MyDrive/CapstoneProject_COVID/non-COVID',
 '/content/drive/MyDrive/CapstoneProject_COVID/COVID']
```

[36]

```python
capstone_project_label = ['COVID', 'non-COVID']
x = Flatten()(resnet.output)
```

[37]

```python
prediction= Dense(len(file), activation = 'softmax')(x)
```



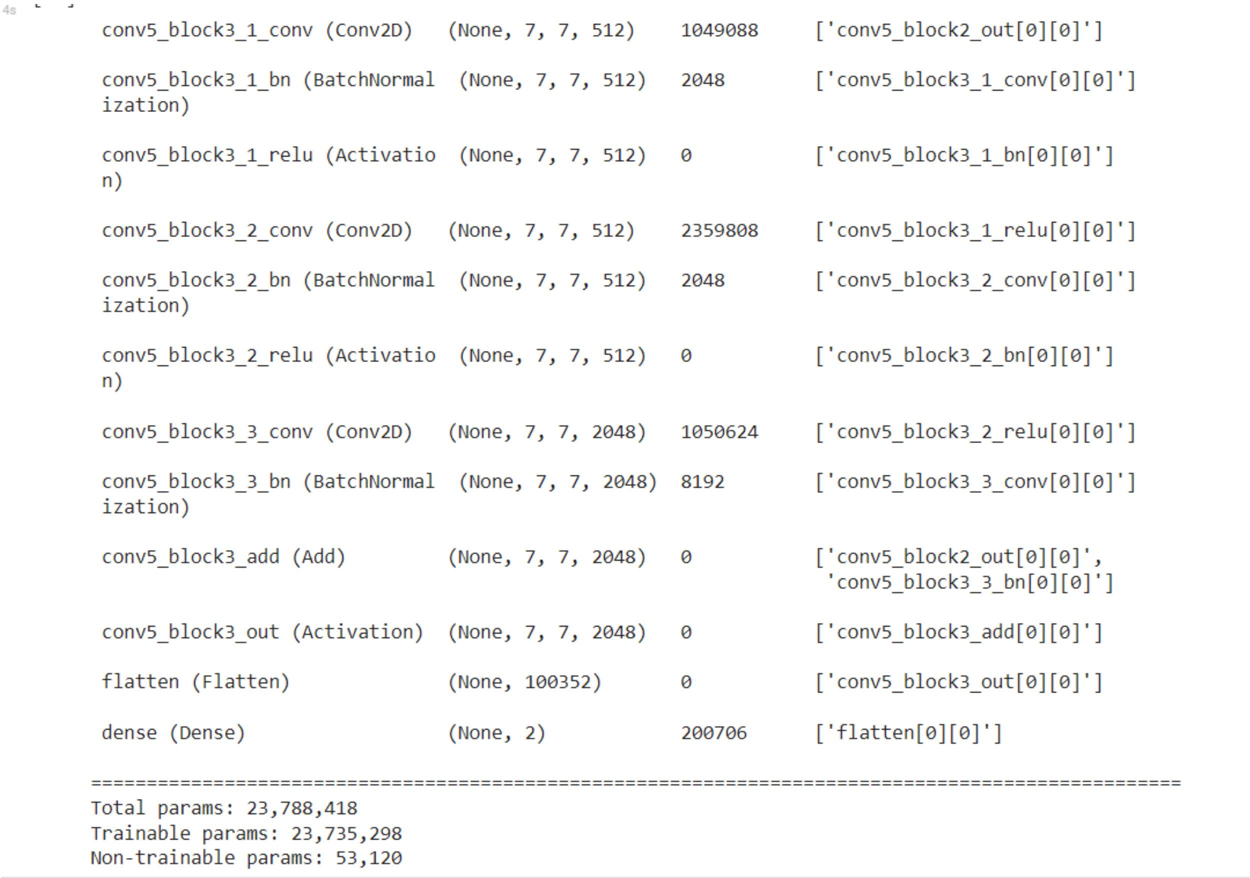
```
[39] resnet.input
```

```
<KerasTensor: shape=(None, 224, 224, 3) dtype=float32 (created by layer 'input_1')>
```

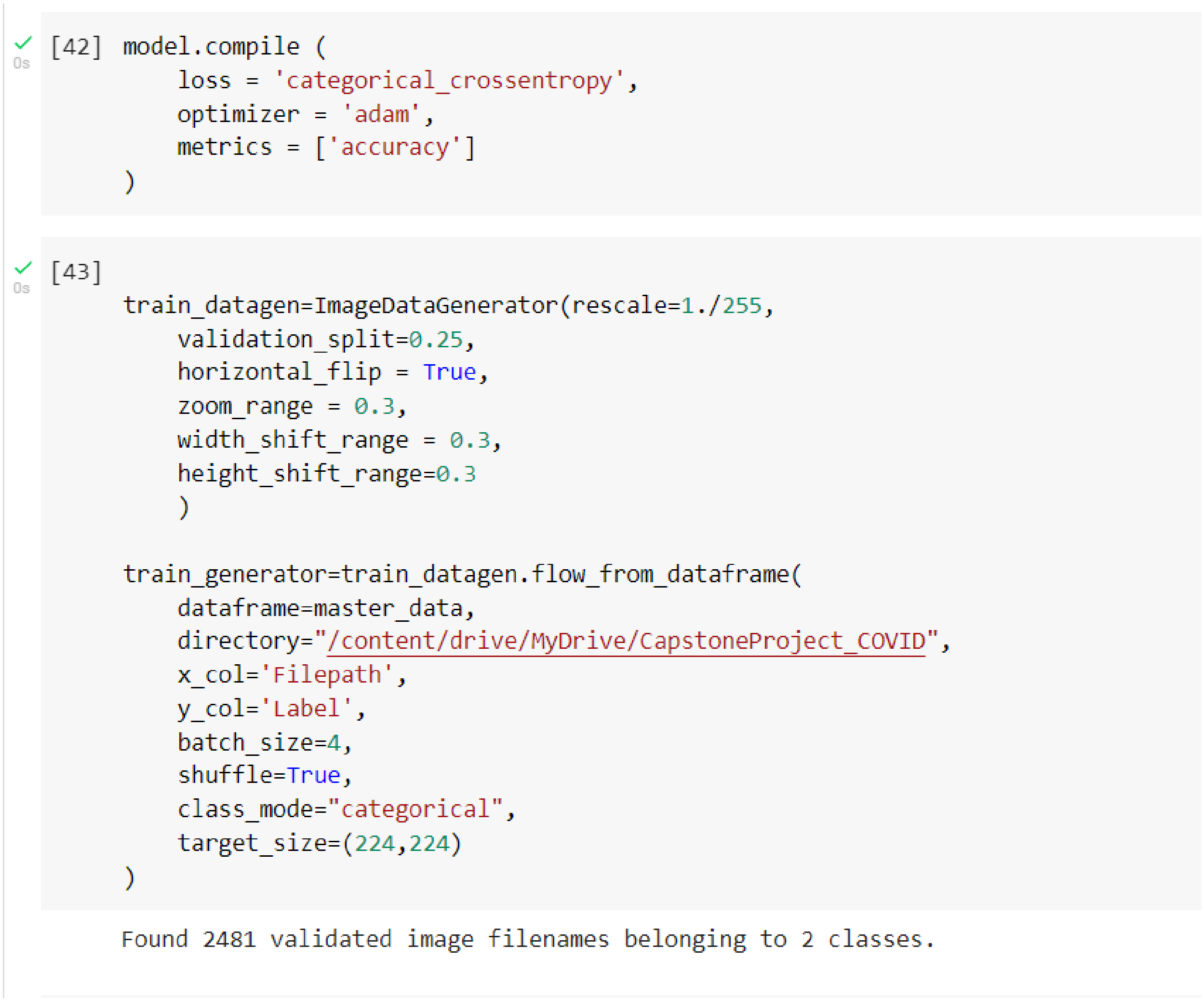
```
[40] #Creating a model object
     model= Model(inputs= resnet.input, outputs= prediction)
```

```
[41] model.summary()
```

```
 ization)

 conv5_block2_1_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block2_1_bn[0][0]']
 n)

 conv5_block2_2_conv (Conv2D)   (None, 7, 7, 512)    2359808     ['conv5_block2_1_relu[0][0]']

 conv5_block2_2_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block2_2_conv[0][0]']
 ization)

 conv5_block2_2_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block2_2_bn[0][0]']
 n)

 conv5_block2_3_conv (Conv2D)   (None, 7, 7, 2048)   1050624     ['conv5_block2_2_relu[0][0]']

 conv5_block2_3_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block2_3_conv[0][0]']
 ization)

 conv5_block2_add (Add)         (None, 7, 7, 2048)   0           ['conv5_block1_out[0][0]',
                                                                  'conv5_block2_3_bn[0][0]']

 conv5_block2_out (Activation)  (None, 7, 7, 2048)   0           ['conv5_block2_add[0][0]']
```



```
 conv5_block3_1_conv (Conv2D)   (None, 7, 7, 512)    1049088     ['conv5_block2_out[0][0]']

 conv5_block3_1_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block3_1_conv[0][0]']
 ization)

 conv5_block3_1_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block3_1_bn[0][0]']
 n)

 conv5_block3_2_conv (Conv2D)   (None, 7, 7, 512)    2359808     ['conv5_block3_1_relu[0][0]']

 conv5_block3_2_bn (BatchNormal  (None, 7, 7, 512)   2048        ['conv5_block3_2_conv[0][0]']
 ization)

 conv5_block3_2_relu (Activatio  (None, 7, 7, 512)   0           ['conv5_block3_2_bn[0][0]']
 n)

 conv5_block3_3_conv (Conv2D)   (None, 7, 7, 2048)   1050624     ['conv5_block3_2_relu[0][0]']

 conv5_block3_3_bn (BatchNormal  (None, 7, 7, 2048)  8192        ['conv5_block3_3_conv[0][0]']
 ization)

 conv5_block3_add (Add)         (None, 7, 7, 2048)   0           ['conv5_block2_out[0][0]',
                                                                  'conv5_block3_3_bn[0][0]']

 conv5_block3_out (Activation)  (None, 7, 7, 2048)   0           ['conv5_block3_add[0][0]']

 flatten (Flatten)              (None, 100352)       0           ['conv5_block3_out[0][0]']

 dense (Dense)                  (None, 2)            200706      ['flatten[0][0]']

==================================================================================================
Total params: 23,788,418
Trainable params: 23,735,298
Non-trainable params: 53,120
```



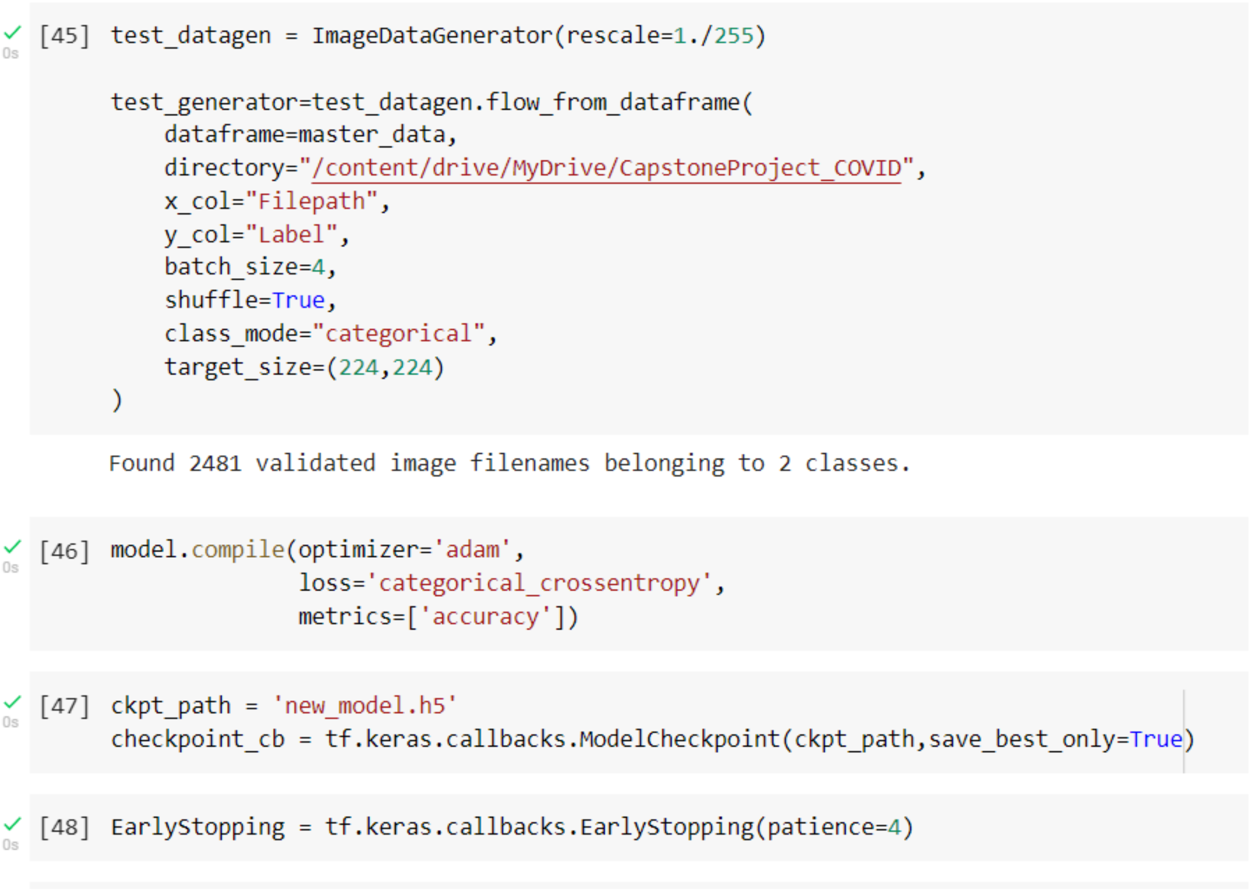
[42]

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

[43]

```

train_datagen=ImageDataGenerator(rescale=1./255,
    validation_split=0.25,
    horizontal_flip = True,
    zoom_range = 0.3,
    width_shift_range = 0.3,
    height_shift_range=0.3
    )

train_generator=train_datagen.flow_from_dataframe(
    dataframe=master_data,
    directory="/content/drive/MyDrive/CapstoneProject_COVID",
    x_col='Filepath',
    y_col='Label',
    batch_size=4,
    shuffle=True,
    class_mode="categorical",
    target_size=(224,224)
)
```

```
Found 2481 validated image filenames belonging to 2 classes.
```



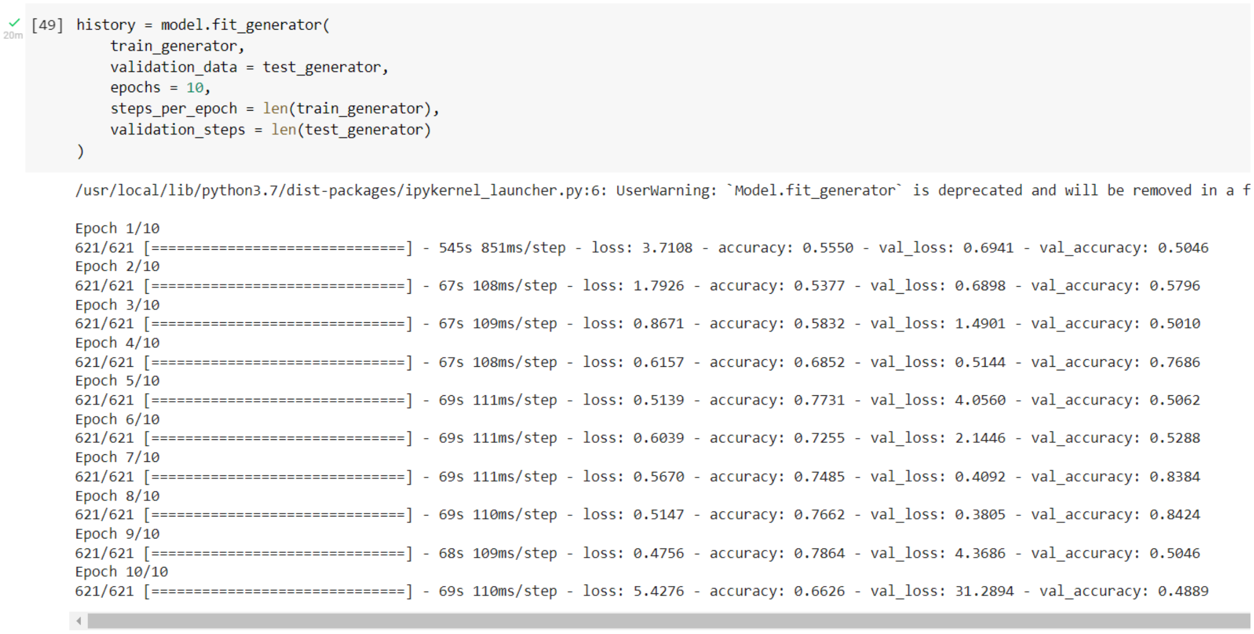
```
[45] test_datagen = ImageDataGenerator(rescale=1./255)

     test_generator=test_datagen.flow_from_dataframe(
         dataframe=master_data,
         directory="/content/drive/MyDrive/CapstoneProject_COVID",
         x_col="Filepath",
         y_col="Label",
         batch_size=4,
         shuffle=True,
         class_mode="categorical",
         target_size=(224,224)
     )
```

```
Found 2481 validated image filenames belonging to 2 classes.
```

```
[46] model.compile(optimizer='adam',
                   loss='categorical_crossentropy',
                   metrics=['accuracy'])
```

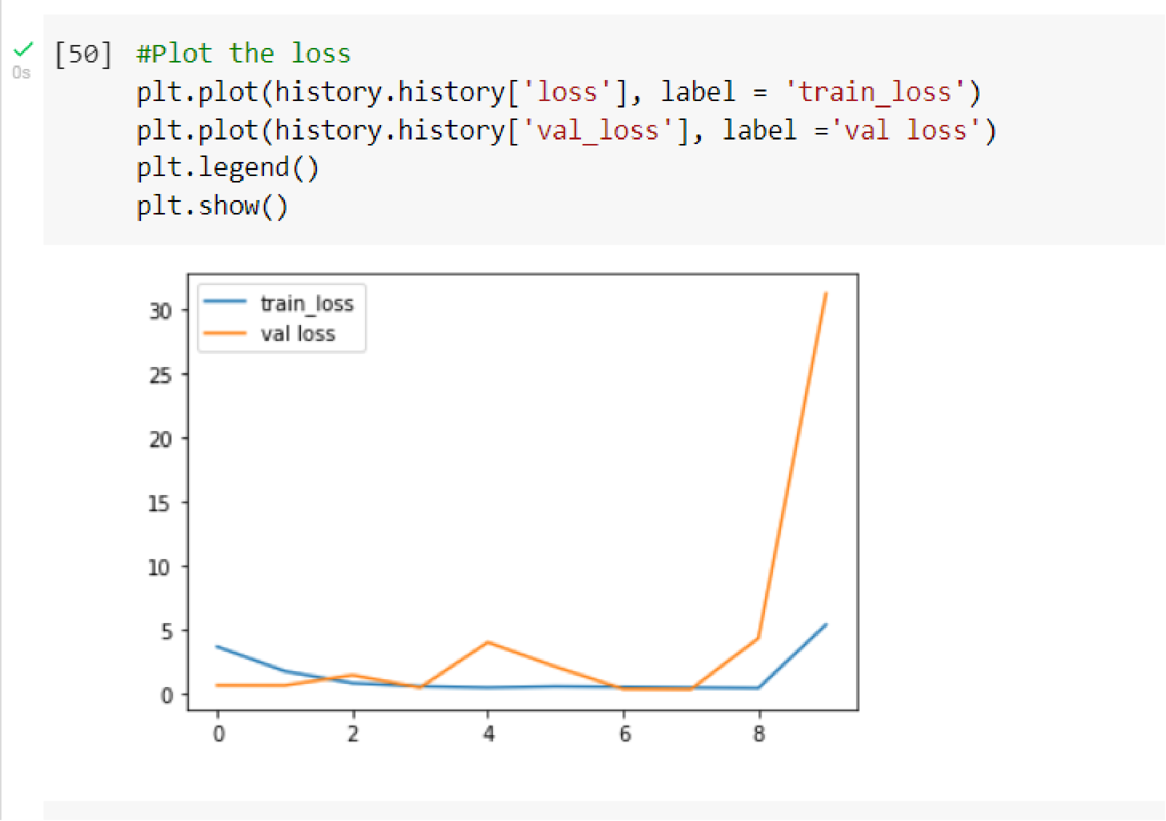
```
[47] ckpt_path = 'new_model.h5'
     checkpoint_cb = tf.keras.callbacks.ModelCheckpoint(ckpt_path,save_best_only=True)
```

```
[48] EarlyStopping = tf.keras.callbacks.EarlyStopping(patience=4)
```



```
[49] history = model.fit_generator(
         train_generator,
         validation_data = test_generator,
         epochs = 10,
         steps_per_epoch = len(train_generator),
         validation_steps = len(test_generator)
     )
```

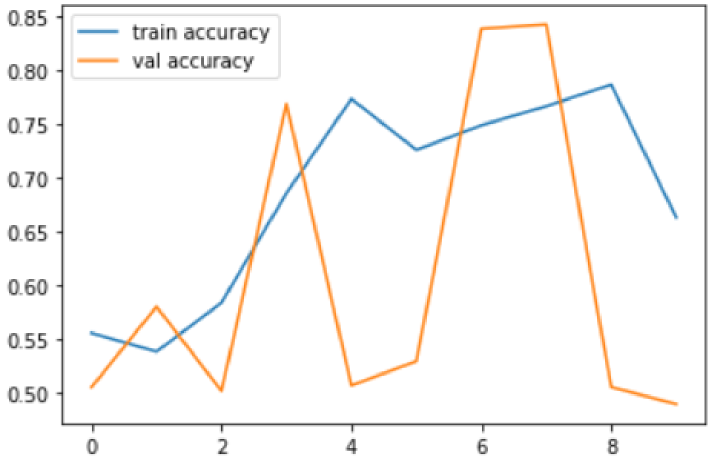
```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:6: UserWarning: `Model.fit_generator` is deprecated and will be removed in a f

Epoch 1/10
621/621 [==============================] - 545s 851ms/step - loss: 3.7108 - accuracy: 0.5550 - val_loss: 0.6941 - val_accuracy: 0.5046
Epoch 2/10
621/621 [==============================] - 67s 108ms/step - loss: 1.7926 - accuracy: 0.5377 - val_loss: 0.6898 - val_accuracy: 0.5796
Epoch 3/10
621/621 [==============================] - 67s 109ms/step - loss: 0.8671 - accuracy: 0.5832 - val_loss: 1.4901 - val_accuracy: 0.5010
Epoch 4/10
621/621 [==============================] - 67s 108ms/step - loss: 0.6157 - accuracy: 0.6852 - val_loss: 0.5144 - val_accuracy: 0.7686
Epoch 5/10
621/621 [==============================] - 69s 111ms/step - loss: 0.5139 - accuracy: 0.7731 - val_loss: 4.0560 - val_accuracy: 0.5062
Epoch 6/10
621/621 [==============================] - 69s 111ms/step - loss: 0.6039 - accuracy: 0.7255 - val_loss: 2.1446 - val_accuracy: 0.5288
Epoch 7/10
621/621 [==============================] - 69s 111ms/step - loss: 0.5670 - accuracy: 0.7485 - val_loss: 0.4092 - val_accuracy: 0.8384
Epoch 8/10
621/621 [==============================] - 69s 110ms/step - loss: 0.5147 - accuracy: 0.7662 - val_loss: 0.3805 - val_accuracy: 0.8424
Epoch 9/10
621/621 [==============================] - 68s 109ms/step - loss: 0.4756 - accuracy: 0.7864 - val_loss: 4.3686 - val_accuracy: 0.5046
Epoch 10/10
621/621 [==============================] - 69s 110ms/step - loss: 5.4276 - accuracy: 0.6626 - val_loss: 31.2894 - val_accuracy: 0.4889
```



```
#Plot the loss
plt.plot(history.history['loss'], label = 'train_loss')
plt.plot(history.history['val_loss'], label ='val loss')
plt.legend()
plt.show()
```

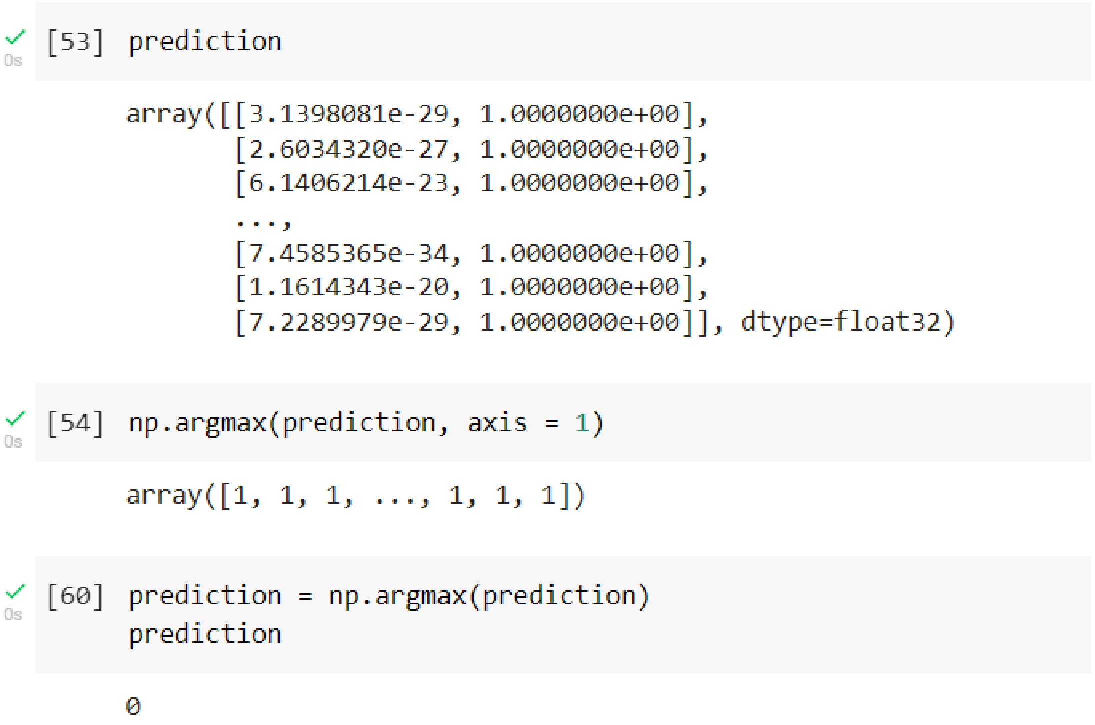
✓ 1s

```
[51] # Plot the Accuracy
     plt.plot(history.history['accuracy'], label = 'train accuracy')
     plt.plot(history.history['val_accuracy'], label ='val accuracy')
     plt.legend()
     plt.show()
```



✓ 18s

```
[52] #Predication on Test Data
     prediction = model.predict(test_generator)
```



```
[53] prediction
```

```
array([[3.1398081e-29, 1.0000000e+00],
       [2.6034320e-27, 1.0000000e+00],
       [6.1406214e-23, 1.0000000e+00],
       ...,
       [7.4585365e-34, 1.0000000e+00],
       [1.1614343e-20, 1.0000000e+00],
       [7.2289979e-29, 1.0000000e+00]], dtype=float32)
```

```
[54] np.argmax(prediction, axis = 1)
```

```
array([1, 1, 1, ..., 1, 1, 1])
```

```
[60] prediction = np.argmax(prediction)
     prediction
```

```
0
```