https://keras.io/api/applications/inceptionresnetv2/

In [1]:

```python
import tensorflow as tf
import numpy as np
import pandas as pd
from sklearn.metrics import classification_report, confusion_matrix
import matplotlib.pyplot as plt
import seaborn as sn
import os
```

```
INFO:tensorflow:Enabling eager execution
INFO:tensorflow:Enabling v2 tensorshape
INFO:tensorflow:Enabling resource variables
INFO:tensorflow:Enabling tensor equality
INFO:tensorflow:Enabling control flow v2
```

In [2]:

```python
epochs = 100 # quantidade de vezes a ser executado o algoritmo, uma epoch é quanto to
batch = 32 # número de amostras que será carregado a cada execução
```

In [3]:

```python
#carrega o modelo da InceptionResNetV2 com os pesos aprendidos no treino da Inception
base_model = tf.keras.applications.InceptionResNetV2(weights='imagenet', include_top=
```

In [4]:

```python
# O restante do modelo e suas camadas são discutidos a seguir
# x recebe o final da InceptionResNetV2
x=base_model.output
```

In [5]:

```python
#Nova configuração para o modelo

#adiciona apos x uma camada GlobalMaxPooling2D e atribui este no a x novamente (logo
x=tf.keras.layers.GlobalMaxPooling2D()(x)

#adiciona apos x uma camada densa com 128 neuronios com funcao de ativacao relu. Atri
x=tf.keras.layers.Dense(128,activation='relu')(x)

#adiciona apos x uma camada densa com 64 neuronios com funcao de ativacao relu. Atrib
x=tf.keras.layers.Dense(64,activation='relu')(x)

#adiciona apos x uma camada densa com 32 neuronios com funcao de ativacao relu. Atrib
x=tf.keras.layers.Dense(32,activation='relu')(x)

#adiciona após x os neurônios que devem ser utilizados, nesse caso foram desligados 2
x=tf.keras.layers.Dropout(0.5)(x)

#adiciona apos x uma camada densa com 7 neuronios (sete classes) com funcao de ativac
preds=tf.keras.layers.Dense(3,activation='softmax')(x)
#preds=tf.keras.layers.Dense(3,activation='sigmoid')(x)

#definindo modelo final
model=tf.keras.models.Model(inputs=base_model.input,outputs=preds)

#mostrando modelo final e sua estrutura
model.summary()
```

```
Model: "model"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
input_1 (InputLayer)            [(None, None, None,  0
conv2d (Conv2D)                 (None, None, None, 3 864         input_1[0][0]
batch_normalization (BatchNorma (None, None, None, 3 96          conv2d[0][0]
activation (Activation)         (None, None, None, 3 0           batch_normalization
[0][0]
conv2d_1 (Conv2D)               (None, None, None, 3 9216        activation[0][0]
batch_normalization_1 (BatchNor (None, None, None, 3 96          conv2d_1[0][0]
activation_1 (Activation)       (None, None, None, 3 0           batch_normalization_1
[0][0]
conv2d_2 (Conv2D)               (None, None, None, 6 18432       activation_1[0][0]
batch_normalization_2 (BatchNor (None, None, None, 6 192         conv2d_2[0][0]
activation_2 (Activation)       (None, None, None, 6 0           batch_normalization_2
[0][0]
max_pooling2d (MaxPooling2D)    (None, None, None, 6 0           activation_2[0][0]
conv2d_3 (Conv2D)               (None, None, None, 8 5120        max_pooling2d[0][0]
batch_normalization_3 (BatchNor (None, None, None, 8 240         conv2d_3[0][0]
activation_3 (Activation)       (None, None, None, 8 0           batch_normalization_3
[0][0]
conv2d_4 (Conv2D)               (None, None, None, 1 138240      activation_3[0][0]
batch_normalization_4 (BatchNor (None, None, None, 1 576         conv2d_4[0][0]
activation_4 (Activation)       (None, None, None, 1 0           batch_normalization_4
[0][0]
max_pooling2d_1 (MaxPooling2D)  (None, None, None, 1 0           activation_4[0][0]
conv2d_8 (Conv2D)               (None, None, None, 6 12288       max_pooling2d_1[0][0]
batch_normalization_8 (BatchNor (None, None, None, 6 192         conv2d_8[0][0]
activation_8 (Activation)       (None, None, None, 6 0           batch_normalization_8
[0][0]
conv2d_6 (Conv2D)               (None, None, None, 4 9216        max_pooling2d_1[0][0]
conv2d_9 (Conv2D)               (None, None, None, 9 55296       activation_8[0][0]
batch_normalization_6 (BatchNor (None, None, None, 4 144         conv2d_6[0][0]
batch_normalization_9 (BatchNor (None, None, None, 9 288         conv2d_9[0][0]
activation_6 (Activation)       (None, None, None, 4 0           batch_normalization_6
[0][0]
activation_9 (Activation)       (None, None, None, 9 0           batch_normalization_9
[0][0]
average_pooling2d (AveragePooli (None, None, None, 1 0           max_pooling2d_1[0][0]
conv2d_5 (Conv2D)               (None, None, None, 9 18432       max_pooling2d_1[0][0]
conv2d_7 (Conv2D)               (None, None, None, 6 76800       activation_6[0][0]
conv2d_10 (Conv2D)              (None, None, None, 9 82944       activation_9[0][0]
conv2d_11 (Conv2D)              (None, None, None, 6 12288       average_pooling2d[0]
[0]
batch_normalization_5 (BatchNor (None, None, None, 9 288         conv2d_5[0][0]
batch_normalization_7 (BatchNor (None, None, None, 6 192         conv2d_7[0][0]
batch_normalization_10 (BatchNo (None, None, None, 9 288         conv2d_10[0][0]
batch_normalization_11 (BatchNo (None, None, None, 6 192         conv2d_11[0][0]
activation_5 (Activation)       (None, None, None, 9 0           batch_normalization_5
[0][0]
activation_7 (Activation)       (None, None, None, 6 0           batch_normalization_7
[0][0]
activation_10 (Activation)      (None, None, None, 9 0           batch_normalization_1
0[0][0]
activation_11 (Activation)      (None, None, None, 6 0           batch_normalization_1
1[0][0]
mixed_5b (Concatenate)          (None, None, None, 3 0           activation_5[0][0]
                                                                 activation_7[0][0]
                                                                 activation_10[0][0]
                                                                 activation_11[0][0]
conv2d_15 (Conv2D)              (None, None, None, 3 10240       mixed_5b[0][0]
batch_normalization_15 (BatchNo (None, None, None, 3 96          conv2d_15[0][0]
activation_15 (Activation)      (None, None, None, 3 0           batch_normalization_1
5[0][0]
conv2d_13 (Conv2D)              (None, None, None, 3 10240       mixed_5b[0][0]
conv2d_16 (Conv2D)              (None, None, None, 4 13824       activation_15[0][0]
batch_normalization_13 (BatchNo (None, None, None, 3 96          conv2d_13[0][0]
batch_normalization_16 (BatchNo (None, None, None, 4 144         conv2d_16[0][0]
activation_13 (Activation)      (None, None, None, 3 0           batch_normalization_1
3[0][0]
activation_16 (Activation)      (None, None, None, 4 0           batch_normalization_1
6[0][0]
conv2d_12 (Conv2D)              (None, None, None, 3 10240       mixed_5b[0][0]
conv2d_14 (Conv2D)              (None, None, None, 3 9216        activation_13[0][0]
conv2d_17 (Conv2D)              (None, None, None, 6 27648       activation_16[0][0]
batch_normalization_12 (BatchNo (None, None, None, 3 96          conv2d_12[0][0]
batch_normalization_14 (BatchNo (None, None, None, 3 96          conv2d_14[0][0]
batch_normalization_17 (BatchNo (None, None, None, 6 192         conv2d_17[0][0]
activation_12 (Activation)      (None, None, None, 3 0           batch_normalization_1
2[0][0]
activation_14 (Activation)      (None, None, None, 3 0           batch_normalization_1
4[0][0]
activation_17 (Activation)      (None, None, None, 6 0           batch_normalization_1
7[0][0]
block35_1_mixed (Concatenate)   (None, None, None, 1 0           activation_12[0][0]
                                                                 activation_14[0][0]
                                                                 activation_17[0][0]
block35_1_conv (Conv2D)         (None, None, None, 3 41280       block35_1_mixed[0][0]
block35_1 (Lambda)              (None, None, None, 3 0           mixed_5b[0][0]
                                                                 block35_1_conv[0][0]
block35_1_ac (Activation)       (None, None, None, 3 0           block35_1[0][0]
conv2d_21 (Conv2D)              (None, None, None, 3 10240       block35_1_ac[0][0]
batch_normalization_21 (BatchNo (None, None, None, 3 96          conv2d_21[0][0]
activation_21 (Activation)      (None, None, None, 3 0           batch_normalization_2
1[0][0]
conv2d_19 (Conv2D)              (None, None, None, 3 10240       block35_1_ac[0][0]
conv2d_22 (Conv2D)              (None, None, None, 4 13824       activation_21[0][0]
batch_normalization_19 (BatchNo (None, None, None, 3 96          conv2d_19[0][0]
batch_normalization_22 (BatchNo (None, None, None, 4 144         conv2d_22[0][0]
activation_19 (Activation)      (None, None, None, 3 0           batch_normalization_1
9[0][0]
activation_22 (Activation)      (None, None, None, 4 0           batch_normalization_2
2[0][0]
conv2d_18 (Conv2D)              (None, None, None, 3 10240       block35_1_ac[0][0]
conv2d_20 (Conv2D)              (None, None, None, 3 9216        activation_19[0][0]
conv2d_23 (Conv2D)              (None, None, None, 6 27648       activation_22[0][0]
batch_normalization_18 (BatchNo (None, None, None, 3 96          conv2d_18[0][0]
batch_normalization_20 (BatchNo (None, None, None, 3 96          conv2d_20[0][0]
batch_normalization_23 (BatchNo (None, None, None, 6 192         conv2d_23[0][0]
activation_18 (Activation)      (None, None, None, 3 0           batch_normalization_1
8[0][0]
activation_20 (Activation)      (None, None, None, 3 0           batch_normalization_2
0[0][0]
activation_23 (Activation)      (None, None, None, 6 0           batch_normalization_2
3[0][0]
block35_2_mixed (Concatenate)   (None, None, None, 1 0           activation_18[0][0]
                                                                 activation_20[0][0]
                                                                 activation_23[0][0]
block35_2_conv (Conv2D)         (None, None, None, 3 41280       block35_2_mixed[0][0]
block35_2 (Lambda)              (None, None, None, 3 0           block35_1_ac[0][0]
                                                                 block35_2_conv[0][0]
block35_2_ac (Activation)       (None, None, None, 3 0           block35_2[0][0]
conv2d_27 (Conv2D)              (None, None, None, 3 10240       block35_2_ac[0][0]
batch_normalization_27 (BatchNo (None, None, None, 3 96          conv2d_27[0][0]
activation_27 (Activation)      (None, None, None, 3 0           batch_normalization_2
7[0][0]
conv2d_25 (Conv2D)              (None, None, None, 3 10240       block35_2_ac[0][0]
conv2d_28 (Conv2D)              (None, None, None, 4 13824       activation_27[0][0]
batch_normalization_25 (BatchNo (None, None, None, 3 96          conv2d_25[0][0]
batch_normalization_28 (BatchNo (None, None, None, 4 144         conv2d_28[0][0]
activation_25 (Activation)      (None, None, None, 3 0           batch_normalization_2
5[0][0]
activation_28 (Activation)      (None, None, None, 4 0           batch_normalization_2
8[0][0]
conv2d_24 (Conv2D)              (None, None, None, 3 10240       block35_2_ac[0][0]
conv2d_26 (Conv2D)              (None, None, None, 3 9216        activation_25[0][0]
conv2d_29 (Conv2D)              (None, None, None, 6 27648       activation_28[0][0]
batch_normalization_24 (BatchNo (None, None, None, 3 96          conv2d_24[0][0]
batch_normalization_26 (BatchNo (None, None, None, 3 96          conv2d_26[0][0]
batch_normalization_29 (BatchNo (None, None, None, 6 192         conv2d_29[0][0]
activation_24 (Activation)      (None, None, None, 3 0           batch_normalization_2
4[0][0]
activation_26 (Activation)      (None, None, None, 3 0           batch_normalization_2
6[0][0]
activation_29 (Activation)      (None, None, None, 6 0           batch_normalization_2
9[0][0]
block35_3_mixed (Concatenate)   (None, None, None, 1 0           activation_24[0][0]
                                                                 activation_26[0][0]
                                                                 activation_29[0][0]
block35_3_conv (Conv2D)         (None, None, None, 3 41280       block35_3_mixed[0][0]
block35_3 (Lambda)              (None, None, None, 3 0           block35_2_ac[0][0]
                                                                 block35_3_conv[0][0]
block35_3_ac (Activation)       (None, None, None, 3 0           block35_3[0][0]
conv2d_33 (Conv2D)              (None, None, None, 3 10240       block35_3_ac[0][0]
batch_normalization_33 (BatchNo (None, None, None, 3 96          conv2d_33[0][0]
activation_33 (Activation)      (None, None, None, 3 0           batch_normalization_3
3[0][0]
conv2d_31 (Conv2D)              (None, None, None, 3 10240       block35_3_ac[0][0]
conv2d_34 (Conv2D)              (None, None, None, 4 13824       activation_33[0][0]
batch_normalization_31 (BatchNo (None, None, None, 3 96          conv2d_31[0][0]
batch_normalization_34 (BatchNo (None, None, None, 4 144         conv2d_34[0][0]
activation_31 (Activation)      (None, None, None, 3 0           batch_normalization_3
1[0][0]
activation_34 (Activation)      (None, None, None, 4 0           batch_normalization_3
4[0][0]
conv2d_30 (Conv2D)              (None, None, None, 3 10240       block35_3_ac[0][0]
conv2d_32 (Conv2D)              (None, None, None, 3 9216        activation_31[0][0]
conv2d_35 (Conv2D)              (None, None, None, 6 27648       activation_34[0][0]
batch_normalization_30 (BatchNo (None, None, None, 3 96          conv2d_30[0][0]
batch_normalization_32 (BatchNo (None, None, None, 3 96          conv2d_32[0][0]
batch_normalization_35 (BatchNo (None, None, None, 6 192         conv2d_35[0][0]
activation_30 (Activation)      (None, None, None, 3 0           batch_normalization_3
0[0][0]
activation_32 (Activation)      (None, None, None, 3 0           batch_normalization_3
2[0][0]
activation_35 (Activation)      (None, None, None, 6 0           batch_normalization_3
5[0][0]
block35_4_mixed (Concatenate)   (None, None, None, 1 0           activation_30[0][0]
                                                                 activation_32[0][0]
                                                                 activation_35[0][0]
block35_4_conv (Conv2D)         (None, None, None, 3 41280       block35_4_mixed[0][0]
block35_4 (Lambda)              (None, None, None, 3 0           block35_3_ac[0][0]
                                                                 block35_4_conv[0][0]
block35_4_ac (Activation)       (None, None, None, 3 0           block35_4[0][0]
conv2d_39 (Conv2D)              (None, None, None, 3 10240       block35_4_ac[0][0]
batch_normalization_39 (BatchNo (None, None, None, 3 96          conv2d_39[0][0]
activation_39 (Activation)      (None, None, None, 3 0           batch_normalization_3
9[0][0]
conv2d_37 (Conv2D)              (None, None, None, 3 10240       block35_4_ac[0][0]
conv2d_40 (Conv2D)              (None, None, None, 4 13824       activation_39[0][0]
batch_normalization_37 (BatchNo (None, None, None, 3 96          conv2d_37[0][0]
batch_normalization_40 (BatchNo (None, None, None, 4 144         conv2d_40[0][0]
activation_37 (Activation)      (None, None, None, 3 0           batch_normalization_3
7[0][0]
activation_40 (Activation)      (None, None, None, 4 0           batch_normalization_4
0[0][0]
conv2d_36 (Conv2D)              (None, None, None, 3 10240       block35_4_ac[0][0]
conv2d_38 (Conv2D)              (None, None, None, 3 9216        activation_37[0][0]
conv2d_41 (Conv2D)              (None, None, None, 6 27648       activation_40[0][0]
batch_normalization_36 (BatchNo (None, None, None, 3 96          conv2d_36[0][0]
batch_normalization_38 (BatchNo (None, None, None, 3 96          conv2d_38[0][0]
batch_normalization_41 (BatchNo (None, None, None, 6 192         conv2d_41[0][0]
activation_36 (Activation)      (None, None, None, 3 0           batch_normalization_3
6[0][0]
activation_38 (Activation)      (None, None, None, 3 0           batch_normalization_3
8[0][0]
activation_41 (Activation)      (None, None, None, 6 0           batch_normalization_4
1[0][0]
block35_5_mixed (Concatenate)   (None, None, None, 1 0           activation_36[0][0]
                                                                 activation_38[0][0]
                                                                 activation_41[0][0]
block35_5_conv (Conv2D)         (None, None, None, 3 41280       block35_5_mixed[0][0]
block35_5 (Lambda)              (None, None, None, 3 0           block35_4_ac[0][0]
                                                                 block35_5_conv[0][0]
block35_5_ac (Activation)       (None, None, None, 3 0           block35_5[0][0]
conv2d_45 (Conv2D)              (None, None, None, 3 10240       block35_5_ac[0][0]
batch_normalization_45 (BatchNo (None, None, None, 3 96          conv2d_45[0][0]
activation_45 (Activation)      (None, None, None, 3 0           batch_normalization_4
5[0][0]
conv2d_43 (Conv2D)              (None, None, None, 3 10240       block35_5_ac[0][0]
conv2d_46 (Conv2D)              (None, None, None, 4 13824       activation_45[0][0]
batch_normalization_43 (BatchNo (None, None, None, 3 96          conv2d_43[0][0]
batch_normalization_46 (BatchNo (None, None, None, 4 144         conv2d_46[0][0]
activation_43 (Activation)      (None, None, None, 3 0           batch_normalization_4
3[0][0]
activation_46 (Activation)      (None, None, None, 4 0           batch_normalization_4
6[0][0]
conv2d_42 (Conv2D)              (None, None, None, 3 10240       block35_5_ac[0][0]
conv2d_44 (Conv2D)              (None, None, None, 3 9216        activation_43[0][0]
conv2d_47 (Conv2D)              (None, None, None, 6 27648       activation_46[0][0]
batch_normalization_42 (BatchNo (None, None, None, 3 96          conv2d_42[0][0]
batch_normalization_44 (BatchNo (None, None, None, 3 96          conv2d_44[0][0]
batch_normalization_47 (BatchNo (None, None, None, 6 192         conv2d_47[0][0]
activation_42 (Activation)      (None, None, None, 3 0           batch_normalization_4
2[0][0]
activation_44 (Activation)      (None, None, None, 3 0           batch_normalization_4
4[0][0]
activation_47 (Activation)      (None, None, None, 6 0           batch_normalization_4
7[0][0]
block35_6_mixed (Concatenate)   (None, None, None, 1 0           activation_42[0][0]
                                                                 activation_44[0][0]
                                                                 activation_47[0][0]
block35_6_conv (Conv2D)         (None, None, None, 3 41280       block35_6_mixed[0][0]
block35_6 (Lambda)              (None, None, None, 3 0           block35_5_ac[0][0]
                                                                 block35_6_conv[0][0]
block35_6_ac (Activation)       (None, None, None, 3 0           block35_6[0][0]
conv2d_51 (Conv2D)              (None, None, None, 3 10240       block35_6_ac[0][0]
batch_normalization_51 (BatchNo (None, None, None, 3 96          conv2d_51[0][0]
activation_51 (Activation)      (None, None, None, 3 0           batch_normalization_5
1[0][0]
conv2d_49 (Conv2D)              (None, None, None, 3 10240       block35_6_ac[0][0]
conv2d_52 (Conv2D)              (None, None, None, 4 13824       activation_51[0][0]
batch_normalization_49 (BatchNo (None, None, None, 3 96          conv2d_49[0][0]
batch_normalization_52 (BatchNo (None, None, None, 4 144         conv2d_52[0][0]
activation_49 (Activation)      (None, None, None, 3 0           batch_normalization_4
9[0][0]
activation_52 (Activation)      (None, None, None, 4 0           batch_normalization_5
2[0][0]
conv2d_48 (Conv2D)              (None, None, None, 3 10240       block35_6_ac[0][0]
conv2d_50 (Conv2D)              (None, None, None, 3 9216        activation_49[0][0]
conv2d_53 (Conv2D)              (None, None, None, 6 27648       activation_52[0][0]
batch_normalization_48 (BatchNo (None, None, None, 3 96          conv2d_48[0][0]
batch_normalization_50 (BatchNo (None, None, None, 3 96          conv2d_50[0][0]
batch_normalization_53 (BatchNo (None, None, None, 6 192         conv2d_53[0][0]
activation_48 (Activation)      (None, None, None, 3 0           batch_normalization_4
8[0][0]
activation_50 (Activation)      (None, None, None, 3 0           batch_normalization_5
0[0][0]
activation_53 (Activation)      (None, None, None, 6 0           batch_normalization_5
3[0][0]
block35_7_mixed (Concatenate)   (None, None, None, 1 0           activation_48[0][0]
                                                                 activation_50[0][0]
                                                                 activation_53[0][0]
block35_7_conv (Conv2D)         (None, None, None, 3 41280       block35_7_mixed[0][0]
block35_7 (Lambda)              (None, None, None, 3 0           block35_6_ac[0][0]
                                                                 block35_7_conv[0][0]
block35_7_ac (Activation)       (None, None, None, 3 0           block35_7[0][0]
conv2d_57 (Conv2D)              (None, None, None, 3 10240       block35_7_ac[0][0]
batch_normalization_57 (BatchNo (None, None, None, 3 96          conv2d_57[0][0]
activation_57 (Activation)      (None, None, None, 3 0           batch_normalization_5
7[0][0]
conv2d_55 (Conv2D)              (None, None, None, 3 10240       block35_7_ac[0][0]
conv2d_58 (Conv2D)              (None, None, None, 4 13824       activation_57[0][0]
batch_normalization_55 (BatchNo (None, None, None, 3 96          conv2d_55[0][0]
batch_normalization_58 (BatchNo (None, None, None, 4 144         conv2d_58[0][0]
activation_55 (Activation)      (None, None, None, 3 0           batch_normalization_5
5[0][0]
activation_58 (Activation)      (None, None, None, 4 0           batch_normalization_5
8[0][0]
conv2d_54 (Conv2D)              (None, None, None, 3 10240       block35_7_ac[0][0]
conv2d_56 (Conv2D)              (None, None, None, 3 9216        activation_55[0][0]
conv2d_59 (Conv2D)              (None, None, None, 6 27648       activation_58[0][0]
batch_normalization_54 (BatchNo (None, None, None, 3 96          conv2d_54[0][0]
batch_normalization_56 (BatchNo (None, None, None, 3 96          conv2d_56[0][0]
batch_normalization_59 (BatchNo (None, None, None, 6 192         conv2d_59[0][0]
activation_54 (Activation)      (None, None, None, 3 0           batch_normalization_5
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74[0][0]
block8_3_mixed (Concatenate)    (None, None, None, 4 0           activation_171[0][0]
                                                                 activation_174[0][0]
block8_3_conv (Conv2D)          (None, None, None, 2 933920      block8_3_mixed[0][0]
block8_3 (Lambda)               (None, None, None, 2 0           block8_2_ac[0][0]
                                                                 block8_3_conv[0][0]
block8_3_ac (Activation)        (None, None, None, 2 0           block8_3[0][0]
conv2d_176 (Conv2D)             (None, None, None, 1 399360      block8_3_ac[0][0]
batch_normalization_176 (BatchN (None, None, None, 1 576         conv2d_176[0][0]
activation_176 (Activation)     (None, None, None, 1 0           batch_normalization_1
76[0][0]
conv2d_177 (Conv2D)             (None, None, None, 2 129024      activation_176[0][0]
batch_normalization_177 (BatchN (None, None, None, 2 672         conv2d_177[0][0]
activation_177 (Activation)     (None, None, None, 2 0           batch_normalization_1
77[0][0]
conv2d_175 (Conv2D)             (None, None, None, 1 399360      block8_3_ac[0][0]
conv2d_178 (Conv2D)             (None, None, None, 2 172032      activation_177[0][0]
batch_normalization_175 (BatchN (None, None, None, 1 576         conv2d_175[0][0]
batch_normalization_178 (BatchN (None, None, None, 2 768         conv2d_178[0][0]
activation_175 (Activation)     (None, None, None, 1 0           batch_normalization_1
75[0][0]
activation_178 (Activation)     (None, None, None, 2 0           batch_normalization_1
78[0][0]
block8_4_mixed (Concatenate)    (None, None, None, 4 0           activation_175[0][0]
                                                                 activation_178[0][0]
block8_4_conv (Conv2D)          (None, None, None, 2 933920      block8_4_mixed[0][0]
block8_4 (Lambda)               (None, None, None, 2 0           block8_3_ac[0][0]
                                                                 block8_4_conv[0][0]
block8_4_ac (Activation)        (None, None, None, 2 0           block8_4[0][0]
conv2d_180 (Conv2D)             (None, None, None, 1 399360      block8_4_ac[0][0]
batch_normalization_180 (BatchN (None, None, None, 1 576         conv2d_180[0][0]
activation_180 (Activation)     (None, None, None, 1 0           batch_normalization_1
80[0][0]
conv2d_181 (Conv2D)             (None, None, None, 2 129024      activation_180[0][0]
batch_normalization_181 (BatchN (None, None, None, 2 672         conv2d_181[0][0]
activation_181 (Activation)     (None, None, None, 2 0           batch_normalization_1
81[0][0]
conv2d_179 (Conv2D)             (None, None, None, 1 399360      block8_4_ac[0][0]
conv2d_182 (Conv2D)             (None, None, None, 2 172032      activation_181[0][0]
batch_normalization_179 (BatchN (None, None, None, 1 576         conv2d_179[0][0]
batch_normalization_182 (BatchN (None, None, None, 2 768         conv2d_182[0][0]
activation_179 (Activation)     (None, None, None, 1 0           batch_normalization_1
79[0][0]
activation_182 (Activation)     (None, None, None, 2 0           batch_normalization_1
82[0][0]
block8_5_mixed (Concatenate)    (None, None, None, 4 0           activation_179[0][0]
                                                                 activation_182[0][0]
block8_5_conv (Conv2D)          (None, None, None, 2 933920      block8_5_mixed[0][0]
block8_5 (Lambda)               (None, None, None, 2 0           block8_4_ac[0][0]
                                                                 block8_5_conv[0][0]
block8_5_ac (Activation)        (None, None, None, 2 0           block8_5[0][0]
conv2d_184 (Conv2D)             (None, None, None, 1 399360      block8_5_ac[0][0]
batch_normalization_184 (BatchN (None, None, None, 1 576         conv2d_184[0][0]
activation_184 (Activation)     (None, None, None, 1 0           batch_normalization_1
84[0][0]
conv2d_185 (Conv2D)             (None, None, None, 2 129024      activation_184[0][0]
batch_normalization_185 (BatchN (None, None, None, 2 672         conv2d_185[0][0]
activation_185 (Activation)     (None, None, None, 2 0           batch_normalization_1
85[0][0]
conv2d_183 (Conv2D)             (None, None, None, 1 399360      block8_5_ac[0][0]
conv2d_186 (Conv2D)             (None, None, None, 2 172032      activation_185[0][0]
batch_normalization_183 (BatchN (None, None, None, 1 576         conv2d_183[0][0]
batch_normalization_186 (BatchN (None, None, None, 2 768         conv2d_186[0][0]
activation_183 (Activation)     (None, None, None, 1 0           batch_normalization_1
83[0][0]
activation_186 (Activation)     (None, None, None, 2 0           batch_normalization_1
86[0][0]
block8_6_mixed (Concatenate)    (None, None, None, 4 0           activation_183[0][0]
                                                                 activation_186[0][0]
block8_6_conv (Conv2D)          (None, None, None, 2 933920      block8_6_mixed[0][0]
block8_6 (Lambda)               (None, None, None, 2 0           block8_5_ac[0][0]
                                                                 block8_6_conv[0][0]
block8_6_ac (Activation)        (None, None, None, 2 0           block8_6[0][0]
conv2d_188 (Conv2D)             (None, None, None, 1 399360      block8_6_ac[0][0]
batch_normalization_188 (BatchN (None, None, None, 1 576         conv2d_188[0][0]
activation_188 (Activation)     (None, None, None, 1 0           batch_normalization_1
88[0][0]
conv2d_189 (Conv2D)             (None, None, None, 2 129024      activation_188[0][0]
batch_normalization_189 (BatchN (None, None, None, 2 672         conv2d_189[0][0]
activation_189 (Activation)     (None, None, None, 2 0           batch_normalization_1
89[0][0]
conv2d_187 (Conv2D)             (None, None, None, 1 399360      block8_6_ac[0][0]
conv2d_190 (Conv2D)             (None, None, None, 2 172032      activation_189[0][0]
batch_normalization_187 (BatchN (None, None, None, 1 576         conv2d_187[0][0]
batch_normalization_190 (BatchN (None, None, None, 2 768         conv2d_190[0][0]
activation_187 (Activation)     (None, None, None, 1 0           batch_normalization_1
87[0][0]
activation_190 (Activation)     (None, None, None, 2 0           batch_normalization_1
90[0][0]
block8_7_mixed (Concatenate)    (None, None, None, 4 0           activation_187[0][0]
                                                                 activation_190[0][0]
block8_7_conv (Conv2D)          (None, None, None, 2 933920      block8_7_mixed[0][0]
block8_7 (Lambda)               (None, None, None, 2 0           block8_6_ac[0][0]
                                                                 block8_7_conv[0][0]
block8_7_ac (Activation)        (None, None, None, 2 0           block8_7[0][0]
conv2d_192 (Conv2D)             (None, None, None, 1 399360      block8_7_ac[0][0]
batch_normalization_192 (BatchN (None, None, None, 1 576         conv2d_192[0][0]
activation_192 (Activation)     (None, None, None, 1 0           batch_normalization_1
92[0][0]
conv2d_193 (Conv2D)             (None, None, None, 2 129024      activation_192[0][0]
batch_normalization_193 (BatchN (None, None, None, 2 672         conv2d_193[0][0]
activation_193 (Activation)     (None, None, None, 2 0           batch_normalization_1
93[0][0]
conv2d_191 (Conv2D)             (None, None, None, 1 399360      block8_7_ac[0][0]
conv2d_194 (Conv2D)             (None, None, None, 2 172032      activation_193[0][0]
batch_normalization_191 (BatchN (None, None, None, 1 576         conv2d_191[0][0]
batch_normalization_194 (BatchN (None, None, None, 2 768         conv2d_194[0][0]
activation_191 (Activation)     (None, None, None, 1 0           batch_normalization_1
91[0][0]
activation_194 (Activation)     (None, None, None, 2 0           batch_normalization_1
94[0][0]
block8_8_mixed (Concatenate)    (None, None, None, 4 0           activation_191[0][0]
                                                                 activation_194[0][0]
block8_8_conv (Conv2D)          (None, None, None, 2 933920      block8_8_mixed[0][0]
block8_8 (Lambda)               (None, None, None, 2 0           block8_7_ac[0][0]
                                                                 block8_8_conv[0][0]
block8_8_ac (Activation)        (None, None, None, 2 0           block8_8[0][0]
conv2d_196 (Conv2D)             (None, None, None, 1 399360      block8_8_ac[0][0]
batch_normalization_196 (BatchN (None, None, None, 1 576         conv2d_196[0][0]
activation_196 (Activation)     (None, None, None, 1 0           batch_normalization_1
96[0][0]
conv2d_197 (Conv2D)             (None, None, None, 2 129024      activation_196[0][0]
batch_normalization_197 (BatchN (None, None, None, 2 672         conv2d_197[0][0]
activation_197 (Activation)     (None, None, None, 2 0           batch_normalization_1
97[0][0]
conv2d_195 (Conv2D)             (None, None, None, 1 399360      block8_8_ac[0][0]
conv2d_198 (Conv2D)             (None, None, None, 2 172032      activation_197[0][0]
batch_normalization_195 (BatchN (None, None, None, 1 576         conv2d_195[0][0]
batch_normalization_198 (BatchN (None, None, None, 2 768         conv2d_198[0][0]
activation_195 (Activation)     (None, None, None, 1 0           batch_normalization_1
95[0][0]
activation_198 (Activation)     (None, None, None, 2 0           batch_normalization_1
98[0][0]
block8_9_mixed (Concatenate)    (None, None, None, 4 0           activation_195[0][0]
                                                                 activation_198[0][0]
block8_9_conv (Conv2D)          (None, None, None, 2 933920      block8_9_mixed[0][0]
block8_9 (Lambda)               (None, None, None, 2 0           block8_8_ac[0][0]
                                                                 block8_9_conv[0][0]
block8_9_ac (Activation)        (None, None, None, 2 0           block8_9[0][0]
conv2d_200 (Conv2D)             (None, None, None, 1 399360      block8_9_ac[0][0]
batch_normalization_200 (BatchN (None, None, None, 1 576         conv2d_200[0][0]
activation_200 (Activation)     (None, None, None, 1 0           batch_normalization_2
00[0][0]
conv2d_201 (Conv2D)             (None, None, None, 2 129024      activation_200[0][0]
batch_normalization_201 (BatchN (None, None, None, 2 672         conv2d_201[0][0]
activation_201 (Activation)     (None, None, None, 2 0           batch_normalization_2
01[0][0]
conv2d_199 (Conv2D)             (None, None, None, 1 399360      block8_9_ac[0][0]
conv2d_202 (Conv2D)             (None, None, None, 2 172032      activation_201[0][0]
batch_normalization_199 (BatchN (None, None, None, 1 576         conv2d_199[0][0]
batch_normalization_202 (BatchN (None, None, None, 2 768         conv2d_202[0][0]
activation_199 (Activation)     (None, None, None, 1 0           batch_normalization_1
99[0][0]
activation_202 (Activation)     (None, None, None, 2 0           batch_normalization_2
02[0][0]
block8_10_mixed (Concatenate)   (None, None, None, 4 0           activation_199[0][0]
                                                                 activation_202[0][0]
block8_10_conv (Conv2D)         (None, None, None, 2 933920      block8_10_mixed[0][0]
block8_10 (Lambda)              (None, None, None, 2 0           block8_9_ac[0][0]
                                                                 block8_10_conv[0][0]
conv_7b (Conv2D)                (None, None, None, 1 3194880     block8_10[0][0]
conv_7b_bn (BatchNormalization) (None, None, None, 1 4608        conv_7b[0][0]
conv_7b_ac (Activation)         (None, None, None, 1 0           conv_7b_bn[0][0]
global_max_pooling2d (GlobalMax (None, 1536)         0           conv_7b_ac[0][0]
dense (Dense)                   (None, 128)          196736      global_max_pooling2d
[0][0]
dense_1 (Dense)                 (None, 64)           8256        dense[0][0]
dense_2 (Dense)                 (None, 32)           2080        dense_1[0][0]
dropout (Dropout)               (None, 32)           0           dense_2[0][0]
dense_3 (Dense)                 (None, 3)            99          dropout[0][0]
==================================================================================================
Total params: 54,543,907
Trainable params: 54,483,363
Non-trainable params: 60,544
__________________________________________________________________________________________________
```

In [6]:

```
#congelando os neuronios já treinados na ImageNet, queremos retreinar somente a ultima
for l in model.layers:
    if l.name.split('_')[0] != 'dense':
        l.trainable=False
    else:
        l.trainable=True
```

In [7]:

```
#iniciando objeto que apanhara todas as imagens de treino, processando as imagens com
train_data_gen = tf.keras.preprocessing.image.ImageDataGenerator(preprocessing_functio

#iniciando objeto que apanhara todas as imagens de teste, processando as imagens com o
test_data_gen = tf.keras.preprocessing.image.ImageDataGenerator(preprocessing_function
```

In [8]:

```
#CARREGANDO PRÓPRIO DATASET PARA USO

#definindo gerador de imagens de treino
train_generator = train_data_gen.flow_from_directory('shapes_split/train',
                                                     target_size=(224, 224), # tamanho da
                                                     batch_size=batch,
                                                     class_mode='categorical',
                                                     shuffle=True)

#definindo gerador de imagens de teste
test_generator = test_data_gen.flow_from_directory('shapes_split/test',
                                                     target_size=(224, 224), # tamanho da
                                                     batch_size=batch,
                                                     class_mode='categorical',
                                                     shuffle=True)
```

```
Found 240 images belonging to 3 classes.
Found 60 images belonging to 3 classes.
```

In [9]:

```
lr = tf.keras.optimizers.Adam(learning_rate=0.001) #estabelecendo taxa de otimização

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

In [10]:

```
#definicao dos steps
step_size_train = train_generator.n//train_generator.batch_size
step_size_test = test_generator.n//test_generator.batch_size
```

In [11]:

```
#treinando e testando o modelo
history = model.fit_generator(generator=train_generator,
                   steps_per_epoch=step_size_train,
                   epochs=epochs,
                   validation_data=test_generator,
                   validation_steps=step_size_test)
```

```
Epoch 1/100
c:\users\vinicius\appdata\local\programs\python\python39\lib\site-packages\tensorflow
\python\keras\engine\training.py:1940: UserWarning: `Model.fit_generator` is deprecate
d and will be removed in a future version. Please use `Model.fit`, which supports gene
rators.
  warnings.warn('`Model.fit_generator` is deprecated and '
7/7 [==============================] - 46s 5s/step - loss: 1.8705 - accuracy: 0.4511 -
val_loss: 0.3173 - val_accuracy: 0.9375
Epoch 2/100
7/7 [==============================] - 31s 5s/step - loss: 0.4232 - accuracy: 0.7959 -
val_loss: 0.0395 - val_accuracy: 1.0000
Epoch 3/100
7/7 [==============================] - 29s 4s/step - loss: 0.1309 - accuracy: 0.9395 -
val_loss: 0.0104 - val_accuracy: 1.0000
Epoch 4/100
7/7 [==============================] - 29s 4s/step - loss: 0.0953 - accuracy: 0.9522 -
val_loss: 0.0065 - val_accuracy: 1.0000
Epoch 5/100
7/7 [==============================] - 29s 5s/step - loss: 0.0989 - accuracy: 0.9681 -
val_loss: 7.1644e-04 - val_accuracy: 1.0000
Epoch 6/100
7/7 [==============================] - 30s 4s/step - loss: 0.0618 - accuracy: 0.9751 -
val_loss: 0.0012 - val_accuracy: 1.0000
Epoch 7/100
7/7 [==============================] - 31s 5s/step - loss: 0.0151 - accuracy: 0.9934 -
val_loss: 7.2008e-04 - val_accuracy: 1.0000
Epoch 8/100
7/7 [==============================] - 29s 4s/step - loss: 0.0221 - accuracy: 0.9918 -
val_loss: 0.0296 - val_accuracy: 0.9688
Epoch 9/100
7/7 [==============================] - 29s 4s/step - loss: 0.0312 - accuracy: 0.9795 -
val_loss: 0.0307 - val_accuracy: 0.9688
Epoch 10/100
7/7 [==============================] - 29s 4s/step - loss: 0.0167 - accuracy: 0.9928 -
val_loss: 4.3702e-04 - val_accuracy: 1.0000
Epoch 11/100
7/7 [==============================] - 31s 5s/step - loss: 0.0088 - accuracy: 0.9982 -
val_loss: 7.6845e-04 - val_accuracy: 1.0000
Epoch 12/100
7/7 [==============================] - 30s 4s/step - loss: 0.0439 - accuracy: 0.9761 -
val_loss: 2.3220e-04 - val_accuracy: 1.0000
Epoch 13/100
7/7 [==============================] - 30s 4s/step - loss: 0.0228 - accuracy: 0.9860 -
val_loss: 1.8959e-04 - val_accuracy: 1.0000
Epoch 14/100
7/7 [==============================] - 29s 5s/step - loss: 0.0069 - accuracy: 1.0000 -
val_loss: 0.0028 - val_accuracy: 1.0000
Epoch 15/100
7/7 [==============================] - 29s 4s/step - loss: 0.0186 - accuracy: 0.9880 -
val_loss: 0.0217 - val_accuracy: 1.0000
Epoch 16/100
7/7 [==============================] - 29s 4s/step - loss: 0.0090 - accuracy: 0.9930 -
val_loss: 0.0174 - val_accuracy: 1.0000
Epoch 17/100
7/7 [==============================] - 29s 4s/step - loss: 0.0097 - accuracy: 0.9935 -
val_loss: 6.7910e-04 - val_accuracy: 1.0000
Epoch 18/100
7/7 [==============================] - 29s 4s/step - loss: 0.0070 - accuracy: 0.9981 -
val_loss: 0.0089 - val_accuracy: 1.0000
Epoch 19/100
7/7 [==============================] - 31s 5s/step - loss: 0.0196 - accuracy: 0.9906 -
val_loss: 0.0018 - val_accuracy: 1.0000
Epoch 20/100
7/7 [==============================] - 29s 4s/step - loss: 0.0076 - accuracy: 1.0000 -
val_loss: 3.0638e-04 - val_accuracy: 1.0000
Epoch 21/100
7/7 [==============================] - 29s 4s/step - loss: 0.0075 - accuracy: 0.9974 -
val_loss: 0.0622 - val_accuracy: 0.9688
Epoch 22/100
7/7 [==============================] - 30s 4s/step - loss: 0.0053 - accuracy: 0.9981 -
val_loss: 0.0048 - val_accuracy: 1.0000
Epoch 23/100
7/7 [==============================] - 29s 4s/step - loss: 0.0110 - accuracy: 0.9930 -
val_loss: 2.5262e-04 - val_accuracy: 1.0000
Epoch 24/100
7/7 [==============================] - 30s 4s/step - loss: 0.0042 - accuracy: 1.0000 -
val_loss: 2.4377e-04 - val_accuracy: 1.0000
Epoch 25/100
7/7 [==============================] - 30s 4s/step - loss: 0.0353 - accuracy: 0.9880 -
val_loss: 4.9184e-05 - val_accuracy: 1.0000
Epoch 26/100
7/7 [==============================] - 30s 4s/step - loss: 0.0194 - accuracy: 0.9902 -
val_loss: 3.9413e-06 - val_accuracy: 1.0000
Epoch 27/100
7/7 [==============================] - 29s 4s/step - loss: 0.0059 - accuracy: 0.9988 -
val_loss: 2.1277e-04 - val_accuracy: 1.0000
Epoch 28/100
7/7 [==============================] - 29s 4s/step - loss: 0.0080 - accuracy: 1.0000 -
val_loss: 0.0051 - val_accuracy: 1.0000
Epoch 29/100
7/7 [==============================] - 29s 4s/step - loss: 0.0072 - accuracy: 1.0000 -
val_loss: 0.0055 - val_accuracy: 1.0000
Epoch 30/100
7/7 [==============================] - 29s 4s/step - loss: 0.0207 - accuracy: 0.9880 -
val_loss: 8.1682e-05 - val_accuracy: 1.0000
Epoch 31/100
7/7 [==============================] - 29s 4s/step - loss: 0.0147 - accuracy: 0.9974 -
val_loss: 5.5602e-05 - val_accuracy: 1.0000
Epoch 32/100
7/7 [==============================] - 31s 5s/step - loss: 0.0150 - accuracy: 0.9975 -
val_loss: 4.4254e-06 - val_accuracy: 1.0000
Epoch 33/100
7/7 [==============================] - 29s 4s/step - loss: 0.0092 - accuracy: 0.9954 -
val_loss: 2.2560e-05 - val_accuracy: 1.0000
Epoch 34/100
7/7 [==============================] - 29s 4s/step - loss: 0.0033 - accuracy: 1.0000 -
val_loss: 7.8598e-06 - val_accuracy: 1.0000
Epoch 35/100
7/7 [==============================] - 30s 4s/step - loss: 0.0143 - accuracy: 0.9892 -
val_loss: 4.3961e-05 - val_accuracy: 1.0000
Epoch 36/100
7/7 [==============================] - 29s 4s/step - loss: 0.0019 - accuracy: 1.0000 -
val_loss: 7.8743e-06 - val_accuracy: 1.0000
Epoch 37/100
7/7 [==============================] - 29s 4s/step - loss: 0.0068 - accuracy: 0.9961 -
val_loss: 1.9215e-05 - val_accuracy: 1.0000
Epoch 38/100
7/7 [==============================] - 29s 4s/step - loss: 0.0222 - accuracy: 0.9788 -
val_loss: 1.5892e-05 - val_accuracy: 1.0000
Epoch 39/100
7/7 [==============================] - 30s 4s/step - loss: 0.0169 - accuracy: 1.0000 -
val_loss: 2.7472e-05 - val_accuracy: 1.0000
Epoch 40/100
7/7 [==============================] - 30s 5s/step - loss: 0.0139 - accuracy: 0.9945 -
val_loss: 1.2222e-04 - val_accuracy: 1.0000
Epoch 41/100
7/7 [==============================] - 30s 4s/step - loss: 0.0045 - accuracy: 0.9981 -
val_loss: 5.9676e-04 - val_accuracy: 1.0000
Epoch 42/100
7/7 [==============================] - 31s 5s/step - loss: 0.0030 - accuracy: 1.0000 -
val_loss: 0.0010 - val_accuracy: 1.0000
Epoch 43/100
7/7 [==============================] - 30s 4s/step - loss: 0.0020 - accuracy: 1.0000 -
val_loss: 7.2834e-04 - val_accuracy: 1.0000
Epoch 44/100
7/7 [==============================] - 29s 5s/step - loss: 0.0082 - accuracy: 0.9945 -
val_loss: 6.1796e-06 - val_accuracy: 1.0000
Epoch 45/100
7/7 [==============================] - 29s 4s/step - loss: 0.0084 - accuracy: 0.9973 -
val_loss: 1.1528e-05 - val_accuracy: 1.0000
Epoch 46/100
7/7 [==============================] - 31s 5s/step - loss: 0.0016 - accuracy: 1.0000 -
val_loss: 7.0035e-07 - val_accuracy: 1.0000
Epoch 47/100
7/7 [==============================] - 30s 5s/step - loss: 0.0052 - accuracy: 1.0000 -
val_loss: 1.6764e-07 - val_accuracy: 1.0000
Epoch 48/100
7/7 [==============================] - 29s 4s/step - loss: 0.0135 - accuracy: 0.9880 -
val_loss: 9.4622e-07 - val_accuracy: 1.0000
Epoch 49/100
7/7 [==============================] - 29s 5s/step - loss: 0.0110 - accuracy: 0.9960 -
val_loss: 1.1160e-04 - val_accuracy: 1.0000
Epoch 50/100
7/7 [==============================] - 29s 4s/step - loss: 0.0175 - accuracy: 0.9960 -
val_loss: 2.9653e-04 - val_accuracy: 1.0000
Epoch 51/100
7/7 [==============================] - 29s 4s/step - loss: 9.8167e-04 - accuracy: 1.00
00 - val_loss: 5.2130e-05 - val_accuracy: 1.0000
Epoch 52/100
7/7 [==============================] - 31s 5s/step - loss: 0.0133 - accuracy: 0.9903 -
val_loss: 1.3415e-04 - val_accuracy: 1.0000
Epoch 53/100
7/7 [==============================] - 29s 5s/step - loss: 0.0025 - accuracy: 1.0000 -
val_loss: 1.1435e-04 - val_accuracy: 1.0000
Epoch 54/100
7/7 [==============================] - 29s 4s/step - loss: 0.0138 - accuracy: 0.9880 -
val_loss: 9.7871e-05 - val_accuracy: 1.0000
Epoch 55/100
7/7 [==============================] - 29s 4s/step - loss: 0.0022 - accuracy: 1.0000 -
val_loss: 2.0210e-04 - val_accuracy: 1.0000
Epoch 56/100
7/7 [==============================] - 29s 4s/step - loss: 0.0114 - accuracy: 0.9974 -
val_loss: 1.0016e-04 - val_accuracy: 1.0000
Epoch 57/100
7/7 [==============================] - 29s 5s/step - loss: 0.0100 - accuracy: 0.9988 -
val_loss: 1.0146e-05 - val_accuracy: 1.0000
Epoch 58/100
7/7 [==============================] - 29s 4s/step - loss: 0.0156 - accuracy: 0.9919 -
val_loss: 2.8237e-06 - val_accuracy: 1.0000
Epoch 59/100
7/7 [==============================] - 29s 5s/step - loss: 0.0060 - accuracy: 1.0000 -
val_loss: 2.9206e-06 - val_accuracy: 1.0000
Epoch 60/100
7/7 [==============================] - 29s 4s/step - loss: 0.0342 - accuracy: 0.9861 -
val_loss: 1.3365e-05 - val_accuracy: 1.0000
Epoch 61/100
7/7 [==============================] - 29s 4s/step - loss: 0.0127 - accuracy: 1.0000 -
val_loss: 7.4764e-05 - val_accuracy: 1.0000
Epoch 62/100
7/7 [==============================] - 30s 4s/step - loss: 0.0137 - accuracy: 0.9892 -
val_loss: 7.1978e-04 - val_accuracy: 1.0000
Epoch 63/100
7/7 [==============================] - 31s 5s/step - loss: 0.0018 - accuracy: 1.0000 -
val_loss: 3.8508e-04 - val_accuracy: 1.0000
Epoch 64/100
7/7 [==============================] - 29s 5s/step - loss: 0.0025 - accuracy: 1.0000 -
val_loss: 3.5925e-04 - val_accuracy: 1.0000
Epoch 65/100
7/7 [==============================] - 29s 4s/step - loss: 0.0029 - accuracy: 0.9988 -
val_loss: 0.0010 - val_accuracy: 1.0000
Epoch 66/100
7/7 [==============================] - 31s 5s/step - loss: 0.0075 - accuracy: 0.9932 -
val_loss: 0.0013 - val_accuracy: 1.0000
Epoch 67/100
7/7 [==============================] - 29s 4s/step - loss: 0.0107 - accuracy: 1.0000 -
val_loss: 4.9647e-04 - val_accuracy: 1.0000
Epoch 68/100
7/7 [==============================] - 29s 4s/step - loss: 0.0211 - accuracy: 0.9786 -
val_loss: 5.9205e-04 - val_accuracy: 1.0000
Epoch 69/100
7/7 [==============================] - 30s 4s/step - loss: 0.0024 - accuracy: 0.9972 -
val_loss: 2.8483e-04 - val_accuracy: 1.0000
Epoch 70/100
7/7 [==============================] - 29s 4s/step - loss: 0.0104 - accuracy: 0.9902 -
val_loss: 1.6003e-04 - val_accuracy: 1.0000
Epoch 71/100
7/7 [==============================] - 29s 4s/step - loss: 0.0102 - accuracy: 0.9889 -
val_loss: 4.9206e-05 - val_accuracy: 1.0000
Epoch 72/100
7/7 [==============================] - 29s 4s/step - loss: 0.0097 - accuracy: 1.0000 -
val_loss: 1.3216e-05 - val_accuracy: 1.0000
Epoch 73/100
7/7 [==============================] - 29s 4s/step - loss: 0.0115 - accuracy: 0.9961 -
val_loss: 1.0866e-05 - val_accuracy: 1.0000
Epoch 74/100
7/7 [==============================] - 31s 5s/step - loss: 0.0200 - accuracy: 0.9884 -
val_loss: 1.4225e-05 - val_accuracy: 1.0000
Epoch 75/100
7/7 [==============================] - 29s 4s/step - loss: 0.0034 - accuracy: 1.0000 -
val_loss: 1.4549e-05 - val_accuracy: 1.0000
Epoch 76/100
7/7 [==============================] - 29s 4s/step - loss: 0.0039 - accuracy: 0.9961 -
val_loss: 7.0780e-08 - val_accuracy: 1.0000
Epoch 77/100
7/7 [==============================] - 29s 4s/step - loss: 0.0027 - accuracy: 1.0000 -
val_loss: 4.0605e-07 - val_accuracy: 1.0000
Epoch 78/100
7/7 [==============================] - 29s 4s/step - loss: 0.0065 - accuracy: 0.9933 -
val_loss: 2.6077e-08 - val_accuracy: 1.0000
Epoch 79/100
7/7 [==============================] - 29s 5s/step - loss: 0.0090 - accuracy: 1.0000 -
val_loss: 1.5907e-06 - val_accuracy: 1.0000
Epoch 80/100
7/7 [==============================] - 29s 4s/step - loss: 0.0051 - accuracy: 0.9964 -
val_loss: 9.9078e-06 - val_accuracy: 1.0000
Epoch 81/100
7/7 [==============================] - 29s 4s/step - loss: 0.0138 - accuracy: 1.0000 -
val_loss: 2.3763e-05 - val_accuracy: 1.0000
Epoch 82/100
7/7 [==============================] - 29s 4s/step - loss: 0.0207 - accuracy: 0.9928 -
val_loss: 4.6265e-06 - val_accuracy: 1.0000
Epoch 83/100
7/7 [==============================] - 31s 5s/step - loss: 0.0108 - accuracy: 0.9952 -
val_loss: 1.8427e-05 - val_accuracy: 1.0000
Epoch 84/100
7/7 [==============================] - 29s 4s/step - loss: 0.0049 - accuracy: 0.9961 -
val_loss: 4.0978e-08 - val_accuracy: 1.0000
Epoch 85/100
7/7 [==============================] - 29s 4s/step - loss: 0.0061 - accuracy: 0.9945 -
val_loss: 1.4212e-05 - val_accuracy: 1.0000
Epoch 86/100
7/7 [==============================] - 29s 4s/step - loss: 8.4068e-04 - accuracy: 1.00
00 - val_loss: 7.9711e-06 - val_accuracy: 1.0000
Epoch 87/100
7/7 [==============================] - 29s 4s/step - loss: 0.0126 - accuracy: 0.9988 -
val_loss: 1.2476e-04 - val_accuracy: 1.0000
Epoch 88/100
7/7 [==============================] - 29s 4s/step - loss: 0.0014 - accuracy: 1.0000 -
val_loss: 2.0596e-04 - val_accuracy: 1.0000
Epoch 89/100
7/7 [==============================] - 29s 4s/step - loss: 0.0018 - accuracy: 1.0000 -
val_loss: 2.6891e-04 - val_accuracy: 1.0000
Epoch 90/100
7/7 [==============================] - 29s 4s/step - loss: 0.0014 - accuracy: 1.0000 -
val_loss: 5.2821e-05 - val_accuracy: 1.0000
Epoch 91/100
7/7 [==============================] - 29s 4s/step - loss: 0.0085 - accuracy: 1.0000 -
val_loss: 7.2745e-04 - val_accuracy: 1.0000
Epoch 92/100
7/7 [==============================] - 30s 4s/step - loss: 0.0095 - accuracy: 0.9931 -
val_loss: 1.5987e-04 - val_accuracy: 1.0000
Epoch 93/100
7/7 [==============================] - 30s 4s/step - loss: 8.6519e-04 - accuracy: 1.00
00 - val_loss: 3.5612e-05 - val_accuracy: 1.0000
Epoch 94/100
7/7 [==============================] - 30s 4s/step - loss: 0.0146 - accuracy: 0.9948 -
val_loss: 1.1176e-07 - val_accuracy: 1.0000
Epoch 95/100
7/7 [==============================] - 30s 4s/step - loss: 0.0136 - accuracy: 0.9947 -
val_loss: 3.3527e-07 - val_accuracy: 1.0000
Epoch 96/100
7/7 [==============================] - 30s 4s/step - loss: 2.4546e-04 - accuracy: 1.00
00 - val_loss: 0.1467 - val_accuracy: 0.9688
Epoch 97/100
7/7 [==============================] - 29s 4s/step - loss: 0.0051 - accuracy: 1.0000 -
val_loss: 0.0243 - val_accuracy: 0.9688
Epoch 98/100
7/7 [==============================] - 29s 4s/step - loss: 7.2235e-04 - accuracy: 1.00
00 - val_loss: 5.7653e-05 - val_accuracy: 1.0000
Epoch 99/100
7/7 [==============================] - 29s 5s/step - loss: 5.2778e-05 - accuracy: 1.00
00 - val_loss: 8.1282e-06 - val_accuracy: 1.0000
Epoch 100/100
7/7 [==============================] - 29s 4s/step - loss: 8.1481e-04 - accuracy: 1.00
00 - val_loss: 3.2707e-06 - val_accuracy: 1.0000
```

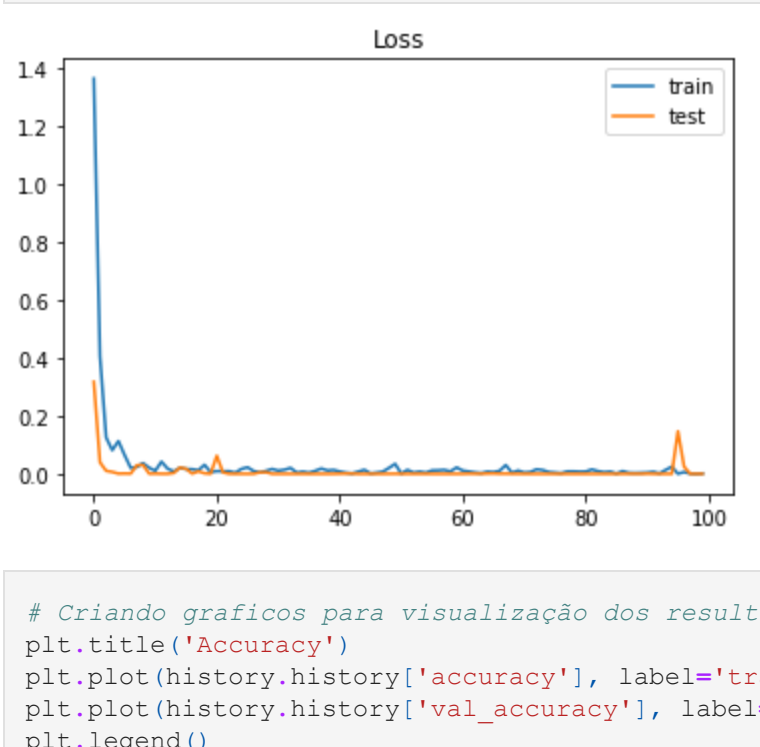
In [12]:

```
#Avaliando o modelo
loss_train, train_acc = model.evaluate_generator(train_generator, steps=step_size_tra
loss_test, test_acc = model.evaluate_generator(test_generator, steps=step_size_test)
print('Train: %.3f, Test: %.3f' % (train_acc, test_acc))
```

```
c:\users\vinicius\appdata\local\programs\python\python39\lib\site-packages\tensorflow
\python\keras\engine\training.py:1973: UserWarning: `Model.evaluate_generator` is depr
ecated and will be removed in a future version. Please use `Model.evaluate`, which sup
ports generators.
  warnings.warn('`Model.evaluate_generator` is deprecated and '
Train: 1.000, Test: 1.000
```

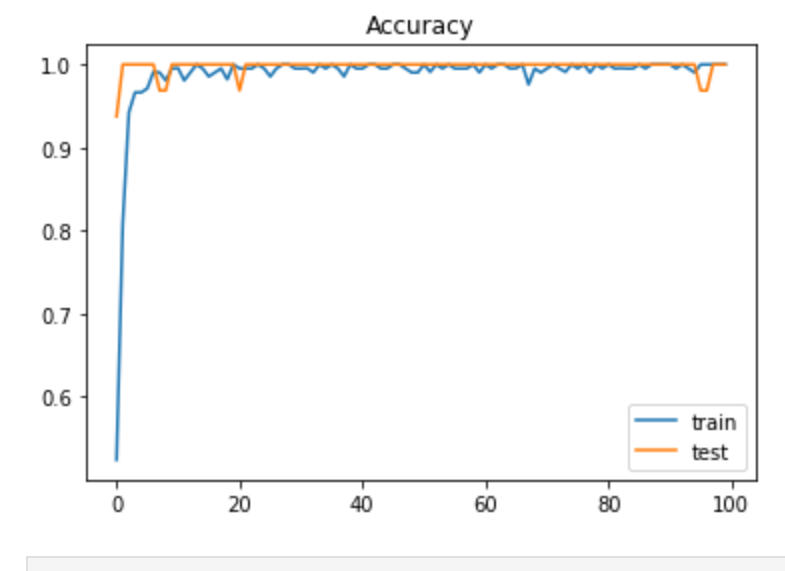
In [13]:

```
#Apresentando resultados em graficos
plt.title('Loss')
plt.plot(history.history['loss'], label='train')
plt.plot(history.history['val_loss'], label='test')
plt.legend()
plt.show()
```



In [14]:

```
# Criando graficos para visualização dos resultados
plt.title('Accuracy')
plt.plot(history.history['accuracy'], label='train')
plt.plot(history.history['val_accuracy'], label='test')
plt.legend()
plt.show()
```



In [15]:

```python
print('Criando classificações..')
labels = os.listdir('shapes_split/test')
print('Rótulos', labels)
#criando estruturas para métricas de avaliação, processo um pouco mais demorado
Y_pred = model.predict_generator(test_generator)
print('Preds Created')
y_pred = np.argmax(Y_pred, axis=1)
print('Preds 1D created')
```

```
Criando classificações..
Rótulos ['circles', 'squares', 'triangles']
c:\users\vinicius\appdata\local\programs\python\python39\lib\site-packages\tensorflow
\python\keras\engine\training.py:2001: UserWarning: `Model.predict_generator` is depre
cated and will be removed in a future version. Please use `Model.predict`, which suppo
rts generators.
  warnings.warn('`Model.predict_generator` is deprecated and '
Preds Created
Preds 1D created
```

In [16]:

```python
classification = classification_report(test_generator.classes, y_pred, target_names=la
print('----------------CLASSIFICATION--------------')
print(classification)
matrix = confusion_matrix(test_generator.classes, y_pred)
df_cm = pd.DataFrame(matrix, index = [i for i in range(3)],
                     columns = [i for i in range(3)])
plt.figure(figsize = (10,7))
print('----------------MATRIX--------------')
sn.heatmap(df_cm, annot=True, linewidths=2.5)
```

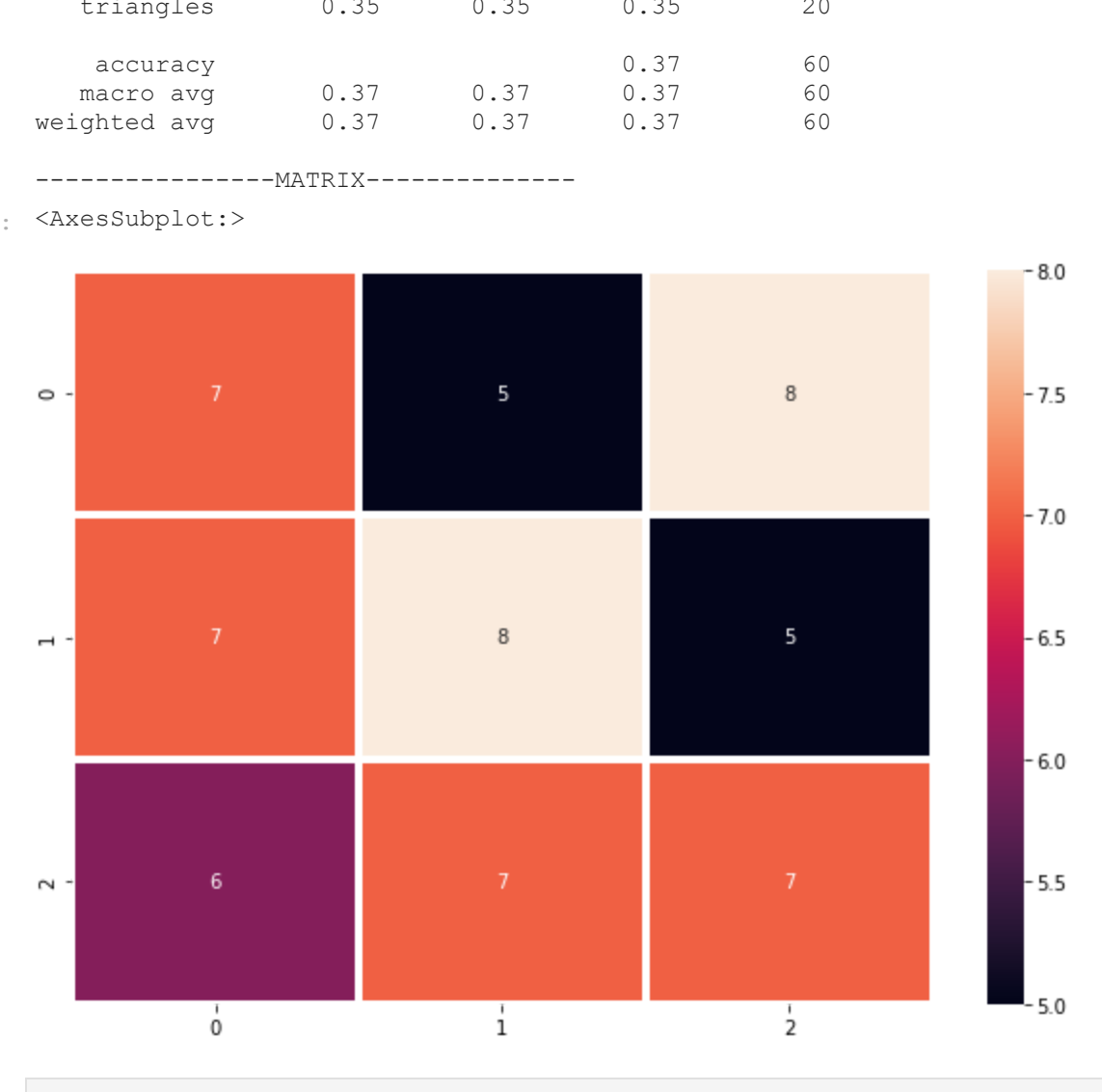
```
----------------CLASSIFICATION--------------
              precision    recall  f1-score   support

     circles       0.35      0.35      0.35        20
     squares       0.40      0.40      0.40        20
   triangles       0.35      0.35      0.35        20

    accuracy                           0.37        60
   macro avg       0.37      0.37      0.37        60
weighted avg       0.37      0.37      0.37        60

----------------MATRIX--------------
```

Out[16]: <AxesSubplot:>



In [ ]: