

## Transferência de aprendizagem

## Importação das bibliotecas

```
In [2]: import tensorflow as tf
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Model
from keras.layers import Input, Dense, GlobalAveragePooling2D, Dropout
import matplotlib.pyplot as plt
import seaborn as sns
import zipfile
import numpy as np
import cv2
import pandas as pd
from google.colab.patches import cv2_imshow
tf.__version__
```

Out[2]: '2.9.2'

## Carregamento das imagens

```
In [3]: #Conectando ao google drive.
from google.colab import drive
drive.mount('/content/drive')
```

Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force\_remount=True).

```
In [5]: # Realizando a extração do arquivo zip.
path = '/content/drive/MyDrive/Colab Notebooks/CatDog500.zip'
zip_object = zipfile.ZipFile(file=path, mode='r')
zip_object.extractall('.')
zip_object.close()
```

```
In [8]: #Visualizando um imagem da pasta de treinamento cat.
tf.keras.preprocessing.image.load_img('/content/CatDog/Cat/cat.1.jpg')
```

Out[8]:



```
In [9]: # visualizando uma imagem da pasta de treinamento dog.
tf.keras.preprocessing.image.load_img('/content/CatDog/Dog/dog.1.jpg')
```

Out[9]:



Base de dados de treinamento e teste

In [10]:

```
# realizando o redimensionamento e a normalização no conjunto de treinamento.
gerador_treinamento = ImageDataGenerator(rescale=1./255, rotation_range=7, horizontal_flip=True, zoom_range=0.2)
dataset_treinamento = gerador_treinamento.flow_from_directory('/content/CatDog',
                                                                target_size = (128, 128),
                                                                batch_size = 128,
                                                                class_mode = 'categorical',
                                                                shuffle = True)
```

Found 1000 images belonging to 2 classes.

In [11]:

```
# Alterando as imagens.
datagen = ImageDataGenerator(
    rotation_range=7, # Rotação
    zoom_range=0.2, # aplicano 20% de zoom
    horizontal_flip=True, # horizontal flip
    brightness_range=[0.2,1.2]) # brilho

# Imagem sem alteração.
datanorm = ImageDataGenerator()

# Conjunto com alterações
treino_alterado = datagen.flow_from_directory(
    '/content/CatDog',
    target_size=(400, 400), # padronizando todas as imagens
    color_mode="rgb", # imagem colorida
    batch_size=1, # numero de imagens extraída por batch
    class_mode="binary", # classes
    seed=2022 # para que os resultados sejam reprodutíveis
```

```

seed=2020 # para que os resultados sejam reproduzidos
)

# Conjunto sem sofrer alterações
treino_normal = datanorm.flow_from_directory(
    '/content/CatDog',
    target_size=(400, 400),
    color_mode="rgb",
    batch_size=1,
    class_mode="binary",
    seed=2020
)

fig, ax = plt.subplots(nrows=2, ncols=4, figsize=(15,15))

# Plotando 5 imagens
for i in range(4):

    # convertendo a imagem para inteiro
    image = next(treino_alterado)[0].astype('uint8')
    image2 = next(treino_normal)[0].astype('uint8')

    # alterando o formato (1, 200, 200, 3) para (200, 200, 3) para plotar a imagem
    image = np.squeeze(image)
    image2 = np.squeeze(image2)

    # plotando as imagens
    ax[0,i].imshow(image2)
    ax[0,i].set_title('Imagem original')
    ax[0,i].axis('off')
    ax[1,i].imshow(image)
    ax[1,i].set_title('Imagem alterada')
    ax[1,i].axis('off')

```

Found 1000 images belonging to 2 classes.  
Found 1000 images belonging to 2 classes.

Imagem original



Imagem original

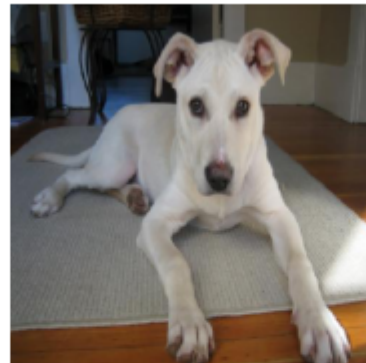


Imagem original

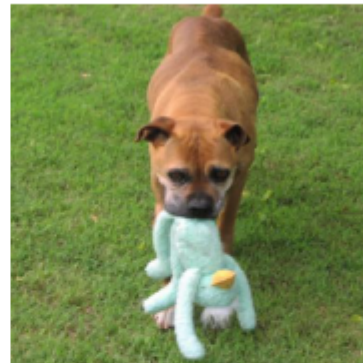
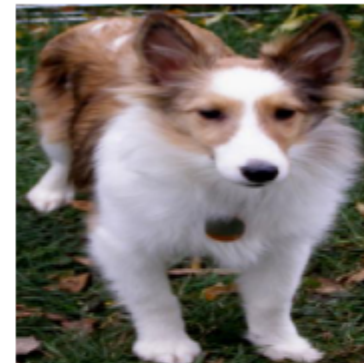
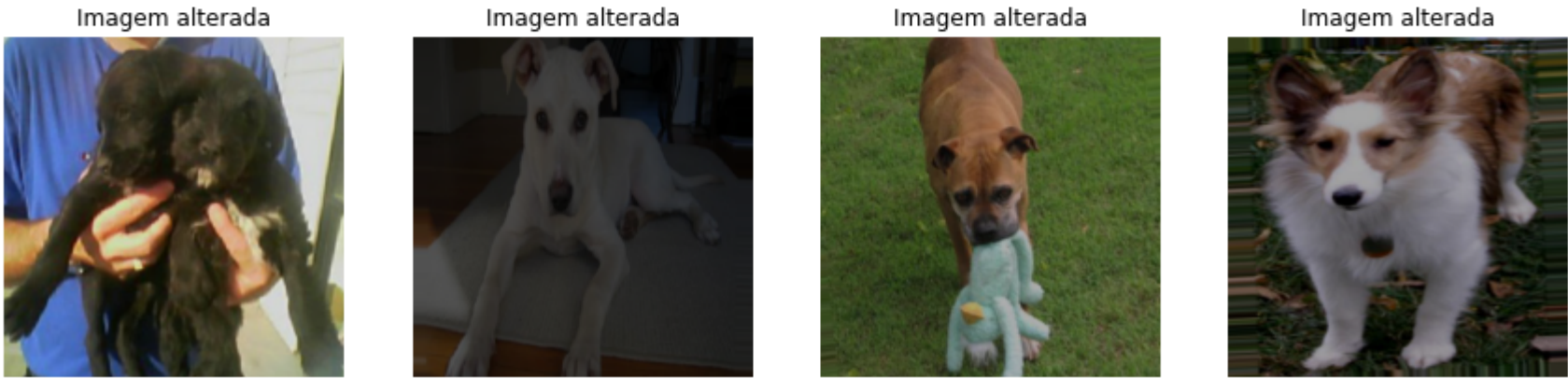


Imagem original





```
In [13]: # realizando o redimensionamento e a normalização no conjunto de teste.
gerador_teste = ImageDataGenerator(rescale=1./255)
dataset_teste = gerador_teste.flow_from_directory('/content/CatDog',
                                                target_size = (128, 128),
                                                batch_size = 1,
                                                class_mode = 'categorical',
                                                shuffle = False)
```

Found 1000 images belonging to 2 classes.

Rede neural pré-treinada

```
In [14]: # Carregando o modelo base MobileNetV2.
modelo_base = tf.keras.applications.MobileNetV2(weights='imagenet', include_top=False,
                                                input_shape = (128,128,3))
```

Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/mobilenet\_v2/mobilenet\_v2\_weights\_tf\_dim\_ordering\_tf\_kernels\_1.0\_128\_no\_top.h5  
9406464/9406464 [=====] - 0s 0us/step

```
In [15]: # informações das camadas do modelo base.
modelo_base.summary()
```

Model: "mobilenetv2\_1.00\_128"

Layer (type)	Output Shape	Param #	Connected to
=====			
input_1 (InputLayer)	[(None, 128, 128, 3)]	0	[]
Conv1 (Conv2D)	(None, 64, 64, 32)	864	['input_1[0][0]']
bn_Conv1 (BatchNormalization)	(None, 64, 64, 32)	128	['Conv1[0][0]']
Conv1_relu (ReLU)	(None, 64, 64, 32)	0	['bn_Conv1[0][0]']
expanded_conv_depthwise (Depth wiseConv2D)	(None, 64, 64, 32)	288	['Conv1_relu[0][0]']
expanded_conv_depthwise_BN (BatchNormalization)	(None, 64, 64, 32)	128	['expanded_conv_depthwise[0][0]']
expanded_conv_depthwise_relu (ReLU)	(None, 64, 64, 32)	0	['expanded_conv_depthwise_BN[0][0]']
expanded_conv_project (Conv2D)	(None, 64, 64, 16)	512	['expanded_conv_depthwise_relu[0][0]']

expanded_conv_project_BN (BatchNormalization)	(None, 64, 64, 16)	64	['expanded_conv_project[0][0]']
block_1_expand (Conv2D)	(None, 64, 64, 96)	1536	['expanded_conv_project_BN[0][0]']
block_1_expand_BN (BatchNormalization)	(None, 64, 64, 96)	384	['block_1_expand[0][0]']
block_1_expand_relu (ReLU)	(None, 64, 64, 96)	0	['block_1_expand_BN[0][0]']
block_1_pad (ZeroPadding2D)	(None, 65, 65, 96)	0	['block_1_expand_relu[0][0]']
block_1_depthwise (DepthwiseConv2D)	(None, 32, 32, 96)	864	['block_1_pad[0][0]']
block_1_depthwise_BN (BatchNormalization)	(None, 32, 32, 96)	384	['block_1_depthwise[0][0]']
block_1_depthwise_relu (ReLU)	(None, 32, 32, 96)	0	['block_1_depthwise_BN[0][0]']
block_1_project (Conv2D)	(None, 32, 32, 24)	2304	['block_1_depthwise_relu[0][0]']
block_1_project_BN (BatchNormalization)	(None, 32, 32, 24)	96	['block_1_project[0][0]']
block_2_expand (Conv2D)	(None, 32, 32, 144)	3456	['block_1_project_BN[0][0]']
block_2_expand_BN (BatchNormalization)	(None, 32, 32, 144)	576	['block_2_expand[0][0]']
block_2_expand_relu (ReLU)	(None, 32, 32, 144)	0	['block_2_expand_BN[0][0]']
block_2_depthwise (DepthwiseConv2D)	(None, 32, 32, 144)	1296	['block_2_expand_relu[0][0]']
block_2_depthwise_BN (BatchNormalization)	(None, 32, 32, 144)	576	['block_2_depthwise[0][0]']
block_2_depthwise_relu (ReLU)	(None, 32, 32, 144)	0	['block_2_depthwise_BN[0][0]']
block_2_project (Conv2D)	(None, 32, 32, 24)	3456	['block_2_depthwise_relu[0][0]']
block_2_project_BN (BatchNormalization)	(None, 32, 32, 24)	96	['block_2_project[0][0]']
block_2_add (Add)	(None, 32, 32, 24)	0	['block_1_project_BN[0][0]', 'block_2_project_BN[0][0]']
block_3_expand (Conv2D)	(None, 32, 32, 144)	3456	['block_2_add[0][0]']
block_3_expand_BN (BatchNormalization)	(None, 32, 32, 144)	576	['block_3_expand[0][0]']
block_3_expand_relu (ReLU)	(None, 32, 32, 144)	0	['block_3_expand_BN[0][0]']
block_3_pad (ZeroPadding2D)	(None, 33, 33, 144)	0	['block_3_expand_relu[0][0]']
block_3_depthwise (DepthwiseConv2D)	(None, 16, 16, 144)	1296	['block_3_pad[0][0]']
block_3_depthwise_BN (BatchNormalization)	(None, 16, 16, 144)	576	['block_3_depthwise[0][0]']



block_3_depthwise_relu (ReLU)	(None, 16, 16, 144)	0	['block_3_depthwise_BN[0][0]']
block_3_project (Conv2D)	(None, 16, 16, 32)	4608	['block_3_depthwise_relu[0][0]']
block_3_project_BN (BatchNormalization)	(None, 16, 16, 32)	128	['block_3_project[0][0]']
block_4_expand (Conv2D)	(None, 16, 16, 192)	6144	['block_3_project_BN[0][0]']
block_4_expand_BN (BatchNormalization)	(None, 16, 16, 192)	768	['block_4_expand[0][0]']
block_4_expand_relu (ReLU)	(None, 16, 16, 192)	0	['block_4_expand_BN[0][0]']
block_4_depthwise (DepthwiseConv2D)	(None, 16, 16, 192)	1728	['block_4_expand_relu[0][0]']
block_4_depthwise_BN (BatchNormalization)	(None, 16, 16, 192)	768	['block_4_depthwise[0][0]']
block_4_depthwise_relu (ReLU)	(None, 16, 16, 192)	0	['block_4_depthwise_BN[0][0]']
block_4_project (Conv2D)	(None, 16, 16, 32)	6144	['block_4_depthwise_relu[0][0]']
block_4_project_BN (BatchNormalization)	(None, 16, 16, 32)	128	['block_4_project[0][0]']
block_4_add (Add)	(None, 16, 16, 32)	0	['block_3_project_BN[0][0]', 'block_4_project_BN[0][0]']
block_5_expand (Conv2D)	(None, 16, 16, 192)	6144	['block_4_add[0][0]']
block_5_expand_BN (BatchNormalization)	(None, 16, 16, 192)	768	['block_5_expand[0][0]']
block_5_expand_relu (ReLU)	(None, 16, 16, 192)	0	['block_5_expand_BN[0][0]']
block_5_depthwise (DepthwiseConv2D)	(None, 16, 16, 192)	1728	['block_5_expand_relu[0][0]']
block_5_depthwise_BN (BatchNormalization)	(None, 16, 16, 192)	768	['block_5_depthwise[0][0]']
block_5_depthwise_relu (ReLU)	(None, 16, 16, 192)	0	['block_5_depthwise_BN[0][0]']
block_5_project (Conv2D)	(None, 16, 16, 32)	6144	['block_5_depthwise_relu[0][0]']
block_5_project_BN (BatchNormalization)	(None, 16, 16, 32)	128	['block_5_project[0][0]']
block_5_add (Add)	(None, 16, 16, 32)	0	['block_4_add[0][0]', 'block_5_project_BN[0][0]']
block_6_expand (Conv2D)	(None, 16, 16, 192)	6144	['block_5_add[0][0]']
block_6_expand_BN (BatchNormalization)	(None, 16, 16, 192)	768	['block_6_expand[0][0]']
block_6_expand_relu (ReLU)	(None, 16, 16, 192)	0	['block_6_expand_BN[0][0]']
block_6_pad (ZeroPadding2D)	(None, 17, 17, 192)	0	['block_6_expand_relu[0][0]']
block_6_depthwise (DepthwiseConv2D)	(None, 8, 8, 192)	1728	['block_6_pad[0][0]']

block_6_depthwise_BN (BatchNormalization)	(None, 8, 8, 192)	768	['block_6_depthwise[0][0]']
block_6_depthwise_relu (ReLU)	(None, 8, 8, 192)	0	['block_6_depthwise_BN[0][0]']
block_6_project (Conv2D)	(None, 8, 8, 64)	12288	['block_6_depthwise_relu[0][0]']
block_6_project_BN (BatchNormalization)	(None, 8, 8, 64)	256	['block_6_project[0][0]']
block_7_expand (Conv2D)	(None, 8, 8, 384)	24576	['block_6_project_BN[0][0]']
block_7_expand_BN (BatchNormalization)	(None, 8, 8, 384)	1536	['block_7_expand[0][0]']
block_7_expand_relu (ReLU)	(None, 8, 8, 384)	0	['block_7_expand_BN[0][0]']
block_7_depthwise (DepthwiseConv2D)	(None, 8, 8, 384)	3456	['block_7_expand_relu[0][0]']
block_7_depthwise_BN (BatchNormalization)	(None, 8, 8, 384)	1536	['block_7_depthwise[0][0]']
block_7_depthwise_relu (ReLU)	(None, 8, 8, 384)	0	['block_7_depthwise_BN[0][0]']
block_7_project (Conv2D)	(None, 8, 8, 64)	24576	['block_7_depthwise_relu[0][0]']
block_7_project_BN (BatchNormalization)	(None, 8, 8, 64)	256	['block_7_project[0][0]']
block_7_add (Add)	(None, 8, 8, 64)	0	['block_6_project_BN[0][0]', 'block_7_project_BN[0][0]']
block_8_expand (Conv2D)	(None, 8, 8, 384)	24576	['block_7_add[0][0]']
block_8_expand_BN (BatchNormalization)	(None, 8, 8, 384)	1536	['block_8_expand[0][0]']
block_8_expand_relu (ReLU)	(None, 8, 8, 384)	0	['block_8_expand_BN[0][0]']
block_8_depthwise (DepthwiseConv2D)	(None, 8, 8, 384)	3456	['block_8_expand_relu[0][0]']
block_8_depthwise_BN (BatchNormalization)	(None, 8, 8, 384)	1536	['block_8_depthwise[0][0]']
block_8_depthwise_relu (ReLU)	(None, 8, 8, 384)	0	['block_8_depthwise_BN[0][0]']
block_8_project (Conv2D)	(None, 8, 8, 64)	24576	['block_8_depthwise_relu[0][0]']
block_8_project_BN (BatchNormalization)	(None, 8, 8, 64)	256	['block_8_project[0][0]']
block_8_add (Add)	(None, 8, 8, 64)	0	['block_7_add[0][0]', 'block_8_project_BN[0][0]']
block_9_expand (Conv2D)	(None, 8, 8, 384)	24576	['block_8_add[0][0]']
block_9_expand_BN (BatchNormalization)	(None, 8, 8, 384)	1536	['block_9_expand[0][0]']
block_9_expand_relu (ReLU)	(None, 8, 8, 384)	0	['block_9_expand_BN[0][0]']
block 9 depthwise (DepthwiseConv2D)	(None, 8, 8, 384)	3456	['block 9 expand_relu[0][0]']

```

nv2D)

block_9_depthwise_BN (BatchNormalization) (None, 8, 8, 384) 1536 ['block_9_depthwise[0][0]']

block_9_depthwise_relu (ReLU) (None, 8, 8, 384) 0 ['block_9_depthwise_BN[0][0]']

block_9_project (Conv2D) (None, 8, 8, 64) 24576 ['block_9_depthwise_relu[0][0]']

block_9_project_BN (BatchNormalization) (None, 8, 8, 64) 256 ['block_9_project[0][0]']

block_9_add (Add) (None, 8, 8, 64) 0 ['block_8_add[0][0]',
'block_9_project_BN[0][0]']

block_10_expand (Conv2D) (None, 8, 8, 384) 24576 ['block_9_add[0][0]']

block_10_expand_BN (BatchNormalization) (None, 8, 8, 384) 1536 ['block_10_expand[0][0]']

block_10_expand_relu (ReLU) (None, 8, 8, 384) 0 ['block_10_expand_BN[0][0]']

block_10_depthwise (DepthwiseConv2D) (None, 8, 8, 384) 3456 ['block_10_expand_relu[0][0]']

block_10_depthwise_BN (BatchNormalization) (None, 8, 8, 384) 1536 ['block_10_depthwise[0][0]']

block_10_depthwise_relu (ReLU) (None, 8, 8, 384) 0 ['block_10_depthwise_BN[0][0]']

block_10_project (Conv2D) (None, 8, 8, 96) 36864 ['block_10_depthwise_relu[0][0]']

block_10_project_BN (BatchNormalization) (None, 8, 8, 96) 384 ['block_10_project[0][0]']

block_11_expand (Conv2D) (None, 8, 8, 576) 55296 ['block_10_project_BN[0][0]']

block_11_expand_BN (BatchNormalization) (None, 8, 8, 576) 2304 ['block_11_expand[0][0]']

block_11_expand_relu (ReLU) (None, 8, 8, 576) 0 ['block_11_expand_BN[0][0]']

block_11_depthwise (DepthwiseConv2D) (None, 8, 8, 576) 5184 ['block_11_expand_relu[0][0]']

block_11_depthwise_BN (BatchNormalization) (None, 8, 8, 576) 2304 ['block_11_depthwise[0][0]']

block_11_depthwise_relu (ReLU) (None, 8, 8, 576) 0 ['block_11_depthwise_BN[0][0]']

block_11_project (Conv2D) (None, 8, 8, 96) 55296 ['block_11_depthwise_relu[0][0]']

block_11_project_BN (BatchNormalization) (None, 8, 8, 96) 384 ['block_11_project[0][0]']

block_11_add (Add) (None, 8, 8, 96) 0 ['block_10_project_BN[0][0]',
'block_11_project_BN[0][0]']

block_12_expand (Conv2D) (None, 8, 8, 576) 55296 ['block_11_add[0][0]']

block_12_expand_BN (BatchNormalization) (None, 8, 8, 576) 2304 ['block_12_expand[0][0]']

block_12_expand_relu (ReLU) (None, 8, 8, 576) 0 ['block_12_expand_BN[0][0]']

```



block_12_depthwise (DepthwiseConv2D)	(None, 8, 8, 576)	5184	['block_12_expand_relu[0][0]']
block_12_depthwise_BN (BatchNormalization)	(None, 8, 8, 576)	2304	['block_12_depthwise[0][0]']
block_12_depthwise_relu (ReLU)	(None, 8, 8, 576)	0	['block_12_depthwise_BN[0][0]']
block_12_project (Conv2D)	(None, 8, 8, 96)	55296	['block_12_depthwise_relu[0][0]']
block_12_project_BN (BatchNormalization)	(None, 8, 8, 96)	384	['block_12_project[0][0]']
block_12_add (Add)	(None, 8, 8, 96)	0	['block_11_add[0][0]', 'block_12_project_BN[0][0]']
block_13_expand (Conv2D)	(None, 8, 8, 576)	55296	['block_12_add[0][0]']
block_13_expand_BN (BatchNormalization)	(None, 8, 8, 576)	2304	['block_13_expand[0][0]']
block_13_expand_relu (ReLU)	(None, 8, 8, 576)	0	['block_13_expand_BN[0][0]']
block_13_pad (ZeroPadding2D)	(None, 9, 9, 576)	0	['block_13_expand_relu[0][0]']
block_13_depthwise (DepthwiseConv2D)	(None, 4, 4, 576)	5184	['block_13_pad[0][0]']
block_13_depthwise_BN (BatchNormalization)	(None, 4, 4, 576)	2304	['block_13_depthwise[0][0]']
block_13_depthwise_relu (ReLU)	(None, 4, 4, 576)	0	['block_13_depthwise_BN[0][0]']
block_13_project (Conv2D)	(None, 4, 4, 160)	92160	['block_13_depthwise_relu[0][0]']
block_13_project_BN (BatchNormalization)	(None, 4, 4, 160)	640	['block_13_project[0][0]']
block_14_expand (Conv2D)	(None, 4, 4, 960)	153600	['block_13_project_BN[0][0]']
block_14_expand_BN (BatchNormalization)	(None, 4, 4, 960)	3840	['block_14_expand[0][0]']
block_14_expand_relu (ReLU)	(None, 4, 4, 960)	0	['block_14_expand_BN[0][0]']
block_14_depthwise (DepthwiseConv2D)	(None, 4, 4, 960)	8640	['block_14_expand_relu[0][0]']
block_14_depthwise_BN (BatchNormalization)	(None, 4, 4, 960)	3840	['block_14_depthwise[0][0]']
block_14_depthwise_relu (ReLU)	(None, 4, 4, 960)	0	['block_14_depthwise_BN[0][0]']
block_14_project (Conv2D)	(None, 4, 4, 160)	153600	['block_14_depthwise_relu[0][0]']
block_14_project_BN (BatchNormalization)	(None, 4, 4, 160)	640	['block_14_project[0][0]']
block_14_add (Add)	(None, 4, 4, 160)	0	['block_13_project_BN[0][0]', 'block_14_project_BN[0][0]']
block_15_expand (Conv2D)	(None, 4, 4, 960)	153600	['block_14_add[0][0]']
block_15_expand_BN (BatchNormalization)	(None, 4, 4, 960)	3840	['block_15_expand[0][0]']

block_15_expand_bn (BatchNormalization)	(None, 4, 4, 960)	3840	['block_15_expand[0][0]']
block_15_expand_relu (ReLU)	(None, 4, 4, 960)	0	['block_15_expand_BN[0][0]']
block_15_depthwise (DepthwiseConv2D)	(None, 4, 4, 960)	8640	['block_15_expand_relu[0][0]']
block_15_depthwise_BN (BatchNormalization)	(None, 4, 4, 960)	3840	['block_15_depthwise[0][0]']
block_15_depthwise_relu (ReLU)	(None, 4, 4, 960)	0	['block_15_depthwise_BN[0][0]']
block_15_project (Conv2D)	(None, 4, 4, 160)	153600	['block_15_depthwise_relu[0][0]']
block_15_project_BN (BatchNormalization)	(None, 4, 4, 160)	640	['block_15_project[0][0]']
block_15_add (Add)	(None, 4, 4, 160)	0	['block_14_add[0][0]', 'block_15_project_BN[0][0]']
block_16_expand (Conv2D)	(None, 4, 4, 960)	153600	['block_15_add[0][0]']
block_16_expand_BN (BatchNormalization)	(None, 4, 4, 960)	3840	['block_16_expand[0][0]']
block_16_expand_relu (ReLU)	(None, 4, 4, 960)	0	['block_16_expand_BN[0][0]']
block_16_depthwise (DepthwiseConv2D)	(None, 4, 4, 960)	8640	['block_16_expand_relu[0][0]']
block_16_depthwise_BN (BatchNormalization)	(None, 4, 4, 960)	3840	['block_16_depthwise[0][0]']
block_16_depthwise_relu (ReLU)	(None, 4, 4, 960)	0	['block_16_depthwise_BN[0][0]']
block_16_project (Conv2D)	(None, 4, 4, 320)	307200	['block_16_depthwise_relu[0][0]']
block_16_project_BN (BatchNormalization)	(None, 4, 4, 320)	1280	['block_16_project[0][0]']
Conv_1 (Conv2D)	(None, 4, 4, 1280)	409600	['block_16_project_BN[0][0]']
Conv_1_bn (BatchNormalization)	(None, 4, 4, 1280)	5120	['Conv_1[0][0]']
out_relu (ReLU)	(None, 4, 4, 1280)	0	['Conv_1_bn[0][0]']
=====			
Total params: 2,257,984			
Trainable params: 2,223,872			
Non-trainable params: 34,112			

```
In [16]: # visualizando a quantidade de camadas que o modelo possui.
len(modelo_base.layers)
```

Out[16]: 154

```
In [17]: # Congelando os pesos das camadas para serem reaproveitadas.
for layer in modelo_base.layers:
    layer.trainable = False
```

Camada densa personalizada

```
In [18]: # acessando a ultima camada do modelo base, pois após ela iremos adicionar a estrutura densa.
modelo_base.output
```

Out[18]:

```
In [19]: head_model = modelo_base.output
head_model = tf.keras.layers.GlobalAveragePooling2D()(head_model)
head_model = Dense(641, activation = 'relu')(head_model)
head_model = Dropout(0.2)(head_model)
head_model = Dense(641, activation = 'relu')(head_model)
head_model = Dropout(0.2)(head_model)
head_model = Dense(2, activation = 'softmax')(head_model)
```

Construção e treinamento da rede neural

```
In [20]: # Agora literalmente realizando a ligação entre o modelo base e as camadas que foram implementadas.
network = Model(inputs = modelo_base.input, outputs = head_model)
```

```
In [21]: # visualizando as informações das camadas.
network.summary()
```

Model: "model"

Layer (type)	Output Shape	Param #	Connected to
=====			
input_1 (InputLayer)	[(None, 128, 128, 3)]	0	[]
Conv1 (Conv2D)	(None, 64, 64, 32)	864	['input_1[0][0]']
bn_Conv1 (BatchNormalization)	(None, 64, 64, 32)	128	['Conv1[0][0]']
Conv1_relu (ReLU)	(None, 64, 64, 32)	0	['bn_Conv1[0][0]']
expanded_conv_depthwise (Depth wiseConv2D)	(None, 64, 64, 32)	288	['Conv1_relu[0][0]']
expanded_conv_depthwise_BN (BatchNormalization)	(None, 64, 64, 32)	128	['expanded_conv_depthwise[0][0]']
expanded_conv_depthwise_relu (ReLU)	(None, 64, 64, 32)	0	['expanded_conv_depthwise_BN[0][0]']
expanded_conv_project (Conv2D)	(None, 64, 64, 16)	512	['expanded_conv_depthwise_relu[0][0]']
expanded_conv_project_BN (BatchNormalization)	(None, 64, 64, 16)	64	['expanded_conv_project[0][0]']
block_1_expand (Conv2D)	(None, 64, 64, 96)	1536	['expanded_conv_project_BN[0][0]']
block_1_expand_BN (BatchNormalization)	(None, 64, 64, 96)	384	['block_1_expand[0][0]']
block_1_expand_relu (ReLU)	(None, 64, 64, 96)	0	['block_1_expand_BN[0][0]']

block_1_pad (ZeroPadding2D)	(None, 65, 65, 96)	0	['block_1_expand_relu[0][0]']
block_1_depthwise (DepthwiseConv2D)	(None, 32, 32, 96)	864	['block_1_pad[0][0]']
block_1_depthwise_BN (BatchNormalization)	(None, 32, 32, 96)	384	['block_1_depthwise[0][0]']
block_1_depthwise_relu (ReLU)	(None, 32, 32, 96)	0	['block_1_depthwise_BN[0][0]']
block_1_project (Conv2D)	(None, 32, 32, 24)	2304	['block_1_depthwise_relu[0][0]']
block_1_project_BN (BatchNormalization)	(None, 32, 32, 24)	96	['block_1_project[0][0]']
block_2_expand (Conv2D)	(None, 32, 32, 144)	3456	['block_1_project_BN[0][0]']
block_2_expand_BN (BatchNormalization)	(None, 32, 32, 144)	576	['block_2_expand[0][0]']
block_2_expand_relu (ReLU)	(None, 32, 32, 144)	0	['block_2_expand_BN[0][0]']
block_2_depthwise (DepthwiseConv2D)	(None, 32, 32, 144)	1296	['block_2_expand_relu[0][0]']
block_2_depthwise_BN (BatchNormalization)	(None, 32, 32, 144)	576	['block_2_depthwise[0][0]']
block_2_depthwise_relu (ReLU)	(None, 32, 32, 144)	0	['block_2_depthwise_BN[0][0]']
block_2_project (Conv2D)	(None, 32, 32, 24)	3456	['block_2_depthwise_relu[0][0]']
block_2_project_BN (BatchNormalization)	(None, 32, 32, 24)	96	['block_2_project[0][0]']
block_2_add (Add)	(None, 32, 32, 24)	0	['block_1_project_BN[0][0]', 'block_2_project_BN[0][0]']
block_3_expand (Conv2D)	(None, 32, 32, 144)	3456	['block_2_add[0][0]']
block_3_expand_BN (BatchNormalization)	(None, 32, 32, 144)	576	['block_3_expand[0][0]']
block_3_expand_relu (ReLU)	(None, 32, 32, 144)	0	['block_3_expand_BN[0][0]']
block_3_pad (ZeroPadding2D)	(None, 33, 33, 144)	0	['block_3_expand_relu[0][0]']
block_3_depthwise (DepthwiseConv2D)	(None, 16, 16, 144)	1296	['block_3_pad[0][0]']
block_3_depthwise_BN (BatchNormalization)	(None, 16, 16, 144)	576	['block_3_depthwise[0][0]']
block_3_depthwise_relu (ReLU)	(None, 16, 16, 144)	0	['block_3_depthwise_BN[0][0]']
block_3_project (Conv2D)	(None, 16, 16, 32)	4608	['block_3_depthwise_relu[0][0]']
block_3_project_BN (BatchNormalization)	(None, 16, 16, 32)	128	['block_3_project[0][0]']
block_4_expand (Conv2D)	(None, 16, 16, 192)	6144	['block_3_project_BN[0][0]']
block_4_expand_BN (BatchNormalization)	(None, 16, 16, 192)	768	['block_4_expand[0][0]']

block_4_expand_relu (ReLU)	(None, 16, 16, 192)	0	['block_4_expand_BN[0][0]']
block_4_depthwise (DepthwiseConv2D)	(None, 16, 16, 192)	1728	['block_4_expand_relu[0][0]']
block_4_depthwise_BN (BatchNormalization)	(None, 16, 16, 192)	768	['block_4_depthwise[0][0]']
block_4_depthwise_relu (ReLU)	(None, 16, 16, 192)	0	['block_4_depthwise_BN[0][0]']
block_4_project (Conv2D)	(None, 16, 16, 32)	6144	['block_4_depthwise_relu[0][0]']
block_4_project_BN (BatchNormalization)	(None, 16, 16, 32)	128	['block_4_project[0][0]']
block_4_add (Add)	(None, 16, 16, 32)	0	['block_3_project_BN[0][0]', 'block_4_project_BN[0][0]']
block_5_expand (Conv2D)	(None, 16, 16, 192)	6144	['block_4_add[0][0]']
block_5_expand_BN (BatchNormalization)	(None, 16, 16, 192)	768	['block_5_expand[0][0]']
block_5_expand_relu (ReLU)	(None, 16, 16, 192)	0	['block_5_expand_BN[0][0]']
block_5_depthwise (DepthwiseConv2D)	(None, 16, 16, 192)	1728	['block_5_expand_relu[0][0]']
block_5_depthwise_BN (BatchNormalization)	(None, 16, 16, 192)	768	['block_5_depthwise[0][0]']
block_5_depthwise_relu (ReLU)	(None, 16, 16, 192)	0	['block_5_depthwise_BN[0][0]']
block_5_project (Conv2D)	(None, 16, 16, 32)	6144	['block_5_depthwise_relu[0][0]']
block_5_project_BN (BatchNormalization)	(None, 16, 16, 32)	128	['block_5_project[0][0]']
block_5_add (Add)	(None, 16, 16, 32)	0	['block_4_add[0][0]', 'block_5_project_BN[0][0]']
block_6_expand (Conv2D)	(None, 16, 16, 192)	6144	['block_5_add[0][0]']
block_6_expand_BN (BatchNormalization)	(None, 16, 16, 192)	768	['block_6_expand[0][0]']
block_6_expand_relu (ReLU)	(None, 16, 16, 192)	0	['block_6_expand_BN[0][0]']
block_6_pad (ZeroPadding2D)	(None, 17, 17, 192)	0	['block_6_expand_relu[0][0]']
block_6_depthwise (DepthwiseConv2D)	(None, 8, 8, 192)	1728	['block_6_pad[0][0]']
block_6_depthwise_BN (BatchNormalization)	(None, 8, 8, 192)	768	['block_6_depthwise[0][0]']
block_6_depthwise_relu (ReLU)	(None, 8, 8, 192)	0	['block_6_depthwise_BN[0][0]']
block_6_project (Conv2D)	(None, 8, 8, 64)	12288	['block_6_depthwise_relu[0][0]']
block_6_project_BN (BatchNormalization)	(None, 8, 8, 64)	256	['block_6_project[0][0]']
block_7_expand (Conv2D)	(None, 8, 8, 384)	24576	['block_6_project_BN[0][0]']



				-----_expand_ (Conv2D), (None, 8, 8, 384), 24576	['block_7_expand[0][0]']
block_7_expand_BN (BatchNormalization)	(None, 8, 8, 384)	1536			
block_7_expand_relu (ReLU)	(None, 8, 8, 384)	0			['block_7_expand_BN[0][0]']
block_7_depthwise (DepthwiseConv2D)	(None, 8, 8, 384)	3456			['block_7_expand_relu[0][0]']
block_7_depthwise_BN (BatchNormalization)	(None, 8, 8, 384)	1536			['block_7_depthwise[0][0]']
block_7_depthwise_relu (ReLU)	(None, 8, 8, 384)	0			['block_7_depthwise_BN[0][0]']
block_7_project (Conv2D)	(None, 8, 8, 64)	24576			['block_7_depthwise_relu[0][0]']
block_7_project_BN (BatchNormalization)	(None, 8, 8, 64)	256			['block_7_project[0][0]']
block_7_add (Add)	(None, 8, 8, 64)	0			['block_6_project_BN[0][0]', 'block_7_project_BN[0][0]']
block_8_expand (Conv2D)	(None, 8, 8, 384)	24576			['block_7_add[0][0]']
block_8_expand_BN (BatchNormalization)	(None, 8, 8, 384)	1536			['block_8_expand[0][0]']
block_8_expand_relu (ReLU)	(None, 8, 8, 384)	0			['block_8_expand_BN[0][0]']
block_8_depthwise (DepthwiseConv2D)	(None, 8, 8, 384)	3456			['block_8_expand_relu[0][0]']
block_8_depthwise_BN (BatchNormalization)	(None, 8, 8, 384)	1536			['block_8_depthwise[0][0]']
block_8_depthwise_relu (ReLU)	(None, 8, 8, 384)	0			['block_8_depthwise_BN[0][0]']
block_8_project (Conv2D)	(None, 8, 8, 64)	24576			['block_8_depthwise_relu[0][0]']
block_8_project_BN (BatchNormalization)	(None, 8, 8, 64)	256			['block_8_project[0][0]']
block_8_add (Add)	(None, 8, 8, 64)	0			['block_7_add[0][0]', 'block_8_project_BN[0][0]']
block_9_expand (Conv2D)	(None, 8, 8, 384)	24576			['block_8_add[0][0]']
block_9_expand_BN (BatchNormalization)	(None, 8, 8, 384)	1536			['block_9_expand[0][0]']
block_9_expand_relu (ReLU)	(None, 8, 8, 384)	0			['block_9_expand_BN[0][0]']
block_9_depthwise (DepthwiseConv2D)	(None, 8, 8, 384)	3456			['block_9_expand_relu[0][0]']
block_9_depthwise_BN (BatchNormalization)	(None, 8, 8, 384)	1536			['block_9_depthwise[0][0]']
block_9_depthwise_relu (ReLU)	(None, 8, 8, 384)	0			['block_9_depthwise_BN[0][0]']
block_9_project (Conv2D)	(None, 8, 8, 64)	24576			['block_9_depthwise_relu[0][0]']
block_9_project_BN (BatchNormalization)	(None, 8, 8, 64)	256			['block_9_project[0][0]']

block_9_add (Add)	(None, 8, 8, 64)	0	['block_8_add[0][0]', 'block_9_project_BN[0][0]']
block_10_expand (Conv2D)	(None, 8, 8, 384)	24576	['block_9_add[0][0]']
block_10_expand_BN (BatchNormalization)	(None, 8, 8, 384)	1536	['block_10_expand[0][0]']
block_10_expand_relu (ReLU)	(None, 8, 8, 384)	0	['block_10_expand_BN[0][0]']
block_10_depthwise (DepthwiseConv2D)	(None, 8, 8, 384)	3456	['block_10_expand_relu[0][0]']
block_10_depthwise_BN (BatchNormalization)	(None, 8, 8, 384)	1536	['block_10_depthwise[0][0]']
block_10_depthwise_relu (ReLU)	(None, 8, 8, 384)	0	['block_10_depthwise_BN[0][0]']
block_10_project (Conv2D)	(None, 8, 8, 96)	36864	['block_10_depthwise_relu[0][0]']
block_10_project_BN (BatchNormalization)	(None, 8, 8, 96)	384	['block_10_project[0][0]']
block_11_expand (Conv2D)	(None, 8, 8, 576)	55296	['block_10_project_BN[0][0]']
block_11_expand_BN (BatchNormalization)	(None, 8, 8, 576)	2304	['block_11_expand[0][0]']
block_11_expand_relu (ReLU)	(None, 8, 8, 576)	0	['block_11_expand_BN[0][0]']
block_11_depthwise (DepthwiseConv2D)	(None, 8, 8, 576)	5184	['block_11_expand_relu[0][0]']
block_11_depthwise_BN (BatchNormalization)	(None, 8, 8, 576)	2304	['block_11_depthwise[0][0]']
block_11_depthwise_relu (ReLU)	(None, 8, 8, 576)	0	['block_11_depthwise_BN[0][0]']
block_11_project (Conv2D)	(None, 8, 8, 96)	55296	['block_11_depthwise_relu[0][0]']
block_11_project_BN (BatchNormalization)	(None, 8, 8, 96)	384	['block_11_project[0][0]']
block_11_add (Add)	(None, 8, 8, 96)	0	['block_10_project_BN[0][0]', 'block_11_project_BN[0][0]']
block_12_expand (Conv2D)	(None, 8, 8, 576)	55296	['block_11_add[0][0]']
block_12_expand_BN (BatchNormalization)	(None, 8, 8, 576)	2304	['block_12_expand[0][0]']
block_12_expand_relu (ReLU)	(None, 8, 8, 576)	0	['block_12_expand_BN[0][0]']
block_12_depthwise (DepthwiseConv2D)	(None, 8, 8, 576)	5184	['block_12_expand_relu[0][0]']
block_12_depthwise_BN (BatchNormalization)	(None, 8, 8, 576)	2304	['block_12_depthwise[0][0]']
block_12_depthwise_relu (ReLU)	(None, 8, 8, 576)	0	['block_12_depthwise_BN[0][0]']
block_12_project (Conv2D)	(None, 8, 8, 96)	55296	['block_12_depthwise_relu[0][0]']
block_12_project_BN (BatchNormalization)	(None, 8, 8, 96)	384	['block_12_project[0][0]']

block_12_project_BN (BatchNorm alization)	(None, 8, 8, 96)	384	['block_12_project[0][0]']
block_12_add (Add)	(None, 8, 8, 96)	0	['block_11_add[0][0]', 'block_12_project_BN[0][0]']
block_13_expand (Conv2D)	(None, 8, 8, 576)	55296	['block_12_add[0][0]']
block_13_expand_BN (BatchNorma lization)	(None, 8, 8, 576)	2304	['block_13_expand[0][0]']
block_13_expand_relu (ReLU)	(None, 8, 8, 576)	0	['block_13_expand_BN[0][0]']
block_13_pad (ZeroPadding2D)	(None, 9, 9, 576)	0	['block_13_expand_relu[0][0]']
block_13_depthwise (DepthwiseC onv2D)	(None, 4, 4, 576)	5184	['block_13_pad[0][0]']
block_13_depthwise_BN (BatchNo rmalization)	(None, 4, 4, 576)	2304	['block_13_depthwise[0][0]']
block_13_depthwise_relu (ReLU)	(None, 4, 4, 576)	0	['block_13_depthwise_BN[0][0]']
block_13_project (Conv2D)	(None, 4, 4, 160)	92160	['block_13_depthwise_relu[0][0]']
block_13_project_BN (BatchNorm alization)	(None, 4, 4, 160)	640	['block_13_project[0][0]']
block_14_expand (Conv2D)	(None, 4, 4, 960)	153600	['block_13_project_BN[0][0]']
block_14_expand_BN (BatchNorma lization)	(None, 4, 4, 960)	3840	['block_14_expand[0][0]']
block_14_expand_relu (ReLU)	(None, 4, 4, 960)	0	['block_14_expand_BN[0][0]']
block_14_depthwise (DepthwiseC onv2D)	(None, 4, 4, 960)	8640	['block_14_expand_relu[0][0]']
block_14_depthwise_BN (BatchNo rmalization)	(None, 4, 4, 960)	3840	['block_14_depthwise[0][0]']
block_14_depthwise_relu (ReLU)	(None, 4, 4, 960)	0	['block_14_depthwise_BN[0][0]']
block_14_project (Conv2D)	(None, 4, 4, 160)	153600	['block_14_depthwise_relu[0][0]']
block_14_project_BN (BatchNorm alization)	(None, 4, 4, 160)	640	['block_14_project[0][0]']
block_14_add (Add)	(None, 4, 4, 160)	0	['block_13_project_BN[0][0]', 'block_14_project_BN[0][0]']
block_15_expand (Conv2D)	(None, 4, 4, 960)	153600	['block_14_add[0][0]']
block_15_expand_BN (BatchNorma lization)	(None, 4, 4, 960)	3840	['block_15_expand[0][0]']
block_15_expand_relu (ReLU)	(None, 4, 4, 960)	0	['block_15_expand_BN[0][0]']
block_15_depthwise (DepthwiseC onv2D)	(None, 4, 4, 960)	8640	['block_15_expand_relu[0][0]']
block_15_depthwise_BN (BatchNo rmalization)	(None, 4, 4, 960)	3840	['block_15_depthwise[0][0]']
block_15_depthwise_relu (ReLU)	(None, 4, 4, 960)	0	['block_15_depthwise_BN[0][0]']

block_15_project (Conv2D)	(None, 4, 4, 160)	153600	['block_15_depthwise_relu[0][0]']
block_15_project_BN (BatchNormalization)	(None, 4, 4, 160)	640	['block_15_project[0][0]']
block_15_add (Add)	(None, 4, 4, 160)	0	['block_14_add[0][0]', 'block_15_project_BN[0][0]']
block_16_expand (Conv2D)	(None, 4, 4, 960)	153600	['block_15_add[0][0]']
block_16_expand_BN (BatchNormalization)	(None, 4, 4, 960)	3840	['block_16_expand[0][0]']
block_16_expand_relu (ReLU)	(None, 4, 4, 960)	0	['block_16_expand_BN[0][0]']
block_16_depthwise (DepthwiseConv2D)	(None, 4, 4, 960)	8640	['block_16_expand_relu[0][0]']
block_16_depthwise_BN (BatchNormalization)	(None, 4, 4, 960)	3840	['block_16_depthwise[0][0]']
block_16_depthwise_relu (ReLU)	(None, 4, 4, 960)	0	['block_16_depthwise_BN[0][0]']
block_16_project (Conv2D)	(None, 4, 4, 320)	307200	['block_16_depthwise_relu[0][0]']
block_16_project_BN (BatchNormalization)	(None, 4, 4, 320)	1280	['block_16_project[0][0]']
Conv_1 (Conv2D)	(None, 4, 4, 1280)	409600	['block_16_project_BN[0][0]']
Conv_1_bn (BatchNormalization)	(None, 4, 4, 1280)	5120	['Conv_1[0][0]']
out_relu (ReLU)	(None, 4, 4, 1280)	0	['Conv_1_bn[0][0]']
global_average_pooling2d (GlobalAveragePooling2D)	(None, 1280)	0	['out_relu[0][0]']
dense (Dense)	(None, 641)	821121	['global_average_pooling2d[0][0]']
dropout (Dropout)	(None, 641)	0	['dense[0][0]']
dense_1 (Dense)	(None, 641)	411522	['dropout[0][0]']
dropout_1 (Dropout)	(None, 641)	0	['dense_1[0][0]']
dense_2 (Dense)	(None, 2)	1284	['dropout_1[0][0]']
=====			
Total params: 3,491,911			
Trainable params: 1,233,927			
Non-trainable params: 2,257,984			

In [22]:

# Adicionamos as 6 camadas finais ao modelo.  
len(network.layers)

Out[22]: 160

In [23]:

# compilando o modelo.  
network.compile(loss = 'categorical\_crossentropy', optimizer='Adam',

```
metrics = ['accuracy'])
```

```
In [25]: # Realizando o treinamento com 10 épocas.
historico = network.fit(dataset_treinamento, epochs=10)
```

```
Epoch 1/10
8/8 [=====] - 15s 2s/step - loss: 0.0356 - accuracy: 0.9850
Epoch 2/10
8/8 [=====] - 14s 2s/step - loss: 0.0350 - accuracy: 0.9910
Epoch 3/10
8/8 [=====] - 14s 2s/step - loss: 0.0270 - accuracy: 0.9920
Epoch 4/10
8/8 [=====] - 14s 2s/step - loss: 0.0295 - accuracy: 0.9900
Epoch 5/10
8/8 [=====] - 16s 2s/step - loss: 0.0290 - accuracy: 0.9880
Epoch 6/10
8/8 [=====] - 15s 2s/step - loss: 0.0180 - accuracy: 0.9940
Epoch 7/10
8/8 [=====] - 14s 2s/step - loss: 0.0156 - accuracy: 0.9930
Epoch 8/10
8/8 [=====] - 14s 2s/step - loss: 0.0216 - accuracy: 0.9920
Epoch 9/10
8/8 [=====] - 14s 2s/step - loss: 0.0072 - accuracy: 0.9960
Epoch 10/10
8/8 [=====] - 16s 2s/step - loss: 0.0170 - accuracy: 0.9950
```

Avaliação da rede neural

```
In [26]: # Avaliando a rede neural com o conjunto de teste.
network.evaluate(dataset_teste)
```

```
1000/1000 [=====] - 23s 22ms/step - loss: 0.0044 - accuracy: 0.9980
```

```
Out[26]: [0.004357820842415094, 0.9980000257492065]
```

```
In [27]: # Realizando as previsões no conjunto de teste.
previsoes = network.predict(dataset_teste)
previsoes
```

```
1000/1000 [=====] - 24s 24ms/step
```

```
Out[27]: array([[9.9999559e-01, 4.4041903e-06],
                [9.9999452e-01, 5.5245187e-06],
                [9.9998772e-01, 1.2218842e-05],
                ...,
                [4.7167270e-11, 1.0000000e+00],
                [2.1981377e-04, 9.9978024e-01],
                [5.3064803e-10, 1.0000000e+00]], dtype=float32)
```

```
In [28]: # previsões para o conjunto de teste.
previsoes = np.argmax(previsoes, axis = 1)
previsoes[:10] # 10 primeiros registros.
```

```
Out[28]: array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0])
```

```
In [29]: # classificação real do conjunto de teste.
dataset_teste.classes[:10] # 10 primeiros registros
```

```
Out[29]: array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0], dtype=int32)
```



```
In [30]: # usando a função de acurária do sklearn apenas para comparar se os resultados estão corretos.
from sklearn.metrics import accuracy_score
accuracy_score(dataset_teste.classes, previsoes)
```

Out[30]: 0.998

```
In [31]: network.evaluate(dataset_teste)
```

1000/1000 [=====] - 24s 24ms/step - loss: 0.0044 - accuracy: 0.9980

Out[31]: [0.004357820842415094, 0.9980000257492065]

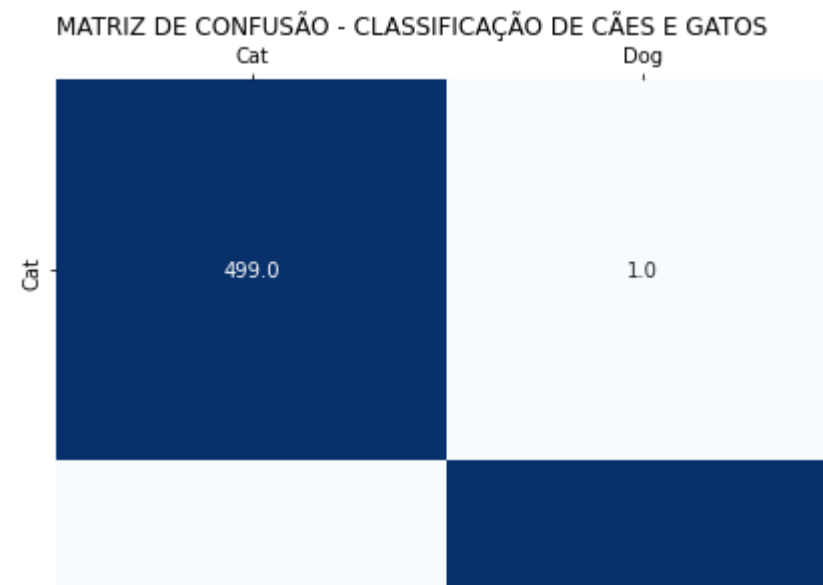
Conforme o resultado, tivemos 99.8% de acurácia no conjunto de teste.

```
In [32]: dataset_treinamento.class_indices
```

Out[32]: {'Cat': 0, 'Dog': 1}

```
In [33]: from sklearn.metrics import confusion_matrix
cm = confusion_matrix(dataset_teste.classes, previsoes)
# figure
fig, ax = plt.subplots(figsize=(7, 7))
# plot heatmap
sns.heatmap(cm, cmap="Blues", annot=True, fmt=".1f", cbar=False)
# xticks
ax.xaxis.tick_top()
xticks_labels = ['Cat', 'Dog']
plt.xticks(np.arange(2) + .5, labels=xticks_labels)

# yticks
ax.yaxis.tick_left()
yticks_labels = ['Cat', 'Dog']
plt.yticks(np.arange(2) + .5, labels=yticks_labels)
# axis labels
plt.xlabel('')
plt.ylabel('')
# title
title = 'Matriz de confusão - Classificação de Cães e Gatos'.upper()
plt.title(title, loc='left')
plt.show()
```





```
In [34]: from sklearn.metrics import classification_report
print(classification_report(dataset_test.classes, previsoos))
```

	precision	recall	f1-score	support
0	1.00	1.00	1.00	500
1	1.00	1.00	1.00	500
accuracy			1.00	1000
macro avg	1.00	1.00	1.00	1000
weighted avg	1.00	1.00	1.00	1000

## Salvar e carregar a rede neural

```
In [35]: # Salvando os parametros do modelo.
          model_json = network.to_json()
          with open('network.json', 'w') as json_file:
              json_file.write(model_json)
```

```
In [36]: # Salvando os pesos das camadas.
from keras.models import save_model
network saved = save_model(network, '/content/weights.hdf5')
```

```
In [37]: # visualizando o arquivo.json
with open('network.json', 'r') as json_file:
    json_saved_model = json_file.read()
    json_saved_model
```

```
Out[37]: {'class_name': "Functional", "config": {"name": "model", "layers": [{"class_name": "InputLayer", "config": {"batch_input_shape": [null, 128, 128, 3], "dtype": "float32", "sparse": false, "ragged": false, "name": "input_1"}, "name": "input_1", "inbound_nodes": []}, {"class_name": "Conv2D", "config": {"name": "Conv1", "trainable": false, "dtype": "float32", "filters": 32, "kernel_size": [3, 3], "strides": [2, 2], "padding": "same", "data_format": "channels_last", "dilation_rate": [1, 1], "groups": 1, "activation": "linear", "use_bias": false, "kernel_initializer": {"class_name": "GlorotUniform", "config": {"seed": null}}, "bias_initializer": {"class_name": "Zeros", "config": {}}, "kernel_regularizer": null, "bias_regularizer": null, "activity_regularizer": null, "kernel_constraint": null, "bias_constraint": null}, {"name": "Conv1", "inbound_nodes": [[[["input_1", 0, 0, {}]]]], {"class_name": "BatchNormalization", "config": {"name": "bn_Conv1", "trainable": false, "dtype": "float32", "axis": [3], "momentum": 0.999, "epsilon": 0.001, "center": true, "scale": true, "beta_initializer": {"class_name": "Zeros", "config": {}}, "gamma_initializer": {"class_name": "Ones", "config": {}}, "moving_mean_initializer": {"class_name": "Zeros", "config": {}}, "moving_variance_initializer": {"class_name": "Ones", "config": {}}, "beta_regularizer": null, "gamma_regularizer": null, "beta_constraint": null, "gamma_constraint": null}, {"name": "bn_Conv1", "inbound_nodes": [[[["Conv1", 0, 0, {}]]]], {"class_name": "ReLU", "config": {"name": "Conv1_relu", "trainable": false, "dtype": "float32", "max_value": 6.0, "negative_slope": 0.0, "threshold": 0.0}, {"name": "Conv1_relu", "inbound_nodes": [[[["bn_Conv1", 0, 0, {}]]]], {"class_name": "DepthwiseConv2D", "config": {"name": "expanded_conv_depthwise", "trainable": false, "dtype": "float32", "kernel_size": [3, 3], "strides": [1, 1], "padding": "same", "data_format": "channels_last", "dilation_rate": [1, 1], "groups": 1, "activation": "linear", "use_bias": false, "bias_initializer": {"class_name": "Zeros", "config": {}}, "bias_regularizer": null, "activity_regularizer": null, "bias_constraint": null, "depth_multiplier": 1, "depthwise_initializer": {"class_name": "GlorotUniform", "config": {"seed": null}}, "depthwise_regularizer": null, "depthwise_constraint": null}, {"name": "expanded_conv_depthwise", "inbound_nodes": [[[["Conv1_relu", 0, 0, {}]]]], {"class_name": "BatchNormalization", "config": {"name": "expanded_conv_depthwise_BN", "trainable": false, "dtype": "float32", "axis": [3], "momentum": 0.999, "epsilon": 0.001, "center": true, "scale": true, "beta_initializer": {"class_name": "Zeros", "config": {}}, "gamma_initializer": {"class_name": "Ones", "config": {}}, "moving_mean_initializer": {"class_name": "Zeros", "config": {}}, "moving_variance_initializer": {"class_name": "Ones", "config": {}}, "beta_regularizer": null, "gamma_regularizer": null, "beta_constraint": null, "gamma_constraint": null}, {"name": "expanded_conv_depthwise_BN", "inbound_nodes": [[[["expanded_conv_depthwise", 0, 0, {}]]]]}]}
```

[https://github.com/Decioagu/Redes-Neurais/blob/main/cat\\_dog.ipynb](https://github.com/Decioagu/Redes-Neurais/blob/main/cat_dog.ipynb)

```
/cat dog.ipynb
```



```
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```



```
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[https://github.com/Decioagu/Redes-Neurais/blob/main/cat\\_dog.ipynb](https://github.com/Decioagu/Redes-Neurais/blob/main/cat_dog.ipynb)



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```



[https://github.com/Decioagu/Redes-Neurais/blob/main/cat\\_dog.ipynb](https://github.com/Decioagu/Redes-Neurais/blob/main/cat_dog.ipynb)

```
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```

In [38]:

```
#Carregando o modelo salvo.
network_loaded = tf.keras.models.model_from_json(json_saved_model)
network_loaded.load_weights('weights.hdf5')
network_loaded.compile(loss = 'categorical_crossentropy', optimizer='Adam', metrics=['accuracy'])
```

Classificação de uma única imagem

In [39]:

```
# carregando uma imagem
imagem = cv2.imread('/content/CatDog/Dog/dog.114.jpg')
```

In [40]:

```
cv2.imshow(imagem)
```





```
In [41]: # Alterando para o tamanho padrão e rotacionando a imagem para dificultar a classificação.
imagem = cv2.resize(imagem, (128, 128))
imagem = cv2.rotate(imagem, cv2.ROTATE_90_COUNTERCLOCKWISE)
cv2_imshow(imagem)
```



```
In [42]: # Normalizando a imagem.
imagem = imagem / 255
imagem
```

```
Out[42]: array([[0.22745098, 0.19607843, 0.16862745],
               [0.34117647, 0.3372549 , 0.34509804],
               [0.39607843, 0.41568627, 0.45882353],
               ...,
               [0.68627451, 0.76470588, 0.7254902 ],
               [0.90196078, 0.91764706, 0.89019608],
               [0.9254902 , 0.96470588, 0.95686275]],

               [[0.23529412, 0.21568627, 0.28235294],
               [0.3372549 , 0.31764706, 0.37647059],
               [0.65098039, 0.63529412, 0.67843137],
               ...,
               [0.65490196, 0.81176471, 0.76470588],
               [0.70588235, 0.79607843, 0.78039216],
               [0.73333333, 0.81568627, 0.80392157]],

               [[0.30588235, 0.30588235, 0.36078431],
               [0.41960784, 0.41568627, 0.45882353],
               [0.76862745, 0.75686275, 0.79607843],
               ...,
               [0.81568627, 0.92156863, 0.88627451],
               [0.78823529, 0.8627451 , 0.85098039],
               [0.90196078, 0.98121373, 0.97251902]])
```



```
[0.50190070, 0.50451375, 0.57254902]],
...,
[[0.69019608, 0.89019608, 0.83137255],
 [0.4627451 , 0.63921569, 0.59215686],
 [0.5254902 , 0.67058824, 0.63921569],
 ...,
 [0.27058824, 0.48235294, 0.36470588],
 [0.32941176, 0.50196078, 0.41568627],
 [0.3254902 , 0.49803922, 0.41176471]],

[[0.37647059, 0.5372549 , 0.45490196],
 [0.50588235, 0.65098039, 0.58823529],
 [0.58039216, 0.69803922, 0.6627451 ],
 ...,
 [0.38823529, 0.57647059, 0.45490196],
 [0.4       , 0.51764706, 0.45882353],
 [0.38823529, 0.50588235, 0.44313725]],

[[0.52941176, 0.59215686, 0.54509804],
 [0.57254902, 0.63921569, 0.60392157],
 [0.62352941, 0.69019608, 0.6627451 ],
 ...,
 [0.32156863, 0.53333333, 0.37647059],
 [0.28627451, 0.4745098 , 0.37647059],
 [0.41568627, 0.60392157, 0.49803922]]])
```

```
In [43]: # Conferindo o formato
         imagem.shape
```

```
Out[43]: (128, 128, 3)
```

```
In [44]: # necessário realizar o reshape para que o modelo entenda o formato.
         imagem = imagem.reshape(1,128,128,3)
```

```
In [45]: # Realizando a previsão.
         previsao = network_loaded(imagem)
         previsao
```

```
Out[45]:
```

```
In [46]: previsao = np.argmax(previsao)
         previsao
```

```
Out[46]: 1
```

```
In [47]: dataset_teste.class_indices
```

```
Out[47]: {'Cat': 0, 'Dog': 1}
```

```
In [48]: if previsao == 0:
         print('O modelo identificou que o animal é um: Gato')
         else:
         print('O modelo identificou que o animal é um: Cão')
```

O modelo identificou que o animal é um: Cão