Classificaço de Patologias usando Imagens Médicas

Carregar imagens do diretório

In [1]:

```
import os
current_dir = os.path.abspath(os.getcwd())
```

Converter base de dados para treino, validação e teste

In [2]:

```
#cria nova pasta para cachorros e gatos atendendo a estrutura do Keras/Tenso
folder = "/novo"
train_folder = current_dir + folder + "/train"
val_folder = current_dir + folder + "/val"
test_folder = current_dir + folder + "/test"

model_filepath = "keras/classificacao_02_02.keras"
conversao_path = "conversao/conversao_02_02"
```

Fazer o Tensorflow carregar as imagens para a RNA

In [3]:

```
import tensorflow as tf

print(tf.config.list_physical_devices('GPU'))
print(tf.__version__)
```

```
2022-06-28 12:56:07.368545: W tensorflow/stream_executor/platform/default/dso
_loader.cc:64] Could not load dynamic library 'libcudart.so.11.0'; dlerror: l
ibcudart.so.11.0: cannot open shared object file: No such file or directory
2022-06-28 12:56:07.368603: I tensorflow/stream_executor/cuda/cudart_stub.cc:
29] Ignore above cudart dlerror if you do not have a GPU set up on your machi
ne.
[]
2.6.1
```

```
2022-06-28 12:56:17.359974: W tensorflow/stream_executor/platform/default/dso
_loader.cc:64] Could not load dynamic library 'libcuda.so.1'; dlerror: libcud
a.so.1: cannot open shared object file: No such file or directory
2022-06-28 12:56:17.360012: W tensorflow/stream_executor/cuda/cuda_driver.cc:
269] failed call to cuInit: UNKNOWN ERROR (303)
2022-06-28 12:56:17.360039: I tensorflow/stream_executor/cuda/cuda_diagnostic
s.cc:156] kernel driver does not appear to be running on this host (pc): /pro
c/driver/nvidia/version does not exist
```

In [4]:

```
from tensorflow.keras.utils import image_dataset_from_directory
#image_dataset_from_directory monta uma estrutura de dados com imagens 180x18
# de 32 em 32 imagens
train_dataset = image_dataset_from_directory(train_folder, image_size=(180, 1

validation_dataset = image_dataset_from_directory(val_folder,image_size=(180,
```

```
test_dataset = image_dataset_from_directory(test_folder, image_size=(180, 18(
```

```
Found 34931 files belonging to 2 classes.
Found 16 files belonging to 2 classes.
Found 484 files belonging to 2 classes.
```

```
2022-06-28 12:56:19.344786: I tensorflow/core/platform/cpu_feature_guard.cc:1
42] This TensorFlow binary is optimized with oneAPI Deep Neural Network Libra
ry (oneDNN) to use the following CPU instructions in performance-critical ope
rations:  AVX2 FMA
To enable them in other operations, rebuild TensorFlow with the appropriate c
ompiler flags.
```

In [5]:

```
#
for data_batch, labels_batch in train_dataset:
    print("data batch shape:", data_batch.shape)
    print("labels batch shape:", labels_batch.shape)
    print(data_batch[0].shape)
    break
```

```
2022-06-28 12:56:19.530172: I tensorflow/compiler/mlir/mlir_graph_optimizatio
n_pass.cc:185] None of the MLIR Optimization Passes are enabled (registered
2)
data batch shape: (32, 180, 180, 3)
labels batch shape: (32,)
(180, 180, 3)
```

Treinando o modelo

In [6]:

```
from tensorflow import keras
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense
from tensorflow.keras.layers.experimental.preprocessing import Rescaling

#cria uma arquitetura de uma rede neural profunda vazia
model = keras.Sequential()
model.add(Rescaling(scale=1.0/255))
model.add(Conv2D(32, kernel_size=(3, 3), activation='relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Conv2D(64, kernel_size=(3, 3), activation='relu'))
model.add(Flatten())
model.add(Dense(1, activation="sigmoid"))
model.compile(loss="binary_crossentropy",optimizer="adam",metrics=["accuracy'
#model.add(Dense(4, activation='softmax'))
#model.compile(loss='categorical_crossentropy',optimizer='adam', metrics=['a(
```

In [7]:

```
from tensorflow.keras.callbacks import ModelCheckpoint

callbacks = [
    ModelCheckpoint(
        filepath = model_filepath,
        save_best_only = True,
        monitor = "val_loss"
    )
]

history = model.fit(
    train_dataset,
    epochs=100,
```

```
    validation_data=validation_dataset,
    callbacks=callbacks)
```

```
Epoch 1/100
1092/1092 [==============================] - 361s 330ms/step - loss: 0.3676 -
accuracy: 0.8439 - val_loss: 0.1545 - val_accuracy: 0.9375
Epoch 2/100
1092/1092 [==============================] - 352s 322ms/step - loss: 0.2330 -
accuracy: 0.9131 - val_loss: 0.0593 - val_accuracy: 1.0000
Epoch 3/100
1092/1092 [==============================] - 361s 330ms/step - loss: 0.1556 -
accuracy: 0.9462 - val_loss: 0.0318 - val_accuracy: 1.0000
Epoch 4/100
1092/1092 [==============================] - 351s 322ms/step - loss: 0.0891 -
accuracy: 0.9706 - val_loss: 0.0148 - val_accuracy: 1.0000
Epoch 5/100
1092/1092 [==============================] - 333s 305ms/step - loss: 0.0476 -
accuracy: 0.9859 - val_loss: 0.0042 - val_accuracy: 1.0000
Epoch 6/100
1092/1092 [==============================] - 334s 306ms/step - loss: 0.0237 -
accuracy: 0.9936 - val_loss: 9.0511e-04 - val_accuracy: 1.0000
Epoch 7/100
1092/1092 [==============================] - 333s 305ms/step - loss: 0.0161 -
accuracy: 0.9958 - val_loss: 0.0057 - val_accuracy: 1.0000
Epoch 8/100
1092/1092 [==============================] - 334s 306ms/step - loss: 0.0173 -
accuracy: 0.9951 - val_loss: 0.0059 - val_accuracy: 1.0000
Epoch 9/100
1092/1092 [==============================] - 334s 305ms/step - loss: 0.0112 -
accuracy: 0.9971 - val_loss: 0.0066 - val_accuracy: 1.0000
Epoch 10/100
1092/1092 [==============================] - 323s 295ms/step - loss: 0.0098 -
accuracy: 0.9974 - val_loss: 1.5634e-04 - val_accuracy: 1.0000
Epoch 11/100
1092/1092 [==============================] - 322s 295ms/step - loss: 0.0096 -
accuracy: 0.9978 - val_loss: 2.0838e-04 - val_accuracy: 1.0000
Epoch 12/100
1092/1092 [==============================] - 322s 295ms/step - loss: 0.0098 -
accuracy: 0.9973 - val_loss: 1.6159e-04 - val_accuracy: 1.0000
Epoch 13/100
1092/1092 [==============================] - 322s 294ms/step - loss: 0.0071 -
accuracy: 0.9987 - val_loss: 2.0946e-06 - val_accuracy: 1.0000
Epoch 14/100
1092/1092 [==============================] - 322s 295ms/step - loss: 0.0085 -
accuracy: 0.9981 - val_loss: 7.2742e-06 - val_accuracy: 1.0000
Epoch 15/100
1092/1092 [==============================] - 322s 295ms/step - loss: 0.0077 -
accuracy: 0.9982 - val_loss: 4.1326e-05 - val_accuracy: 1.0000
Epoch 16/100
1092/1092 [==============================] - 322s 295ms/step - loss: 0.0053 -
accuracy: 0.9988 - val_loss: 5.2312e-06 - val_accuracy: 1.0000
Epoch 17/100
1092/1092 [==============================] - 367s 336ms/step - loss: 0.0062 -
accuracy: 0.9983 - val_loss: 3.0179e-06 - val_accuracy: 1.0000
Epoch 18/100
1092/1092 [==============================] - 387s 354ms/step - loss: 0.0079 -
accuracy: 0.9982 - val_loss: 9.1291e-06 - val_accuracy: 1.0000
Epoch 19/100
1092/1092 [==============================] - 362s 332ms/step - loss: 0.0065 -
accuracy: 0.9987 - val_loss: 0.0577 - val_accuracy: 0.9375
Epoch 20/100
1092/1092 [==============================] - 348s 318ms/step - loss: 0.0103 -
accuracy: 0.9976 - val_loss: 5.0744e-07 - val_accuracy: 1.0000
Epoch 21/100
```

```
1092/1092 [==============================] - 321s 294ms/step - loss: 0.0053 -
accuracy: 0.9990 - val_loss: 8.4073e-07 - val_accuracy: 1.0000
Epoch 22/100
1092/1092 [==============================] - 318s 291ms/step - loss: 0.0061 -
accuracy: 0.9987 - val_loss: 7.3125e-07 - val_accuracy: 1.0000
Epoch 23/100
1092/1092 [==============================] - 318s 292ms/step - loss: 0.0065 -
accuracy: 0.9985 - val_loss: 0.0022 - val_accuracy: 1.0000
Epoch 24/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.0038 -
accuracy: 0.9991 - val_loss: 5.1503e-04 - val_accuracy: 1.0000
Epoch 25/100
1092/1092 [==============================] - 320s 293ms/step - loss: 0.0038 -
accuracy: 0.9992 - val_loss: 2.4902e-05 - val_accuracy: 1.0000
Epoch 26/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.0058 -
accuracy: 0.9987 - val_loss: 9.1529e-05 - val_accuracy: 1.0000
Epoch 27/100
1092/1092 [==============================] - 316s 290ms/step - loss: 0.0049 -
accuracy: 0.9991 - val_loss: 0.0015 - val_accuracy: 1.0000
Epoch 28/100
1092/1092 [==============================] - 317s 290ms/step - loss: 0.0045 -
accuracy: 0.9990 - val_loss: 1.5508e-06 - val_accuracy: 1.0000
Epoch 29/100
1092/1092 [==============================] - 317s 290ms/step - loss: 0.0039 -
accuracy: 0.9992 - val_loss: 1.2210e-06 - val_accuracy: 1.0000
Epoch 30/100
1092/1092 [==============================] - 315s 289ms/step - loss: 0.0061 -
accuracy: 0.9987 - val_loss: 1.8878e-04 - val_accuracy: 1.0000
Epoch 31/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0052 -
accuracy: 0.9993 - val_loss: 1.4813e-05 - val_accuracy: 1.0000
Epoch 32/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0036 -
accuracy: 0.9993 - val_loss: 2.9605e-06 - val_accuracy: 1.0000
Epoch 33/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0054 -
accuracy: 0.9991 - val_loss: 6.6004e-09 - val_accuracy: 1.0000
Epoch 34/100
1092/1092 [==============================] - 315s 289ms/step - loss: 0.0076 -
accuracy: 0.9985 - val_loss: 5.7859e-04 - val_accuracy: 1.0000
Epoch 35/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0064 -
accuracy: 0.9986 - val_loss: 2.8584e-05 - val_accuracy: 1.0000
Epoch 36/100
1092/1092 [==============================] - 318s 291ms/step - loss: 0.0044 -
accuracy: 0.9991 - val_loss: 4.6527e-07 - val_accuracy: 1.0000
Epoch 37/100
1092/1092 [==============================] - 317s 291ms/step - loss: 0.0052 -
accuracy: 0.9993 - val_loss: 3.1131e-05 - val_accuracy: 1.0000
Epoch 38/100
1092/1092 [==============================] - 317s 291ms/step - loss: 0.0039 -
accuracy: 0.9992 - val_loss: 0.0011 - val_accuracy: 1.0000
Epoch 39/100
1092/1092 [==============================] - 318s 292ms/step - loss: 0.0045 -
accuracy: 0.9992 - val_loss: 1.2602e-05 - val_accuracy: 1.0000
Epoch 40/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.0047 -
accuracy: 0.9993 - val_loss: 2.0143e-06 - val_accuracy: 1.0000
Epoch 41/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.0020 -
accuracy: 0.9997 - val_loss: 2.3160e-08 - val_accuracy: 1.0000
Epoch 42/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.0063 -
```

```
accuracy: 0.9990 - val_loss: 5.7640e-07 - val_accuracy: 1.0000
Epoch 43/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.0037 -
accuracy: 0.9993 - val_loss: 2.3926e-07 - val_accuracy: 1.0000
Epoch 44/100
1092/1092 [==============================] - 318s 291ms/step - loss: 0.0056 -
accuracy: 0.9990 - val_loss: 3.2708e-08 - val_accuracy: 1.0000
Epoch 45/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.0046 -
accuracy: 0.9991 - val_loss: 1.6059e-06 - val_accuracy: 1.0000
Epoch 46/100
1092/1092 [==============================] - 317s 291ms/step - loss: 0.0040 -
accuracy: 0.9991 - val_loss: 3.3807e-10 - val_accuracy: 1.0000
Epoch 47/100
1092/1092 [==============================] - 329s 301ms/step - loss: 0.0038 -
accuracy: 0.9995 - val_loss: 1.7576e-06 - val_accuracy: 1.0000
Epoch 48/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.0026 -
accuracy: 0.9994 - val_loss: 2.9485e-07 - val_accuracy: 1.0000
Epoch 49/100
1092/1092 [==============================] - 319s 293ms/step - loss: 0.0040 -
accuracy: 0.9994 - val_loss: 7.1964e-09 - val_accuracy: 1.0000
Epoch 50/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.0060 -
accuracy: 0.9991 - val_loss: 2.1758e-08 - val_accuracy: 1.0000
Epoch 51/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.0020 -
accuracy: 0.9997 - val_loss: 2.1860e-07 - val_accuracy: 1.0000
Epoch 52/100
1092/1092 [==============================] - 320s 293ms/step - loss: 0.0036 -
accuracy: 0.9995 - val_loss: 1.4614e-06 - val_accuracy: 1.0000
Epoch 53/100
1092/1092 [==============================] - 318s 291ms/step - loss: 0.0038 -
accuracy: 0.9993 - val_loss: 6.0964e-10 - val_accuracy: 1.0000
Epoch 54/100
1092/1092 [==============================] - 316s 290ms/step - loss: 0.0033 -
accuracy: 0.9995 - val_loss: 7.3864e-09 - val_accuracy: 1.0000
Epoch 55/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0039 -
accuracy: 0.9991 - val_loss: 1.0112e-07 - val_accuracy: 1.0000
Epoch 56/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0045 -
accuracy: 0.9992 - val_loss: 5.2245e-06 - val_accuracy: 1.0000
Epoch 57/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0026 -
accuracy: 0.9995 - val_loss: 7.8543e-08 - val_accuracy: 1.0000
Epoch 58/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0022 -
accuracy: 0.9996 - val_loss: 3.6798e-06 - val_accuracy: 1.0000
Epoch 59/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0044 -
accuracy: 0.9993 - val_loss: 5.4356e-06 - val_accuracy: 1.0000
Epoch 60/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0034 -
accuracy: 0.9995 - val_loss: 5.3843e-09 - val_accuracy: 1.0000
Epoch 61/100
1092/1092 [==============================] - 315s 289ms/step - loss: 0.0037 -
accuracy: 0.9991 - val_loss: 2.6423e-06 - val_accuracy: 1.0000
Epoch 62/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0020 -
accuracy: 0.9997 - val_loss: 2.5116e-06 - val_accuracy: 1.0000
Epoch 63/100
1092/1092 [==============================] - 317s 290ms/step - loss: 0.0048 -
accuracy: 0.9991 - val_loss: 9.2811e-06 - val_accuracy: 1.0000
```

```
Epoch 64/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0022 -
accuracy: 0.9997 - val_loss: 1.2124e-07 - val_accuracy: 1.0000
Epoch 65/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0028 -
accuracy: 0.9997 - val_loss: 3.4824e-05 - val_accuracy: 1.0000
Epoch 66/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0014 -
accuracy: 0.9998 - val_loss: 9.3214e-07 - val_accuracy: 1.0000
Epoch 67/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0057 -
accuracy: 0.9989 - val_loss: 1.5144e-06 - val_accuracy: 1.0000
Epoch 68/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0041 -
accuracy: 0.9994 - val_loss: 1.0838e-06 - val_accuracy: 1.0000
Epoch 69/100
1092/1092 [==============================] - 316s 290ms/step - loss: 0.0016 -
accuracy: 0.9997 - val_loss: 1.5612e-07 - val_accuracy: 1.0000
Epoch 70/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0038 -
accuracy: 0.9993 - val_loss: 1.2070e-09 - val_accuracy: 1.0000
Epoch 71/100
1092/1092 [==============================] - 316s 290ms/step - loss: 0.0024 -
accuracy: 0.9997 - val_loss: 2.3116e-07 - val_accuracy: 1.0000
Epoch 72/100
1092/1092 [==============================] - 316s 290ms/step - loss: 0.0018 -
accuracy: 0.9998 - val_loss: 2.9923e-07 - val_accuracy: 1.0000
Epoch 73/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0026 -
accuracy: 0.9993 - val_loss: 3.2524e-09 - val_accuracy: 1.0000
Epoch 74/100
1092/1092 [==============================] - 315s 289ms/step - loss: 0.0034 -
accuracy: 0.9995 - val_loss: 6.3320e-09 - val_accuracy: 1.0000
Epoch 75/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0017 -
accuracy: 0.9998 - val_loss: 1.3898e-07 - val_accuracy: 1.0000
Epoch 76/100
1092/1092 [==============================] - 316s 290ms/step - loss: 0.0020 -
accuracy: 0.9996 - val_loss: 4.8334e-10 - val_accuracy: 1.0000
Epoch 77/100
1092/1092 [==============================] - 316s 290ms/step - loss: 0.0030 -
accuracy: 0.9995 - val_loss: 1.2547e-07 - val_accuracy: 1.0000
Epoch 78/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0034 -
accuracy: 0.9993 - val_loss: 3.8641e-09 - val_accuracy: 1.0000
Epoch 79/100
1092/1092 [==============================] - 315s 289ms/step - loss: 0.0033 -
accuracy: 0.9995 - val_loss: 6.5766e-09 - val_accuracy: 1.0000
Epoch 80/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0035 -
accuracy: 0.9995 - val_loss: 1.7354e-05 - val_accuracy: 1.0000
Epoch 81/100
1092/1092 [==============================] - 315s 289ms/step - loss: 0.0012 -
accuracy: 0.9997 - val_loss: 3.3725e-06 - val_accuracy: 1.0000
Epoch 82/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0030 -
accuracy: 0.9996 - val_loss: 2.7089e-06 - val_accuracy: 1.0000
Epoch 83/100
1092/1092 [==============================] - 316s 290ms/step - loss: 0.0023 -
accuracy: 0.9996 - val_loss: 1.4902e-08 - val_accuracy: 1.0000
Epoch 84/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0022 -
accuracy: 0.9995 - val_loss: 3.9207e-10 - val_accuracy: 1.0000
Epoch 85/100
```

```
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0048 - accuracy: 0.9991 - val_loss: 1.5537e-08 - val_accuracy: 1.0000
Epoch 86/100
1092/1092 [==============================] - 317s 290ms/step - loss: 0.0034 - accuracy: 0.9995 - val_loss: 9.8225e-07 - val_accuracy: 1.0000
Epoch 87/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0028 - accuracy: 0.9994 - val_loss: 4.6289e-07 - val_accuracy: 1.0000
Epoch 88/100
1092/1092 [==============================] - 316s 290ms/step - loss: 0.0021 - accuracy: 0.9996 - val_loss: 6.0379e-07 - val_accuracy: 1.0000
Epoch 89/100
1092/1092 [==============================] - 316s 290ms/step - loss: 0.0020 - accuracy: 0.9998 - val_loss: 1.7238e-07 - val_accuracy: 1.0000
Epoch 90/100
1092/1092 [==============================] - 323s 296ms/step - loss: 0.0031 - accuracy: 0.9993 - val_loss: 3.4326e-09 - val_accuracy: 1.0000
Epoch 91/100
1092/1092 [==============================] - 338s 310ms/step - loss: 0.0032 - accuracy: 0.9995 - val_loss: 1.3276e-06 - val_accuracy: 1.0000
Epoch 92/100
1092/1092 [==============================] - 327s 299ms/step - loss: 0.0020 - accuracy: 0.9995 - val_loss: 9.1877e-10 - val_accuracy: 1.0000
Epoch 93/100
1092/1092 [==============================] - 323s 295ms/step - loss: 0.0027 - accuracy: 0.9993 - val_loss: 1.9742e-09 - val_accuracy: 1.0000
Epoch 94/100
1092/1092 [==============================] - 323s 295ms/step - loss: 0.0028 - accuracy: 0.9995 - val_loss: 7.5781e-07 - val_accuracy: 1.0000
Epoch 95/100
1092/1092 [==============================] - 322s 295ms/step - loss: 0.0024 - accuracy: 0.9995 - val_loss: 8.4013e-10 - val_accuracy: 1.0000
Epoch 96/100
1092/1092 [==============================] - 325s 298ms/step - loss: 0.0028 - accuracy: 0.9997 - val_loss: 1.4185e-08 - val_accuracy: 1.0000
Epoch 97/100
1092/1092 [==============================] - 322s 295ms/step - loss: 0.0016 - accuracy: 0.9998 - val_loss: 7.6542e-08 - val_accuracy: 1.0000
Epoch 98/100
1092/1092 [==============================] - 321s 294ms/step - loss: 0.0013 - accuracy: 0.9998 - val_loss: 2.2833e-07 - val_accuracy: 1.0000
Epoch 99/100
1092/1092 [==============================] - 321s 294ms/step - loss: 0.0040 - accuracy: 0.9993 - val_loss: 3.3477e-09 - val_accuracy: 1.0000
Epoch 100/100
1092/1092 [==============================] - 327s 299ms/step - loss: 0.0032 - accuracy: 0.9996 - val_loss: 2.7495e-08 - val_accuracy: 1.0000
```

In [8]:

```python
model.summary()
```

Model: "sequential"

Layer (type)	Output Shape	Param #
rescaling (Rescaling)	(None, 180, 180, 3)	0
conv2d (Conv2D)	(None, 178, 178, 32)	896
max_pooling2d (MaxPooling2D)	(None, 89, 89, 32)	0
conv2d_1 (Conv2D)	(None, 87, 87, 64)	18496
flatten (Flatten)	(None, 484416)	0

```
dense (Dense)                (None, 1)                 484417
=================================================================
Total params: 503,809
Trainable params: 503,809
Non-trainable params: 0
_________________________________________________________________
```

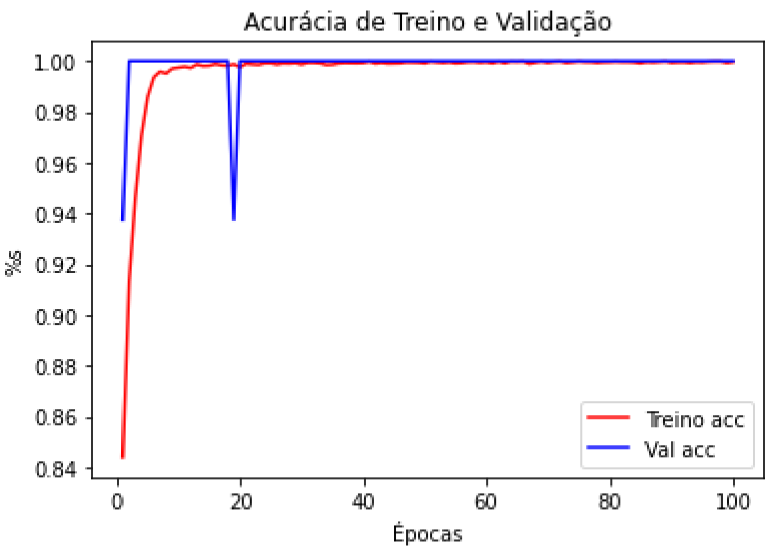
In [9]:

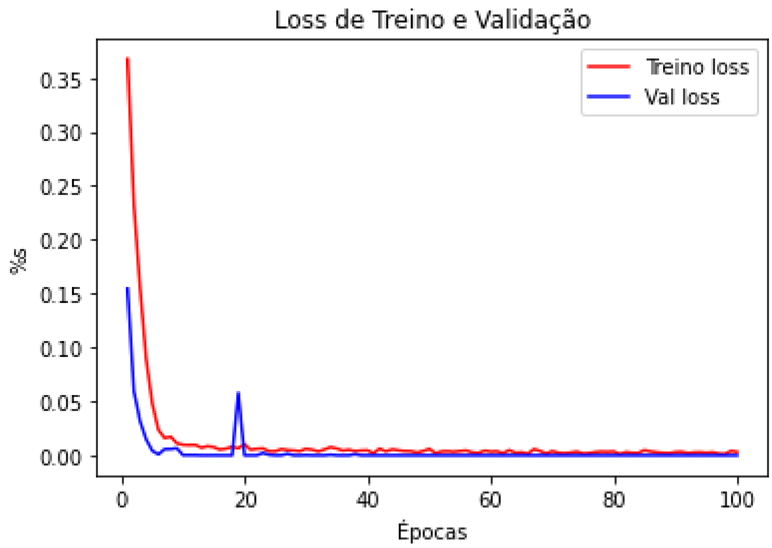
```
#https://www.tensorflow.org/js/tutorials/conversion/import_keras?hl=pt-br#alt
import tensorflowjs as tfjs
tfjs.converters.save_keras_model(model, conversao_path)
```

Visualização de Resultados

In [10]:

```
import matplotlib.pyplot as plt
accuracy = history.history["accuracy"]
val_accuracy = history.history["val_accuracy"]
loss = history.history["loss"]
val_loss = history.history["val_loss"]
epochs = range(1, len(accuracy) + 1)
plt.plot(epochs, accuracy, "r", label="Treino acc")
plt.plot(epochs, val_accuracy, "b", label="Val acc")
plt.xlabel("Épocas")
plt.ylabel("%s")
plt.title("Acurácia de Treino e Validação")
plt.legend()
plt.figure()
plt.plot(epochs, loss, "r", label="Treino loss")
plt.plot(epochs, val_loss, "b", label="Val loss")
plt.xlabel("Épocas")
plt.ylabel("%s")
plt.title("Loss de Treino e Validação")
plt.legend()
plt.show()
```





Resultados do Conjunto de Teste

In [11]:
```
from tensorflow import keras
model = keras.models.load_model(model_filepath)
```

In [12]:
```
test_loss, test_acc = model.evaluate(test_dataset)
print(f"Test accuracy: {test_acc:.3f}")
```

```
16/16 [==============================] - 2s 65ms/step - loss: 0.0042 - accura
cy: 0.9979
Test accuracy: 0.998
```

Referências

- https://machinelearningmastery.com/how-to-develop-a-convolutional-neural-network-to-classify-photos-of-dogs-and-cats/
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