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"
```

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__)
```

```
2022-06-27 20:33:38.134848: 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
2022-06-27 20:33:38.134872: 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
```

```
2022-06-27 20:33:47.536036: 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
2022-06-27 20:33:47.536103: W tensorflow/stream_executor/cuda/cuda_driver.cc:
269] failed call to cuInit: UNKNOWN ERROR (303)
2022-06-27 20:33:47.536149: 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, 180),
                                             batch_size=32)

#validation_dataset = image_dataset_from_directory(val_folder,
                                                   #image_size=(180, 180),
                                                   #batch_size=32)
```

```
test_dataset = image_dataset_from_directory(test_folder,
                                            image_size=(180, 180),
                                            batch_size=32)
```

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

```
2022-06-27 20:33:49.402272: 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
```

```
2022-06-27 20:33:49.566476: 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', input_shape=(180,
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=['ac
```

In [7]:

```
from tensorflow.keras.callbacks import ModelCheckpoint

callbacks = [
    ModelCheckpoint(
        filepath="classificacao16.keras",
        save_best_only=True,
        monitor="loss"
    )
]

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

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

```
Epoch 1/100
1092/1092 [==============================] - 332s 303ms/step - loss: 2.6374 -
accuracy: 0.7511
Epoch 2/100
1092/1092 [==============================] - 324s 296ms/step - loss: 0.3514 -
accuracy: 0.8476
Epoch 3/100
1092/1092 [==============================] - 323s 296ms/step - loss: 0.3081 -
accuracy: 0.8801
Epoch 4/100
1092/1092 [==============================] - 323s 295ms/step - loss: 0.2716 -
accuracy: 0.8957
Epoch 5/100
1092/1092 [==============================] - 322s 295ms/step - loss: 0.2362 -
accuracy: 0.9115
Epoch 6/100
1092/1092 [==============================] - 321s 294ms/step - loss: 0.2226 -
accuracy: 0.9184
Epoch 7/100
1092/1092 [==============================] - 319s 292ms/step - loss: 0.1940 -
accuracy: 0.9284
Epoch 8/100
1092/1092 [==============================] - 317s 290ms/step - loss: 0.1780 -
accuracy: 0.9364
Epoch 9/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.1499 -
accuracy: 0.9476
Epoch 10/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.1413 -
accuracy: 0.9511
Epoch 11/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.1217 -
accuracy: 0.9574
Epoch 12/100
1092/1092 [==============================] - 315s 288ms/step - loss: 0.1164 -
accuracy: 0.9626
Epoch 13/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0821 -
accuracy: 0.9746
Epoch 14/100
1092/1092 [==============================] - 315s 288ms/step - loss: 0.0668 -
accuracy: 0.9791
Epoch 15/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0732 -
accuracy: 0.9779
Epoch 16/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0671 -
accuracy: 0.9805
Epoch 17/100
1092/1092 [==============================] - 315s 288ms/step - loss: 0.0470 -
accuracy: 0.9855
Epoch 18/100
1092/1092 [==============================] - 315s 288ms/step - loss: 0.0577 -
accuracy: 0.9839
Epoch 19/100
1092/1092 [==============================] - 315s 289ms/step - loss: 0.0459 -
accuracy: 0.9867
Epoch 20/100
1092/1092 [==============================] - 315s 288ms/step - loss: 0.0510 -
accuracy: 0.9872
Epoch 21/100
```

```
1092/1092 [==============================] - 315s 289ms/step - loss: 0.0516 -
accuracy: 0.9873
Epoch 22/100
1092/1092 [==============================] - 315s 289ms/step - loss: 0.0457 -
accuracy: 0.9892
Epoch 23/100
1092/1092 [==============================] - 315s 288ms/step - loss: 0.0506 -
accuracy: 0.9885
Epoch 24/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0476 -
accuracy: 0.9892
Epoch 25/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0405 -
accuracy: 0.9904
Epoch 26/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0697 -
accuracy: 0.9866
Epoch 27/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0371 -
accuracy: 0.9919
Epoch 28/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0313 -
accuracy: 0.9928
Epoch 29/100
1092/1092 [==============================] - 313s 286ms/step - loss: 0.0467 -
accuracy: 0.9916
Epoch 30/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0435 -
accuracy: 0.9919
Epoch 31/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0308 -
accuracy: 0.9929
Epoch 32/100
1092/1092 [==============================] - 313s 286ms/step - loss: 0.0388 -
accuracy: 0.9931
Epoch 33/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0373 -
accuracy: 0.9931
Epoch 34/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0411 -
accuracy: 0.9925
Epoch 35/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0422 -
accuracy: 0.9935
Epoch 36/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0425 -
accuracy: 0.9938
Epoch 37/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0575 -
accuracy: 0.9914
Epoch 38/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0407 -
accuracy: 0.9940
Epoch 39/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0293 -
accuracy: 0.9948
Epoch 40/100
1092/1092 [==============================] - 313s 286ms/step - loss: 0.0381 -
accuracy: 0.9951
Epoch 41/100
1092/1092 [==============================] - 313s 286ms/step - loss: 0.0351 -
accuracy: 0.9948
Epoch 42/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0460 -
```

```
accuracy: 0.9936
Epoch 43/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0404 -
accuracy: 0.9944
Epoch 44/100
1092/1092 [==============================] - 315s 288ms/step - loss: 0.2247 -
accuracy: 0.9675
Epoch 45/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0344 -
accuracy: 0.9943
Epoch 46/100
1092/1092 [==============================] - 316s 289ms/step - loss: 0.0214 -
accuracy: 0.9964
Epoch 47/100
1092/1092 [==============================] - 315s 288ms/step - loss: 0.0356 -
accuracy: 0.9949
Epoch 48/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0408 -
accuracy: 0.9945
Epoch 49/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0340 -
accuracy: 0.9948
Epoch 50/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0364 -
accuracy: 0.9956
Epoch 51/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0288 -
accuracy: 0.9960
Epoch 52/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0217 -
accuracy: 0.9967
Epoch 53/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0416 -
accuracy: 0.9951
Epoch 54/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0312 -
accuracy: 0.9964
Epoch 55/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0453 -
accuracy: 0.9955
Epoch 56/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0330 -
accuracy: 0.9965
Epoch 57/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0253 -
accuracy: 0.9975
Epoch 58/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0315 -
accuracy: 0.9961
Epoch 59/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0349 -
accuracy: 0.9956
Epoch 60/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0402 -
accuracy: 0.9966
Epoch 61/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0484 -
accuracy: 0.9954
Epoch 62/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0417 -
accuracy: 0.9963
Epoch 63/100
1092/1092 [==============================] - 315s 288ms/step - loss: 0.0487 -
accuracy: 0.9959
```

```
Epoch 64/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0297 -
accuracy: 0.9973
Epoch 65/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0242 -
accuracy: 0.9973
Epoch 66/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0749 -
accuracy: 0.9947
Epoch 67/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0268 -
accuracy: 0.9977
Epoch 68/100
1092/1092 [==============================] - 313s 286ms/step - loss: 0.0392 -
accuracy: 0.9967
Epoch 69/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0325 -
accuracy: 0.9971
Epoch 70/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0385 -
accuracy: 0.9967
Epoch 71/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0507 -
accuracy: 0.9958
Epoch 72/100
1092/1092 [==============================] - 313s 286ms/step - loss: 0.0506 -
accuracy: 0.9962
Epoch 73/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0523 -
accuracy: 0.9966
Epoch 74/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0337 -
accuracy: 0.9973
Epoch 75/100
1092/1092 [==============================] - 313s 286ms/step - loss: 0.0311 -
accuracy: 0.9971
Epoch 76/100
1092/1092 [==============================] - 312s 286ms/step - loss: 0.0453 -
accuracy: 0.9971
Epoch 77/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0392 -
accuracy: 0.9970
Epoch 78/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0226 -
accuracy: 0.9983
Epoch 79/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0472 -
accuracy: 0.9971
Epoch 80/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0565 -
accuracy: 0.9965
Epoch 81/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0457 -
accuracy: 0.9961
Epoch 82/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0339 -
accuracy: 0.9975
Epoch 83/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0592 -
accuracy: 0.9962
Epoch 84/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0437 -
accuracy: 0.9967
Epoch 85/100
```

```
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0257 -
accuracy: 0.9981
Epoch 86/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0582 -
accuracy: 0.9967
Epoch 87/100
1092/1092 [==============================] - 315s 288ms/step - loss: 0.0415 -
accuracy: 0.9975
Epoch 88/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0568 -
accuracy: 0.9972
Epoch 89/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0366 -
accuracy: 0.9975
Epoch 90/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0456 -
accuracy: 0.9974
Epoch 91/100
1092/1092 [==============================] - 314s 288ms/step - loss: 0.0430 -
accuracy: 0.9974
Epoch 92/100
1092/1092 [==============================] - 315s 289ms/step - loss: 0.0413 -
accuracy: 0.9973
Epoch 93/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0477 -
accuracy: 0.9973
Epoch 94/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0405 -
accuracy: 0.9976
Epoch 95/100
1092/1092 [==============================] - 313s 286ms/step - loss: 0.0463 -
accuracy: 0.9979
Epoch 96/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0489 -
accuracy: 0.9972
Epoch 97/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0779 -
accuracy: 0.9967
Epoch 98/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0382 -
accuracy: 0.9981
Epoch 99/100
1092/1092 [==============================] - 313s 287ms/step - loss: 0.0453 -
accuracy: 0.9974
Epoch 100/100
1092/1092 [==============================] - 314s 287ms/step - loss: 0.0399 -
accuracy: 0.9974
```

In [8]:

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
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
_________________________________________________________________
```

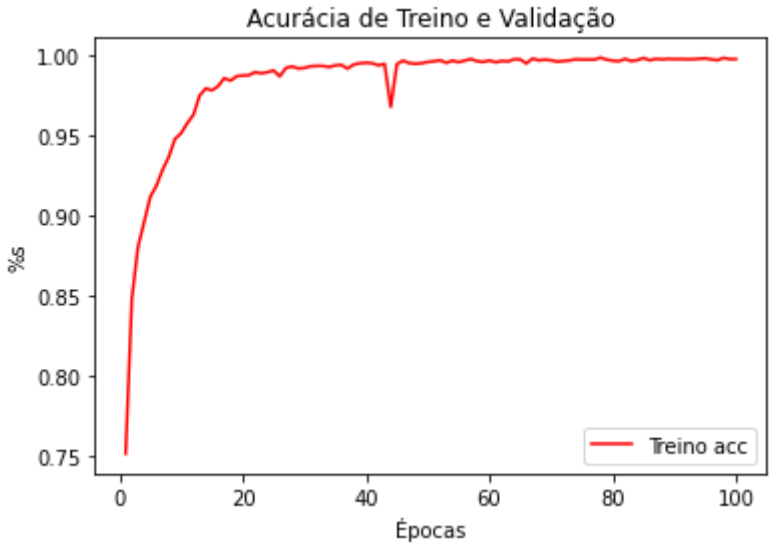
In [9]:

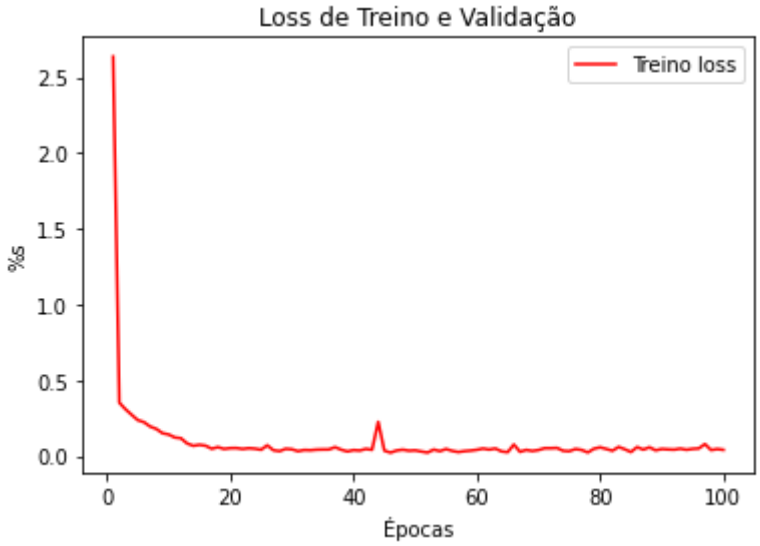
```
#https://www.tensorflow.org/js/tutorials/conversion/import_keras?hl=pt-br#al
import tensorflowjs as tfjs
tfjs.converters.save_keras_model(model, "conversao_01_16")
```

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("classificacao01.keras")
# serialize model to JSON
#model_json = model.to_json()
#with open("classificacao01.json", "w") as json_file:json_file.write(model_js
# serialize weights to HDF5
#model.save_weights("classificacao01.h5")
#print("Saved model to disk")
```

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

```
16/16 [==============================] - 1s 57ms/step - loss: 0.9463 - accura
cy: 0.9835
Test accuracy: 0.983
```

Referências

- https://machinelearningmastery.com/how-to-develop-a-convolutional-neural-network-to-classify-photos-of-dogs-and-cats/
- https://stackoverflow.com/questions/3430372/how-do-i-get-the-full-path-of-the-current-files-directory
- https://www.geeksforgeeks.org/python-list-files-in-a-directory/
- https://pynative.com/python-random-sample/
- https://machinelearningmastery.com/how-to-develop-a-convolutional-neural-network-to-classify-photos-of-dogs-and-cats/
- https://www.mygreatlearning.com/blog/keras-tutorial/
- https://www.machinecurve.com/index.php/2020/03/30/how-to-use-conv2d-with-keras/
- https://www.pyimagesearch.com/2021/06/30/how-to-use-the-modelcheckpoint-callback-with-keras-and-tensorflow/