

The background is a dark blue gradient. On the left, there is a large, semi-transparent circular image of a circuit board. Overlaid on this and the background are several geometric shapes: a blue parallelogram and a green parallelogram in the upper left, and a series of white, 3D-looking rectangular blocks arranged in a grid-like pattern in the upper right.

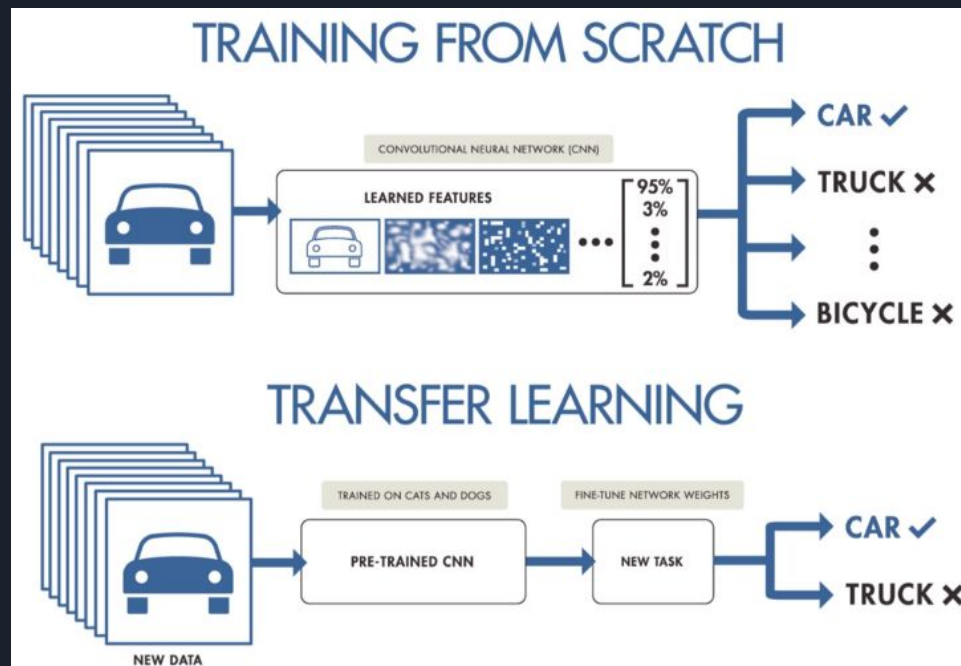
# Transfer Learning com VGG16 e ResNet50

Gildson Bezerra;

Mateus de Assis;

Micael Balza.

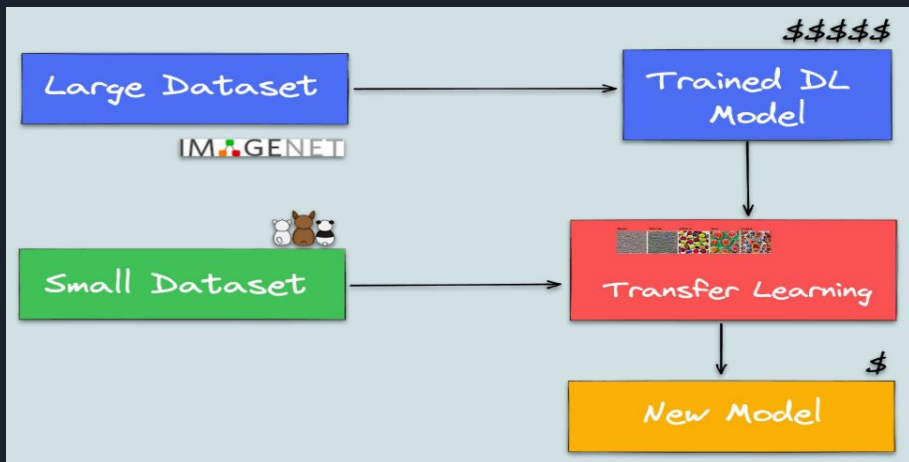
# O que é transfer learning?



(Fonte: <https://medium.datadriveninvestor.com/introducing-transfer-learning-as-your-next-engine-to-drive-future-innovations-5e81a15bb567> acesso em 27/11/2022)

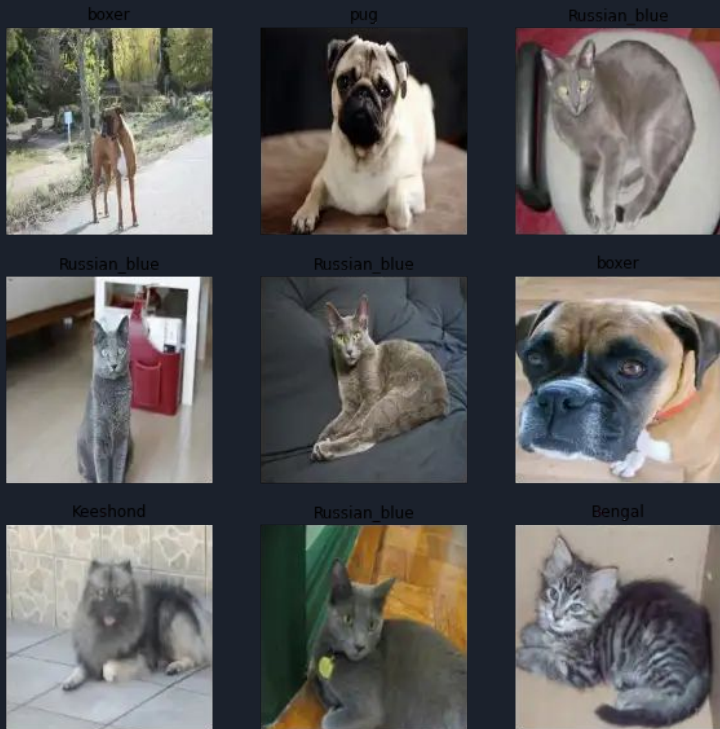
# Por que usar transfer learning?

- Custo (Infraestrutura e energético);
- Velocidade;
- Resolve o problema.



(Fonte: [https://raw.githubusercontent.com/ivanovitchm/embedded.ai/main/lessons/week\\_10/TransferLearning.pdf](https://raw.githubusercontent.com/ivanovitchm/embedded.ai/main/lessons/week_10/TransferLearning.pdf) acesso em 27/11/2022 )

# Dataset:



- Dataset com 98,8 MB;
- 5 classes;
  - Bengal;
  - Boxer;
  - Keeshond;
  - Pug;
  - Russian blue.
- 950 Imagens
  - 190 imagens por classe.

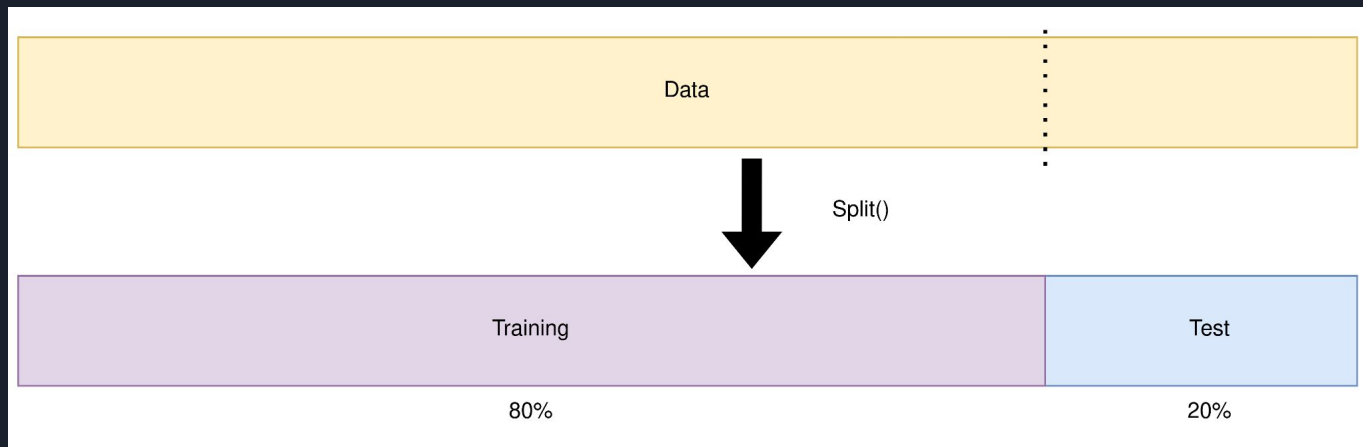
# Pré-processamento:

*Resize() do OpenCV  $\Rightarrow$  32x32x3*



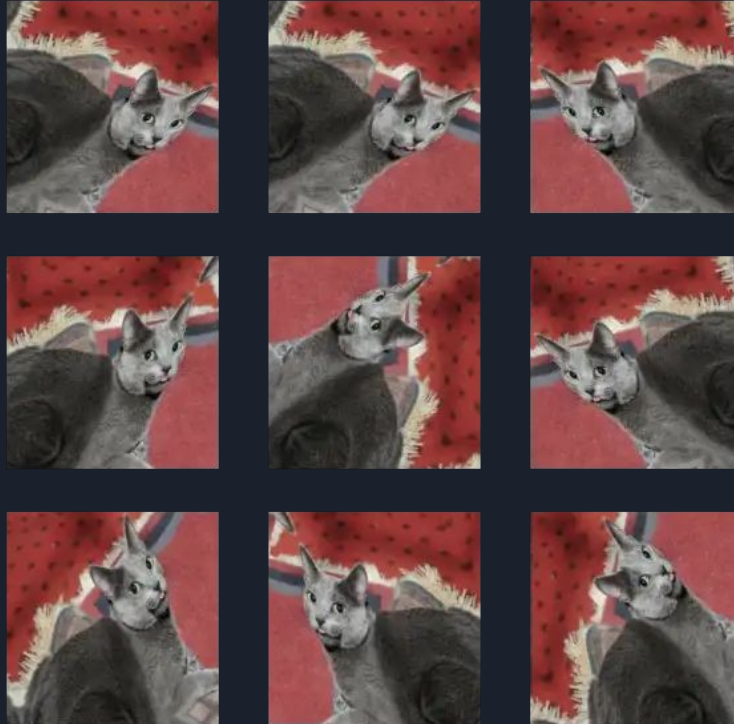
# Data Segregation

⇒ Função `train_test_split()` da biblioteca [Scikit Learn](#)



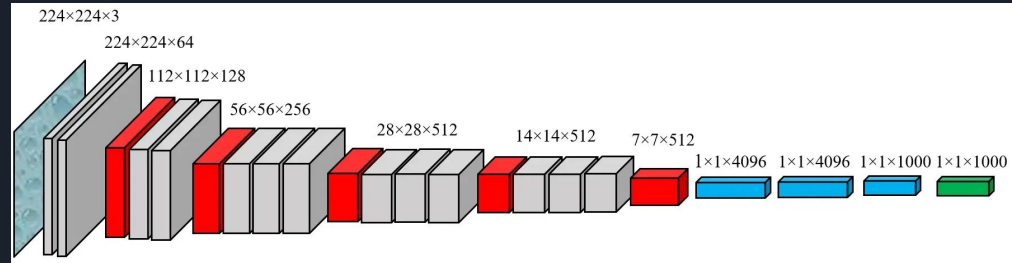


# Data Augmentation



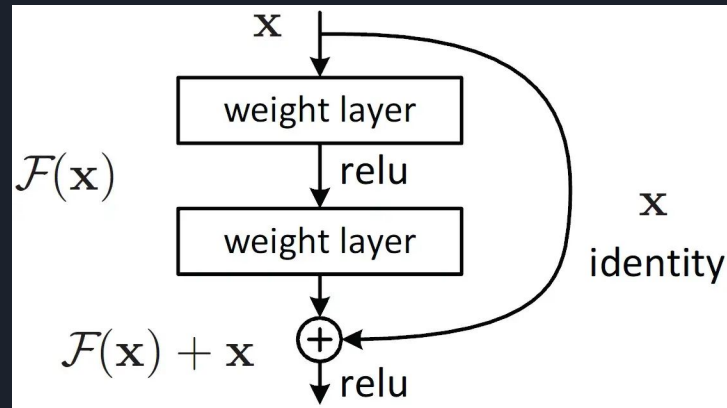
# Treinamento:

- VGG16



Arquitetura VGG ([Wikimedia Commons](#)).

- ResNet50



Conexões Residuais, o bloco básico da ResNet ([Papers With Code](#))



# Treinadas com:

- +14 milhões de imagens
- 1000 classes

IMAGENET

14,197,122 Images, 21841 synsets indexed

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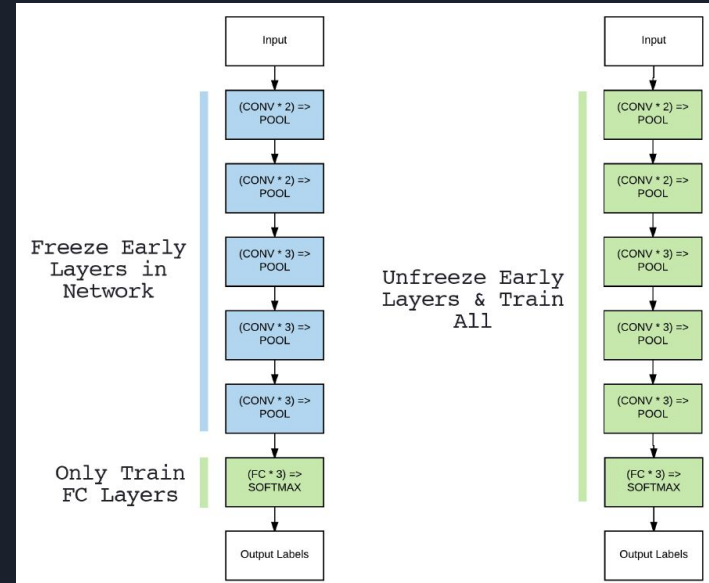
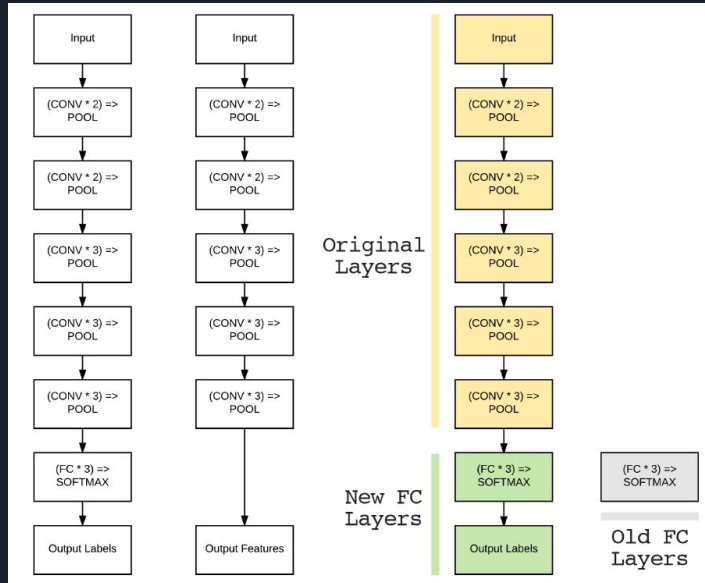
**ImageNet** is an image database organized according to the **WordNet** hierarchy (currently only the nouns), in which each node of the hierarchy is depicted by hundreds and thousands of images. The project has been **instrumental** in advancing computer vision and deep learning research. The data is available for free to researchers for non-commercial use.

**Mar 11 2021. ImageNet website update.**

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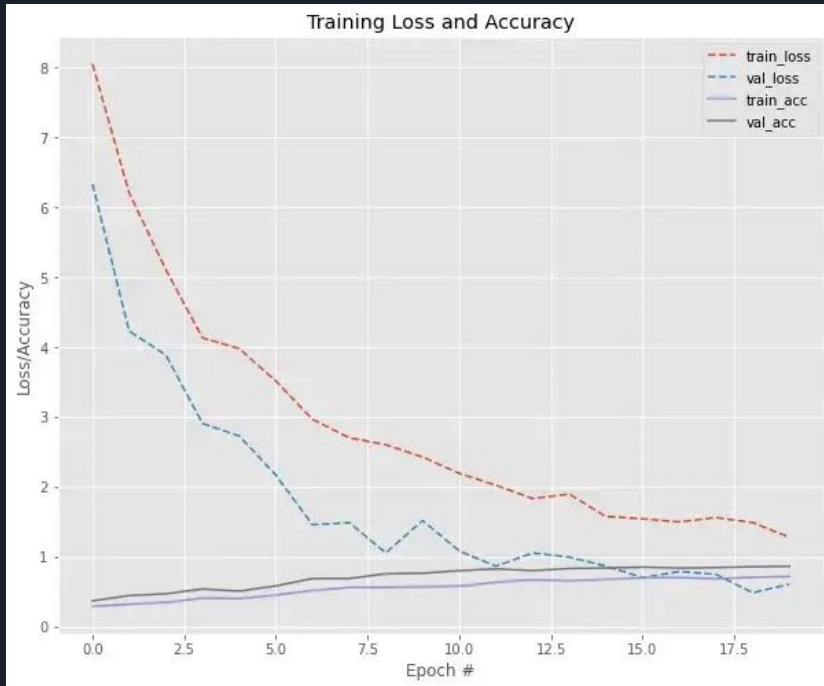
# Transfer learning

## Feature Extraction X Fine Tuning

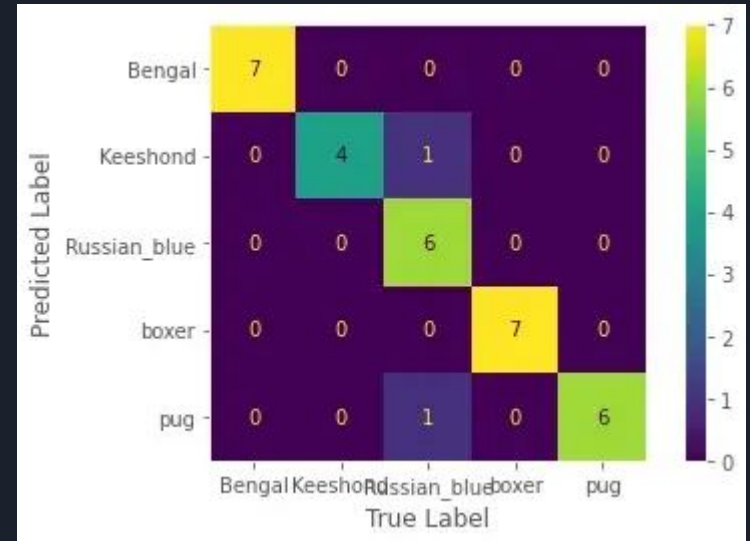


# VGG16 - Feature Extraction

- Learning rate de 0.0001
- 20 épocas



Loss e Acurácia, modelo VGG – Feature Extraction



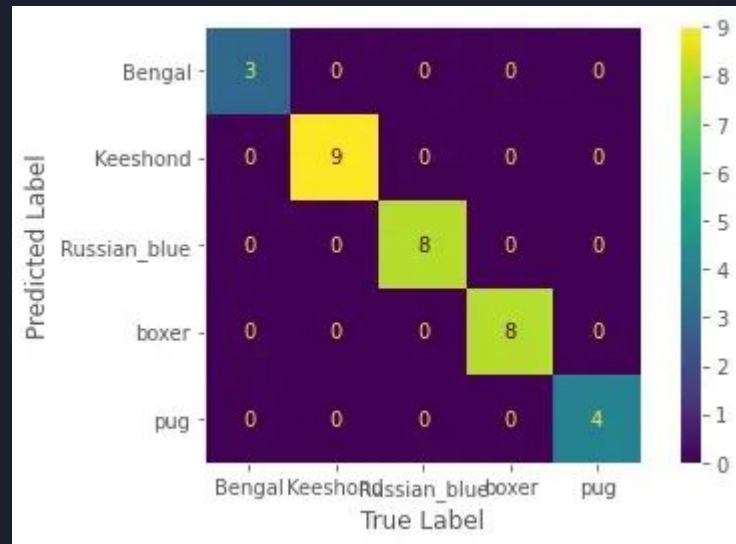
Matriz de Confusão, modelo VGG – Feature Extraction

# VGG16 - *Fine Tuning*

- Learning rate de 0.0001
- 20 épocas
- + 1 camada FC



Loss e Acurácia, modelo VGG – Fine Tuning



Matriz de Confusão, modelo VGG – Fine Tuning

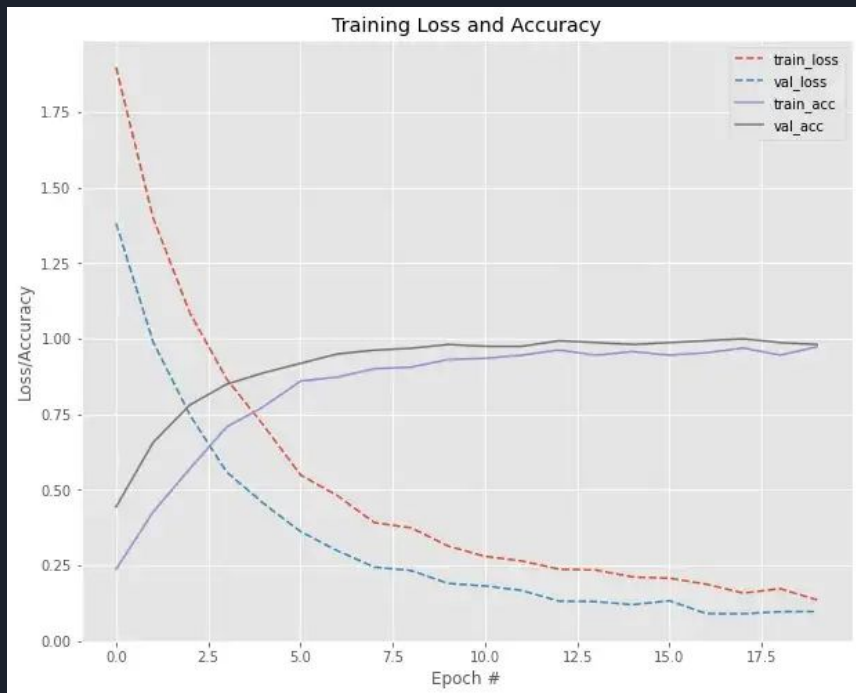
# VGG16 - *Fine Tuning*

- CodeCarbon
- Métricas

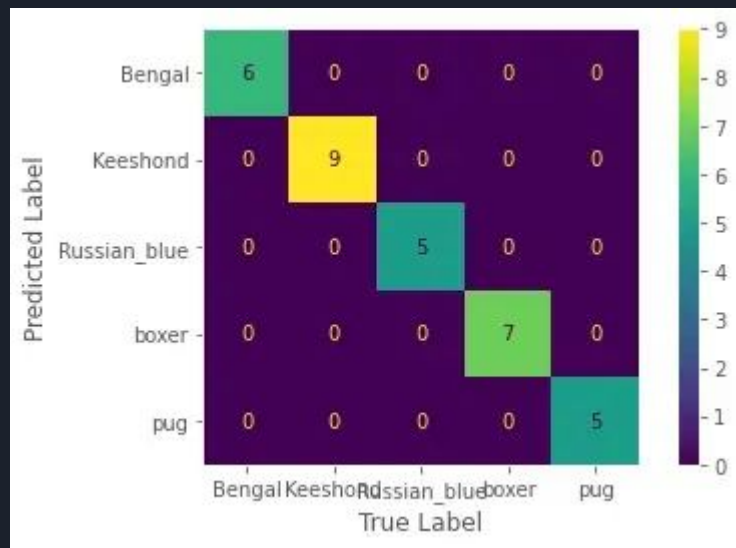
CO2_Emissions transfer learning with feature extractor	0.00394
CO2_Emissions transfer learning with fine tuning	0.00324
Count_Params transfer learning with feature extractor	14717253
Count_Params transfer learning with fine tuning	21138757
Energy_CPU transfer learning with feature extractor	0.00285
Energy_CPU transfer learning with fine tuning	0.00219
Energy_Consumed transfer learning with feature extractor	0.00624
Energy_Consumed transfer learning with fine tuning	0.00513
Energy_GPU transfer learning with feature extractor	0.00308
Energy_GPU transfer learning with fine tuning	0.0027
Energy_RAM transfer learning with feature extractor	0.00032
Energy_RAM transfer learning with fine tuning	0.00024
GFLOPs	15.36296
accuracy	0.9934
best_epoch	9
best_val_loss	0.0
epoch	19
loss	0.03178
val_accuracy	1.0
val_loss	0.00054

# ResNet50 - *Feature Extraction*

- Learning rate de 0.0001
- 20 épocas



Loss e Acurácia, modelo ResNet50 – Feature Extraction



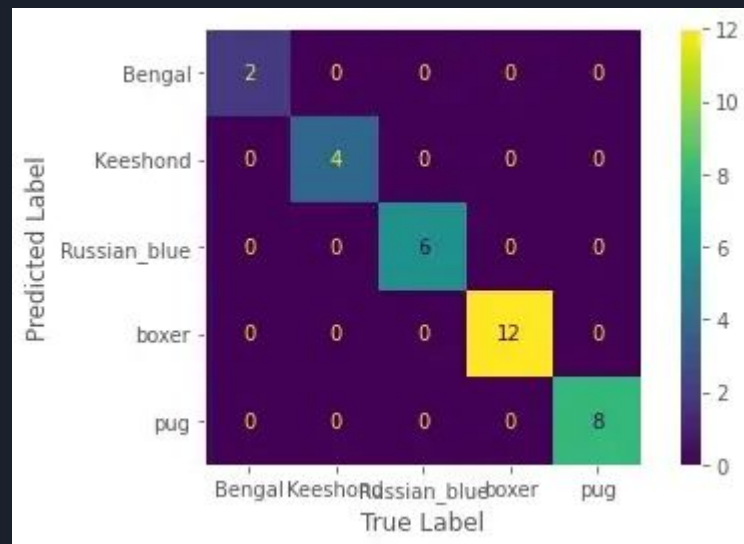
Matriz de Confusão, modelo ResNet50 – Feature Extraction

# ResNet50 - *Fine Tuning*

- Learning rate de 0.0001
- 20 épocas  
⇒ Mais profunda



Loss e Acurácia, modelo ResNet50 – Fine Tuning



Matriz de Confusão, modelo ResNet50 – Fine Tuning

# ResNet50 - *Fine Tuning*

- CodeCarbon
- Métricas

CO2_Emissions of the transfer learning with feature extractor	0.00909
CO2_Emissions of the transfer learning with fine tuning	0.00759
CO2_Emissions of the transfer learning with fine tuning (head)	0.00512
Count_Params of the transfer learning with feature extractor	23597957
Count_Params of the transfer learning with fine tuning	49279365
Count_Params of the transfer learning with fine tuning (head)	49279365
Energy_CPU	0.0038
Energy_CPU of the transfer learning with feature extractor	0.00745
Energy_CPU of the transfer learning with fine tuning	0.00519
Energy_Consumed of the transfer learning with feature extractor	0.01441
Energy_Consumed of the transfer learning with fine tuning	0.01204
Energy_Consumed of the transfer learning with fine tuning (head)	0.00811
Energy_GPU of the transfer learning with feature extractor	0.00613
Energy_GPU of the transfer learning with fine tuning	0.00627
Energy_GPU of the transfer learning with fine tuning (head)	0.00388
Energy_RAM of the transfer learning with feature extractor	0.00083
Energy_RAM of the transfer learning with fine tuning	0.00058
Energy_RAM of the transfer learning with fine tuning (head)	0.00042
GFLOPs	3.88789
accuracy	0.99604
best_epoch	16
best_val_loss	0.0
epoch	19
loss	0.01574
val_accuracy	1.0
val_loss	1e-05

Run Summary — ResNet50



# Mais informações:

- <https://github.com/Gildson/MODEL-CARD-Transfer-learning>
- <https://medium.com/@mateus.d.assis.silva/transfer-learning-com-vgg16-e-resnet50-39e58c3e84c3>



colab

