

# Deep Learning na indústria

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WHEN A USER TAKES A PHOTO,  
THE APP SHOULD CHECK WHETHER  
THEY'RE IN A NATIONAL PARK...

SURE, EASY GIS LOOKUP.  
GIMME A FEW HOURS.

... AND CHECK WHETHER  
THE PHOTO IS OF A BIRD.

I'LL NEED A RESEARCH  
TEAM AND FIVE YEARS.



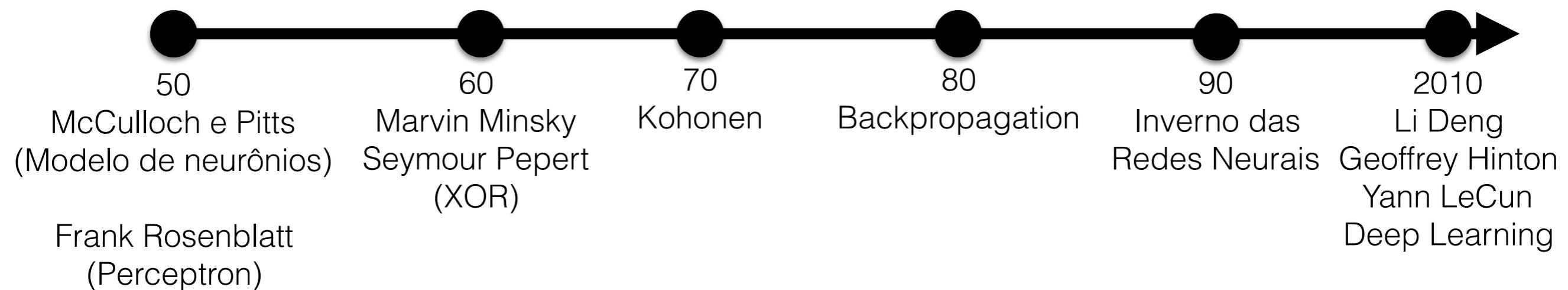
IN CS, IT CAN BE HARD TO EXPLAIN  
THE DIFFERENCE BETWEEN THE EASY  
AND THE VIRTUALLY IMPOSSIBLE.

<http://xkcd.com/1425/>

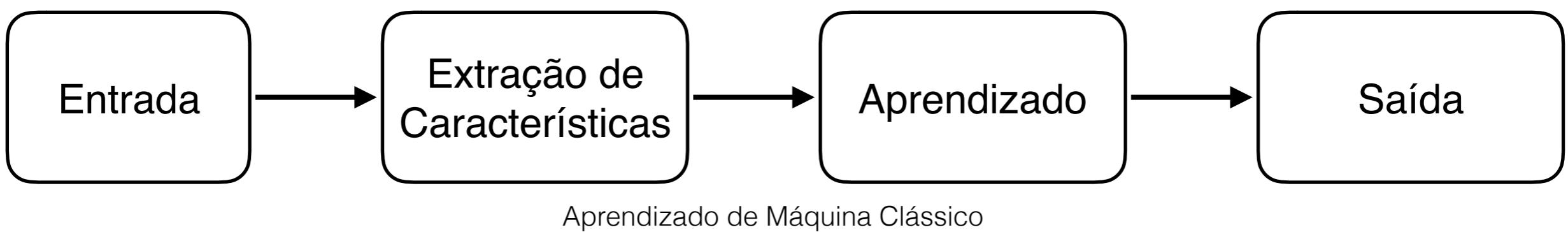
# Aprendizado de Máquina

- Aprendizado supervisionado: inferir uma saída a partir de uma entrada
  - Regressão: saída com valores reais
  - Classificação: saída com rótulos
- Aprendizado por reforço: selecionar ações para maximizar uma função
- Aprendizado não supervisionado: descobrir representações internas a partir de uma entrada

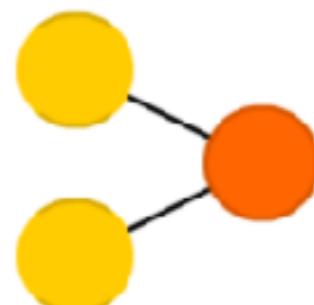
# Redes Neurais Artificiais: Breve História



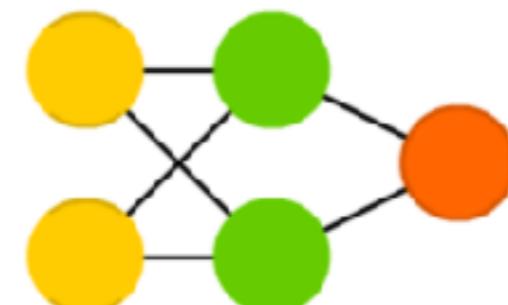
# Redes Neurais Artificiais



Perceptron (P)

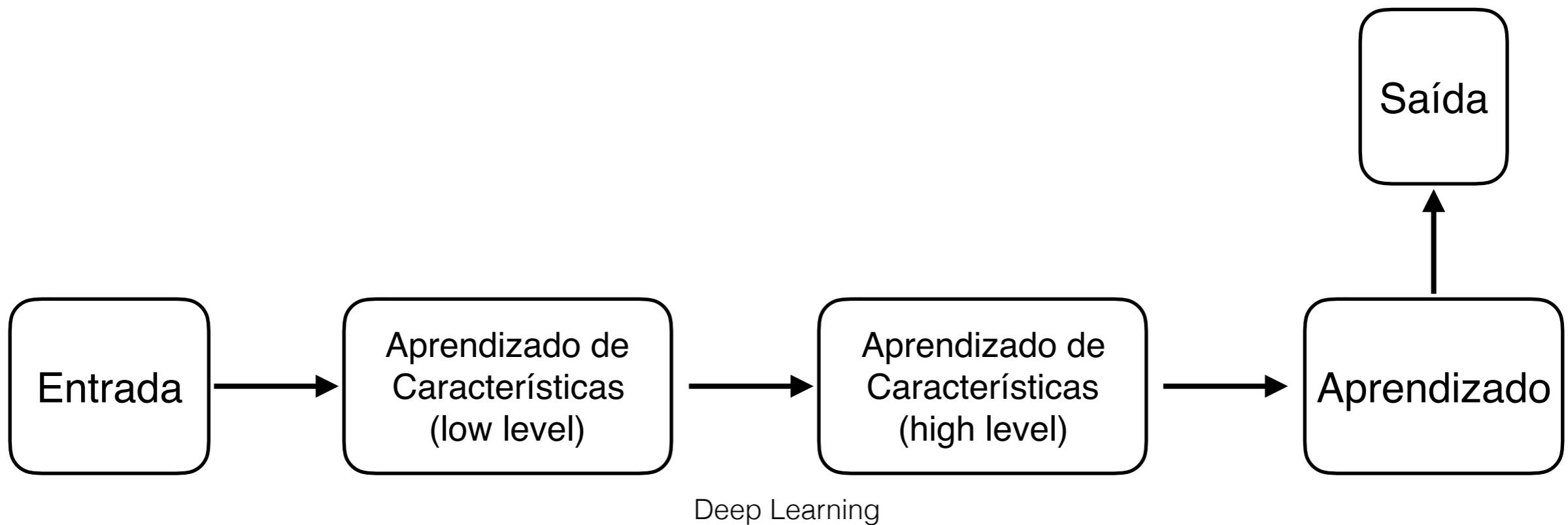


Feed Forward (FF)

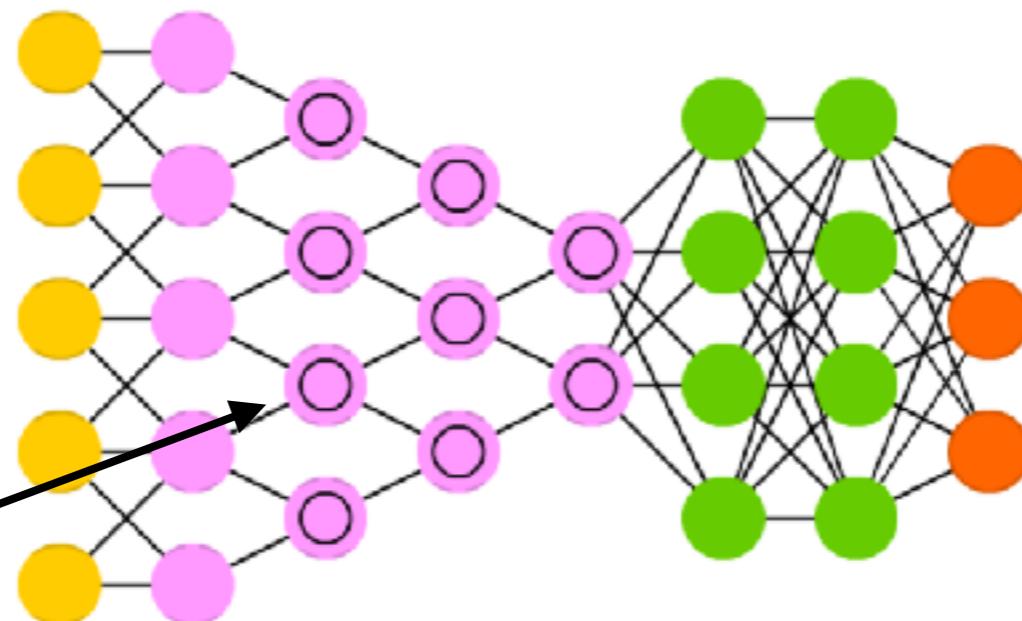


<http://www.asimovinstitute.org/neural-network-zoo>

# Deep Learning



Deep Convolutional Network (DCN)

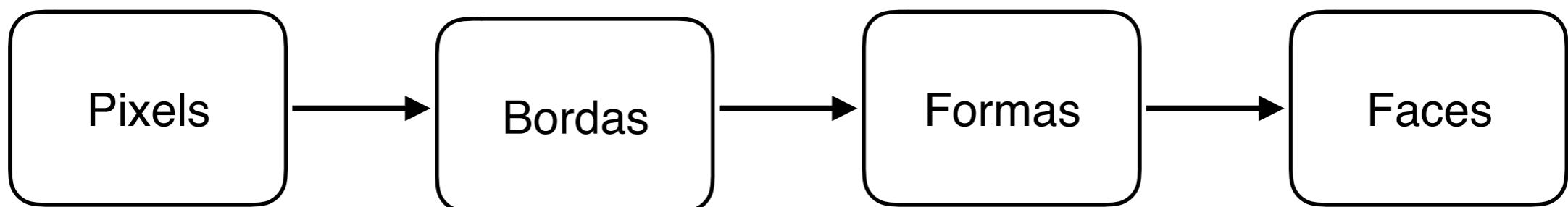


Convolução

<http://www.asimovinstitute.org/neural-network-zoo>

# Deep Learning

- Buzz word para Redes Neurais Artificiais
- Técnica de IA para aprender múltiplos níveis de abstrações diretamente de dados crus
- Modelar abstrações de alto nível usando transformações não lineares



# Deep Learning: Indústria



facebook.

amazon

Google



Microsoft

QUALCOMM®

Bai du 百度



nVIDIA®

YAHOO!

# Deep Learning: Frameworks

Caffe

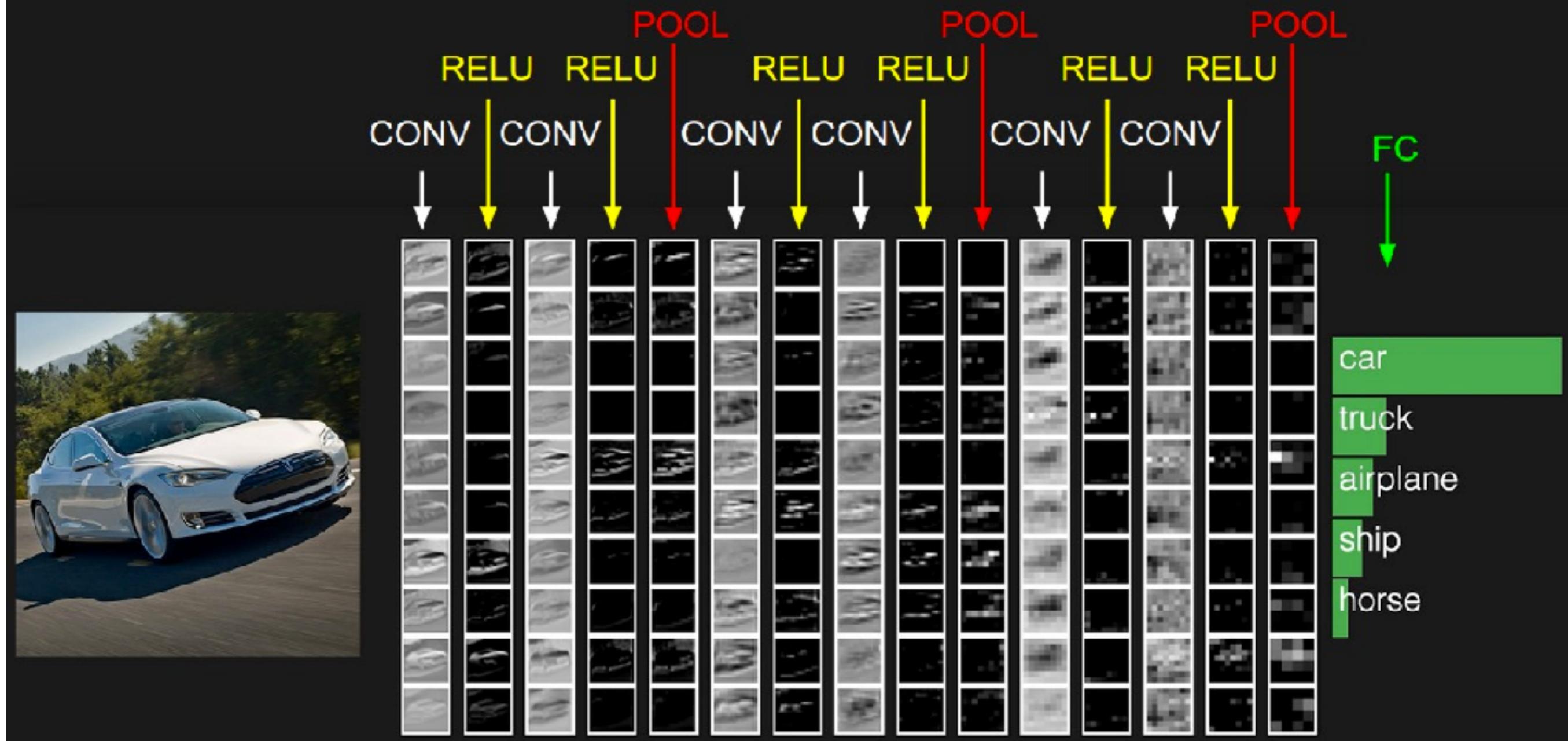


theano



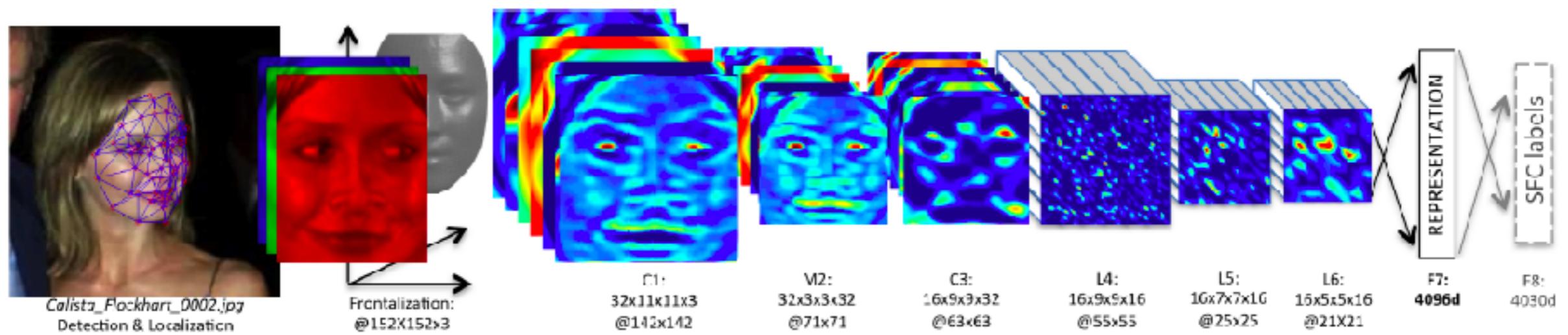
DEEPLEARNING4J

# Deep Convolutional Neural Networks



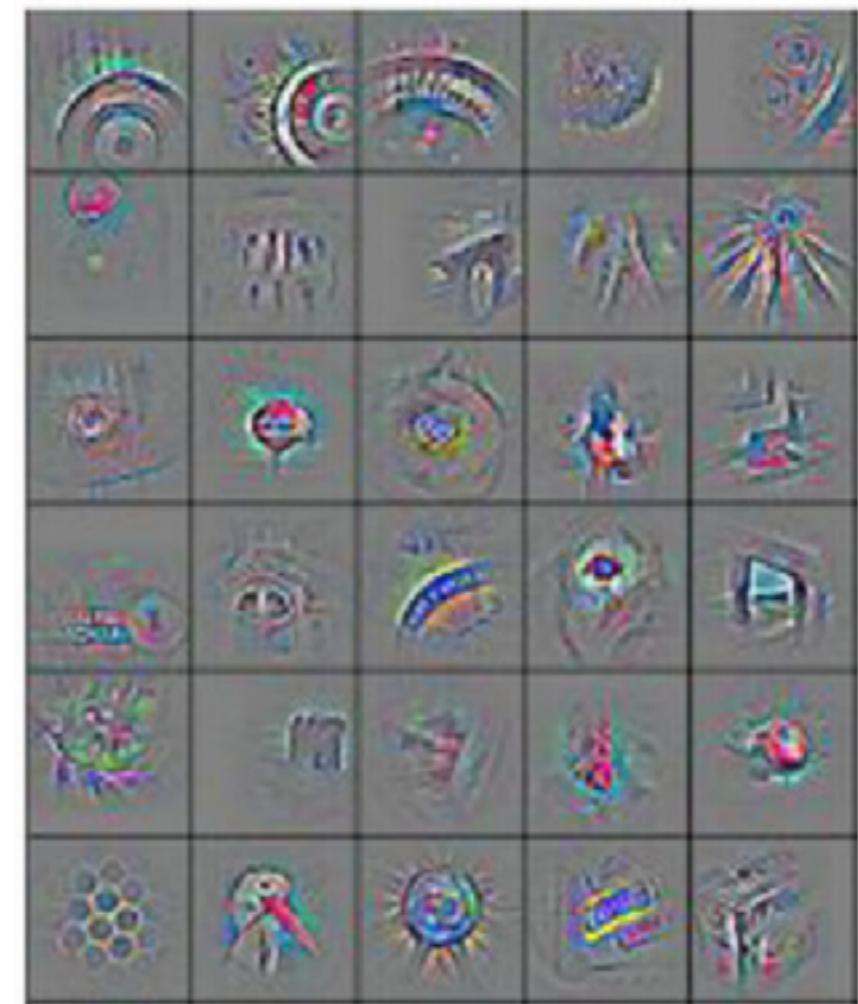
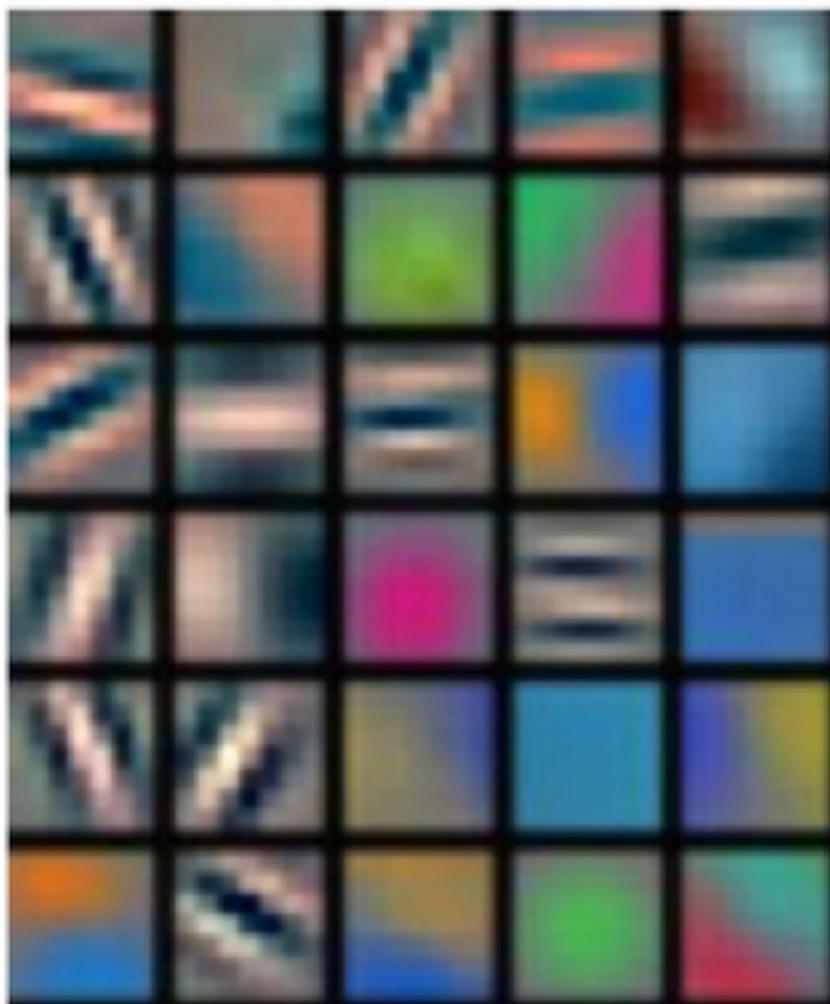
<http://cs231n.github.io/convolutional-networks>

# Deep Convolutional Neural Networks

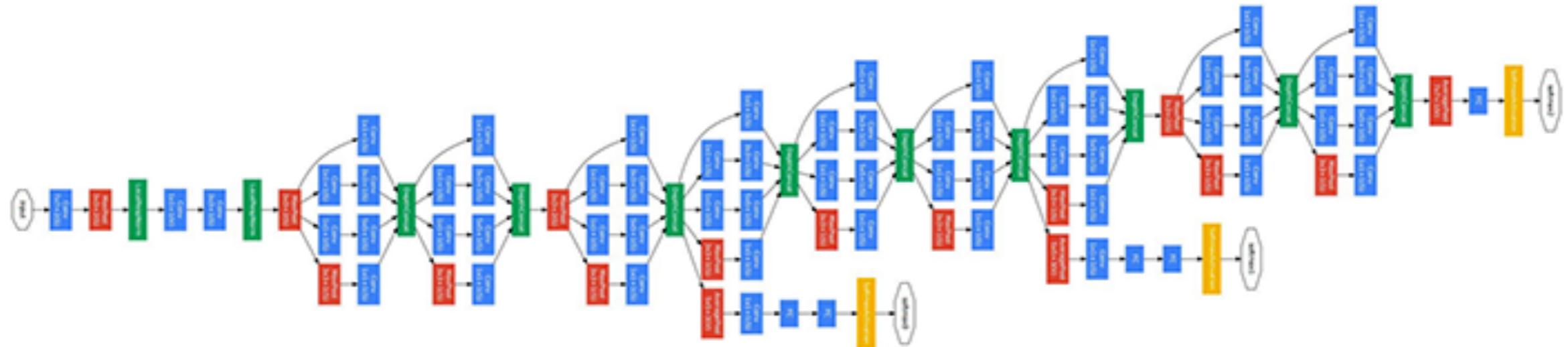


Yaniv Taigman, Ming Yang, Marc'Aurelio Ranzato (Facebook), Lior Wolf,  
DeepFace: Closing the Gap to Human-Level Performance in Face Verification, 2014

# Deep Convolutional Neural Networks

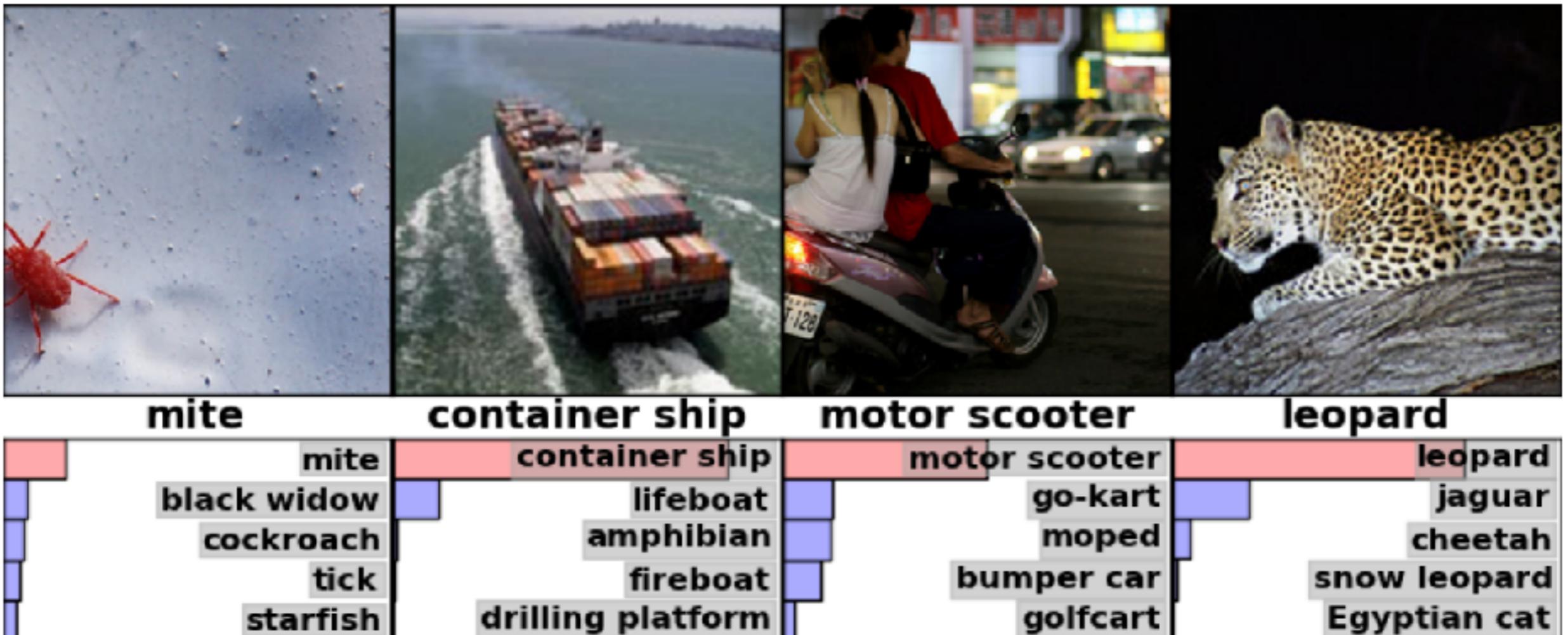


# Deep Convolutional Neural Networks



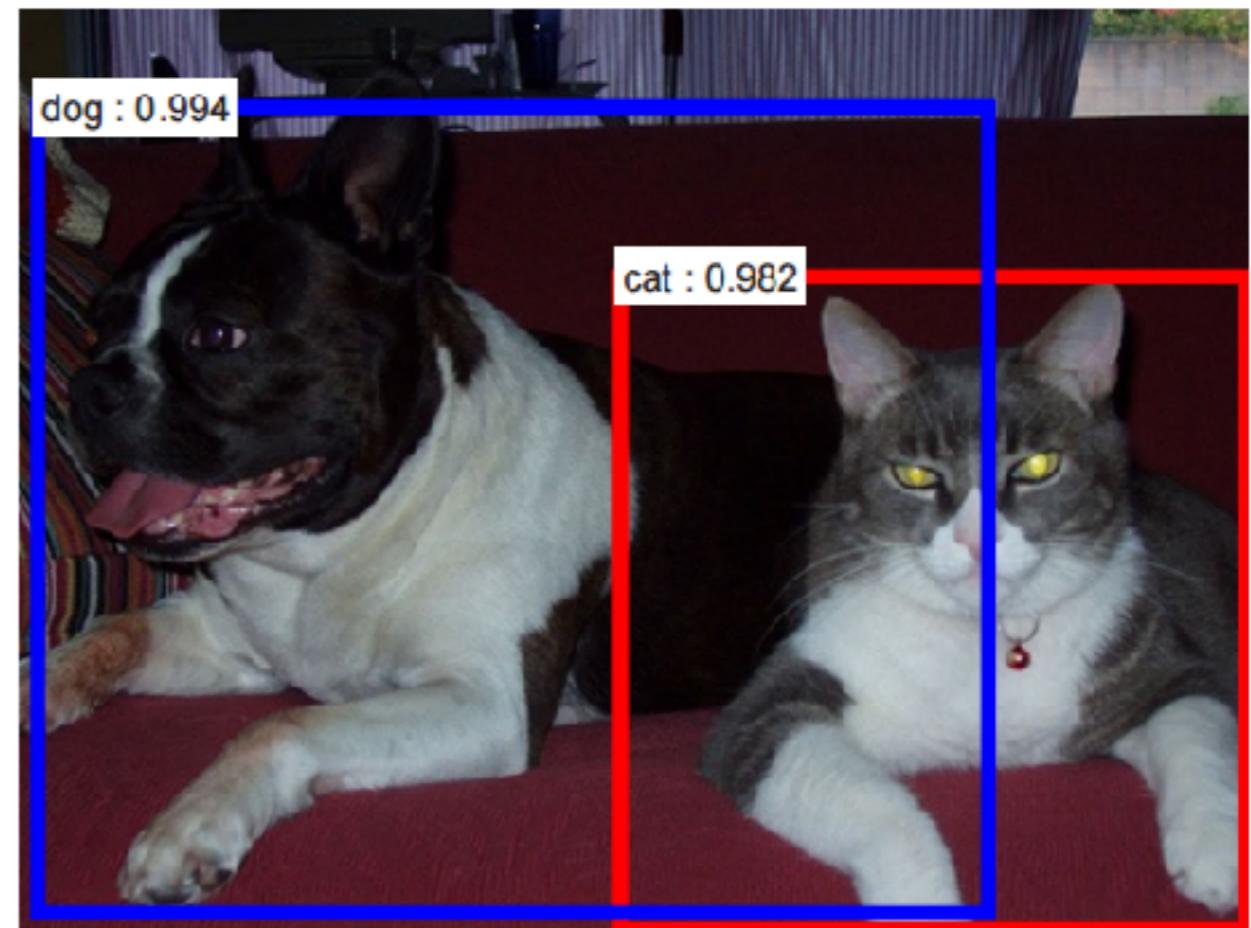
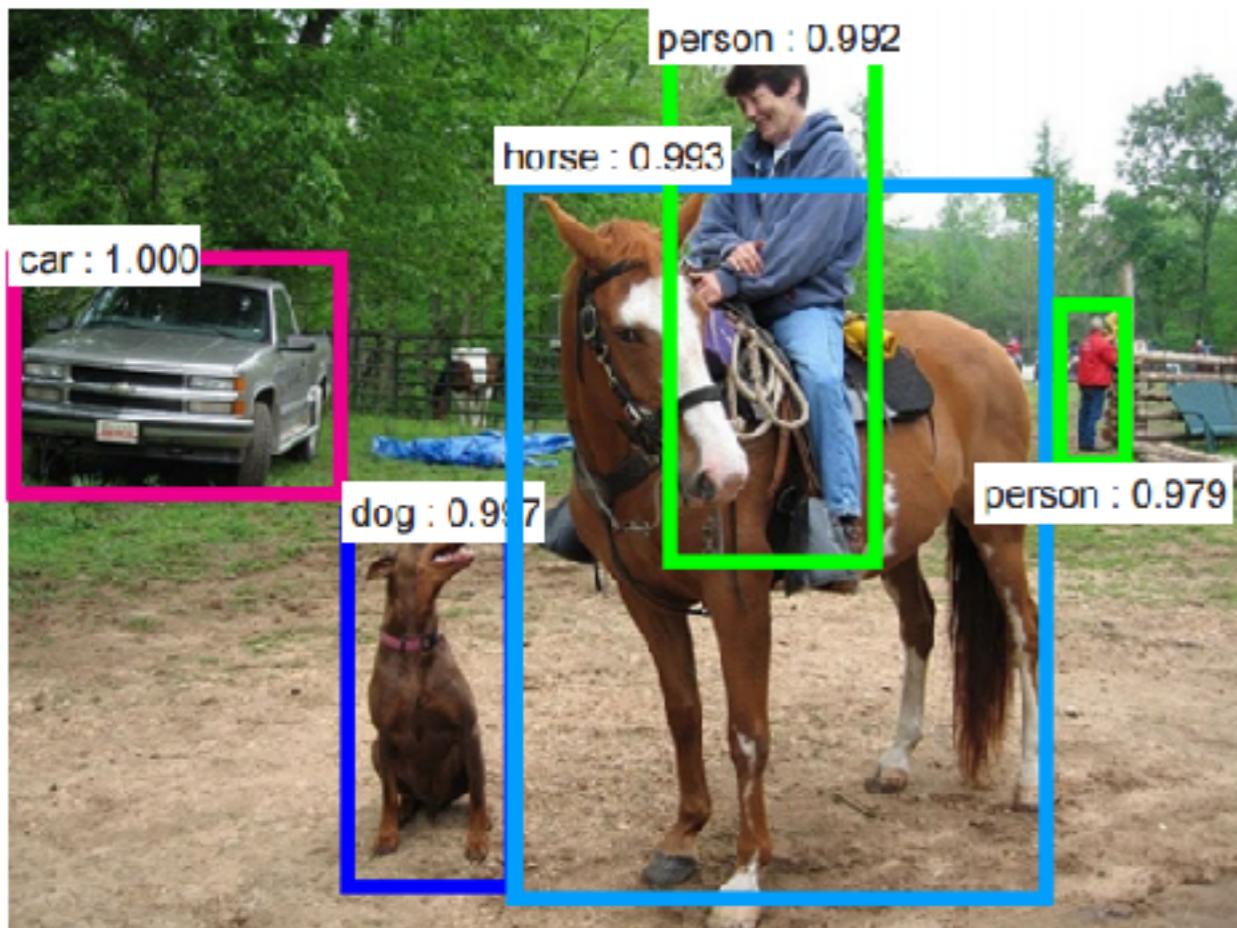
Google Inception Network

# Aplicações: Classificação



Alex Krizhevsky, Ilya Sutskever, Geoffrey E. Hinton, ImageNet Classification with Deep Convolutional Neural Networks, NIPS, 2012.

# Aplicações: Detecção de Objetos



Shaoqing Ren, Kaiming He, Ross Girshick, Jian Sun, Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks, arXiv:1506.01497

# Aplicações: Segmentação

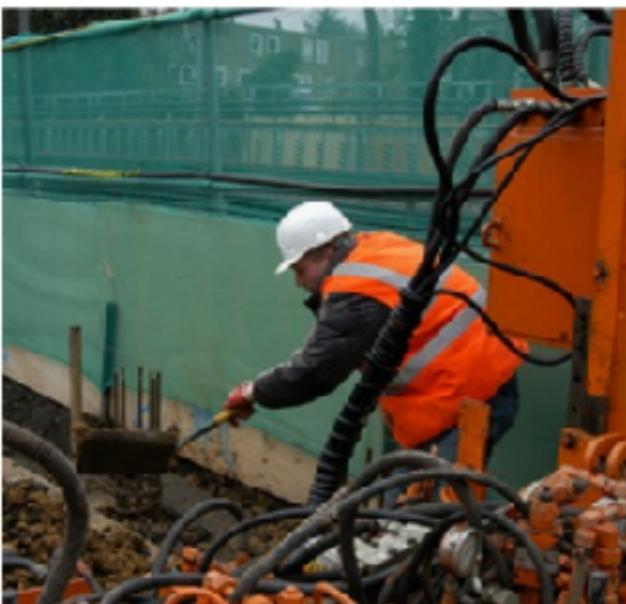


Jifeng Dai, Kaiming He, Jian Sun, BoxSup: Exploiting Bounding Boxes to Supervise Convolutional Networks for Semantic Segmentation,  
arXiv:1503.01640

# Aplicações: Legendas



man in black shirt is playing guitar.



construction worker in orange safety vest is working on road.



two young girls are playing with lego toy.



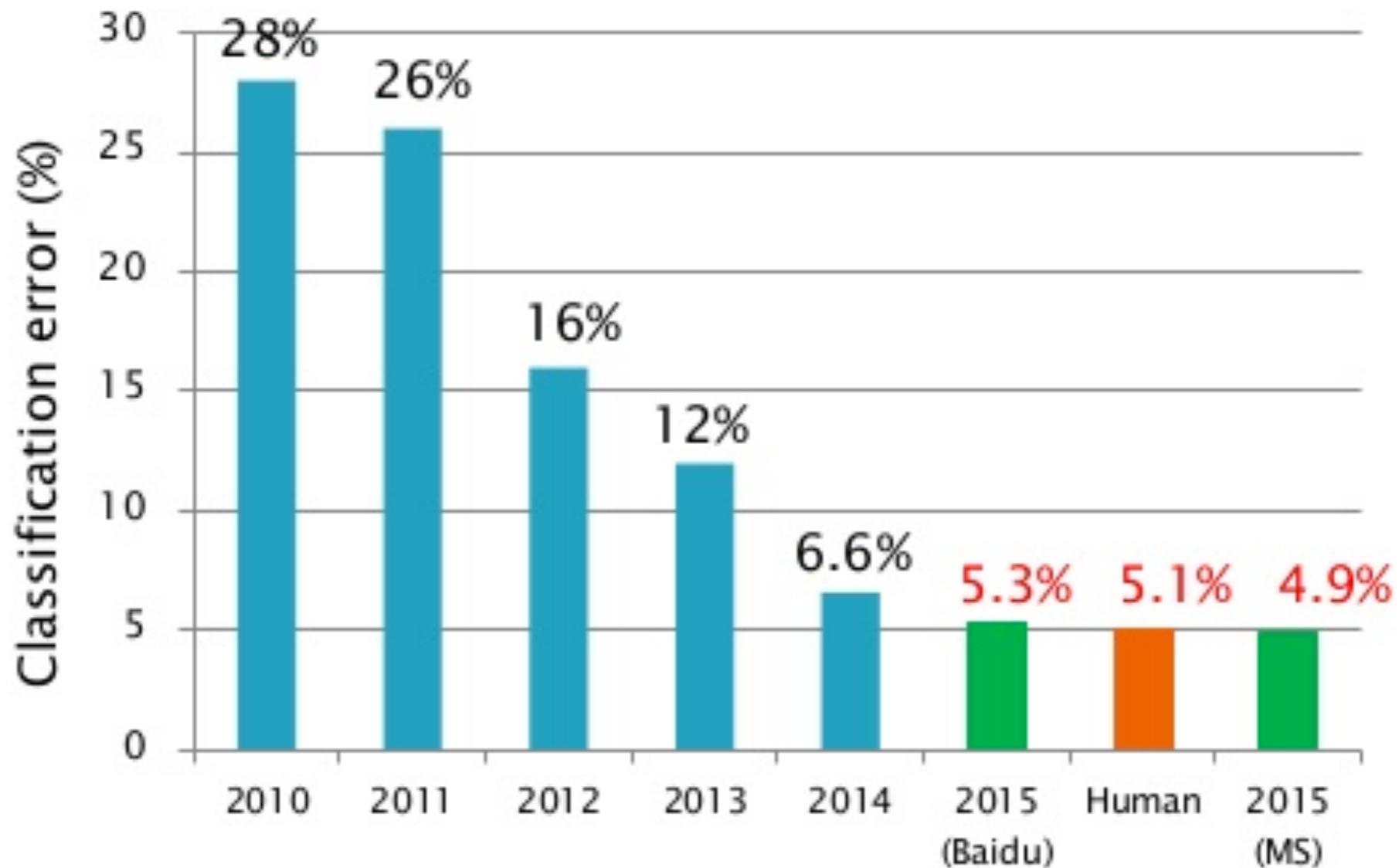
boy is doing backflip on wakeboard.

Andrej Karpathy, Li Fei-Fei, Deep Visual-Semantic Alignments for Generating Image Description, CVPR, 2015

# Aplicações: Legendas

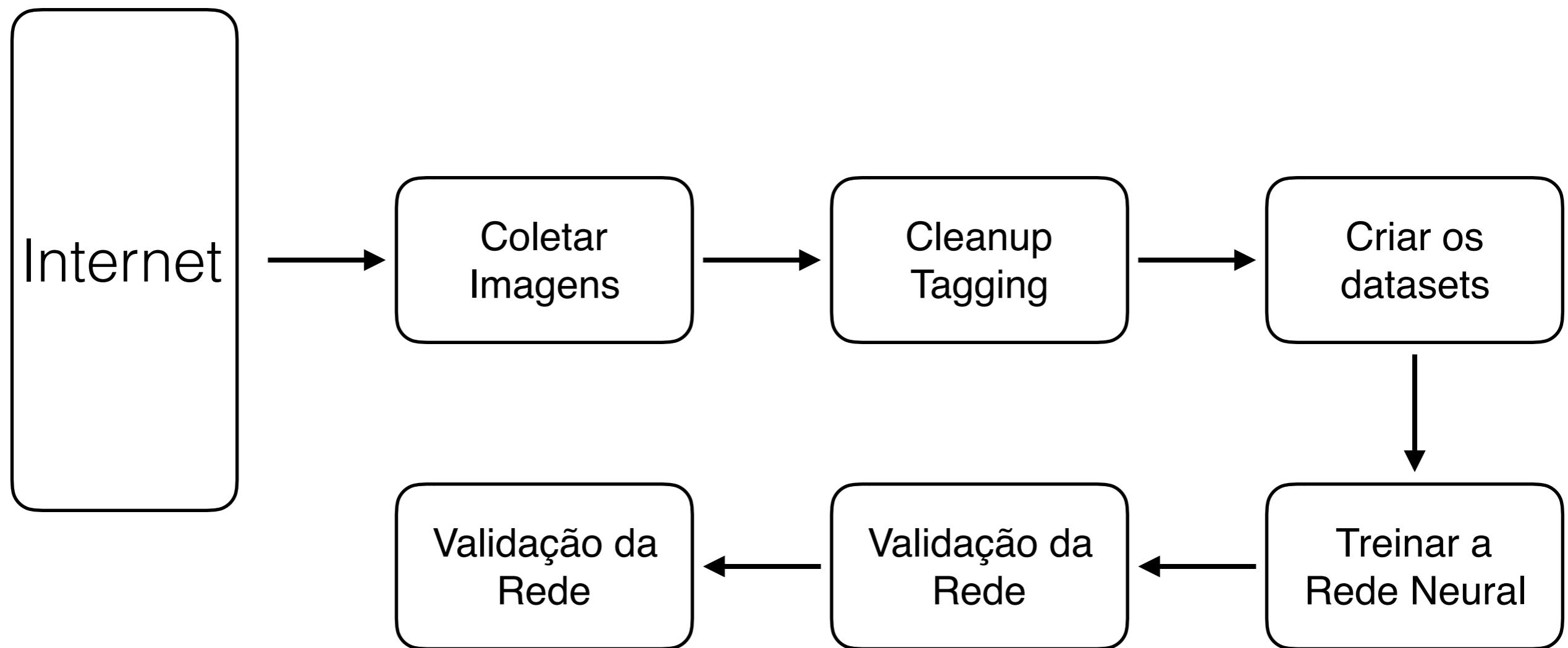


# Image-net



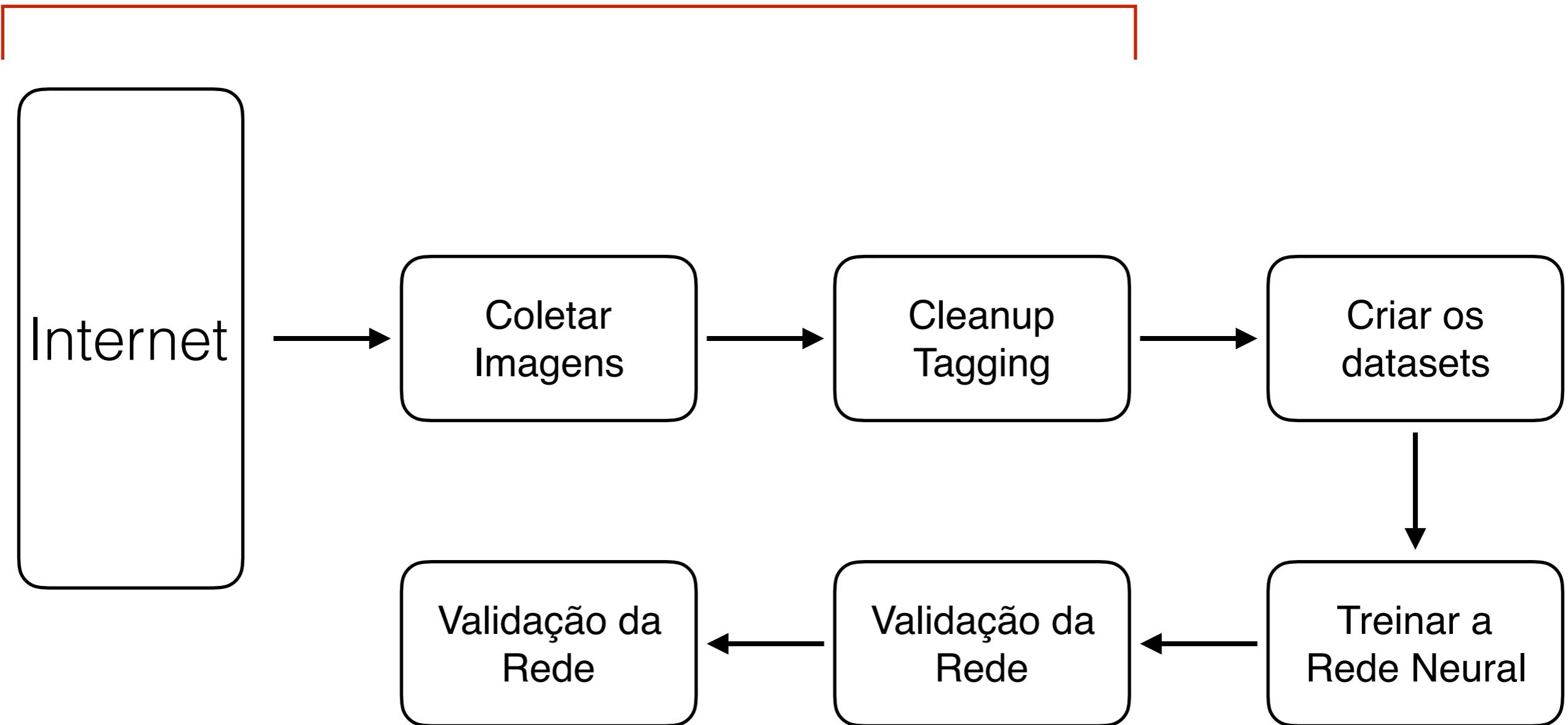
- SIFT (Scale Invariant Feature Transformation) + SVM
- Problema: Como extrair características das imagens?
- 2012: GPUs
- Grandes Bases de dados ao invés de extração de características

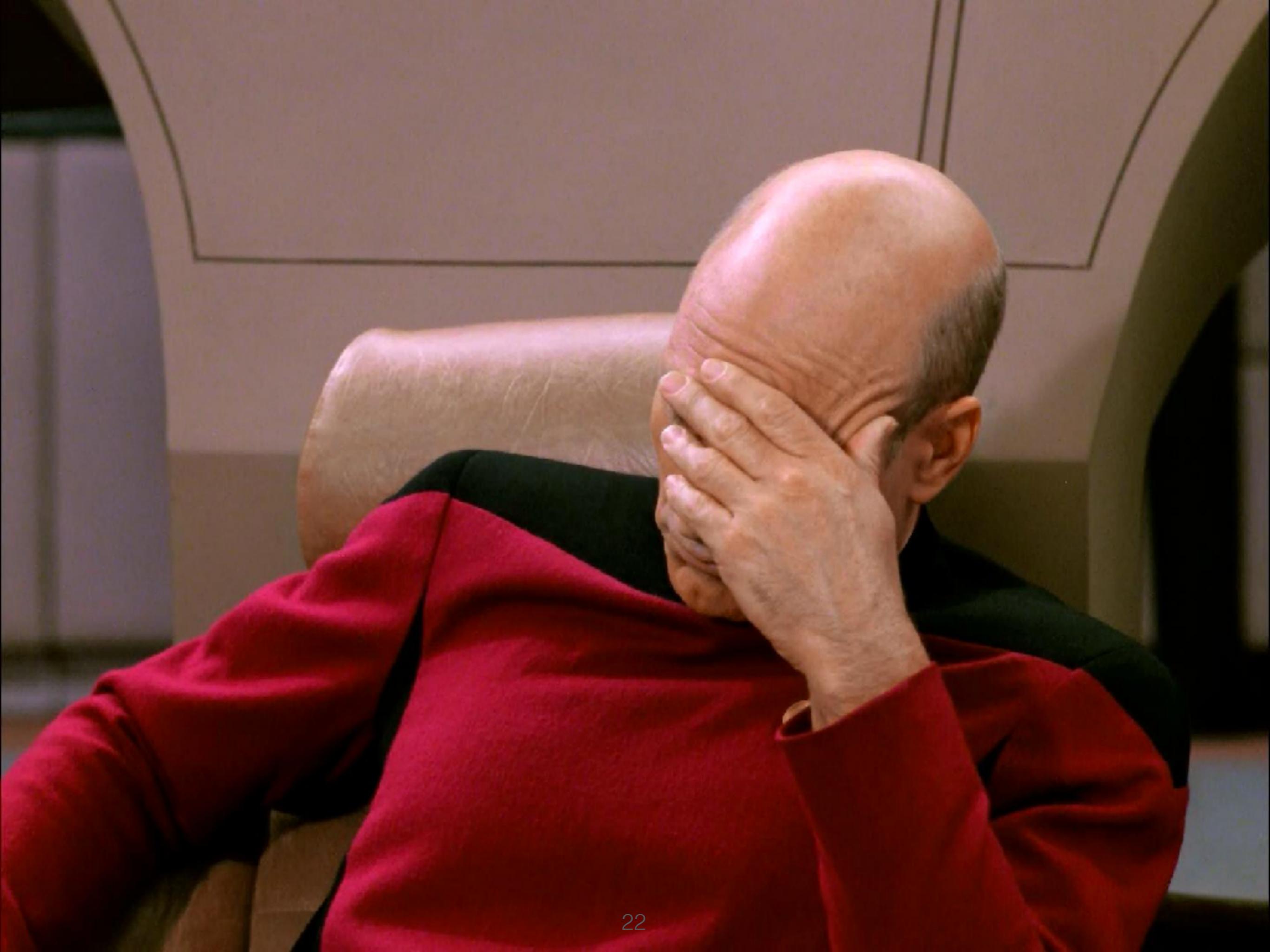
# Training Pipeline



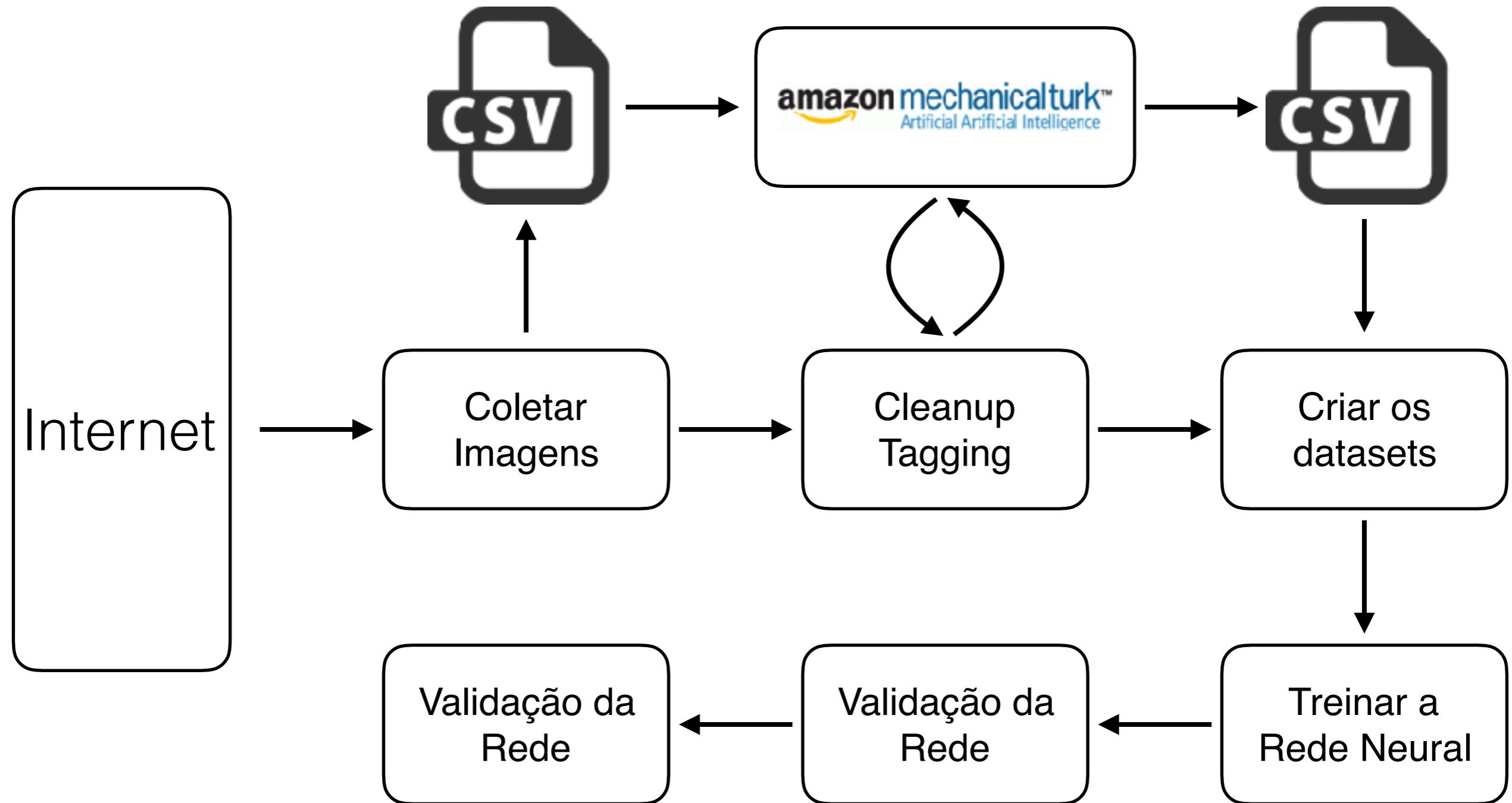
# Training Pipeline

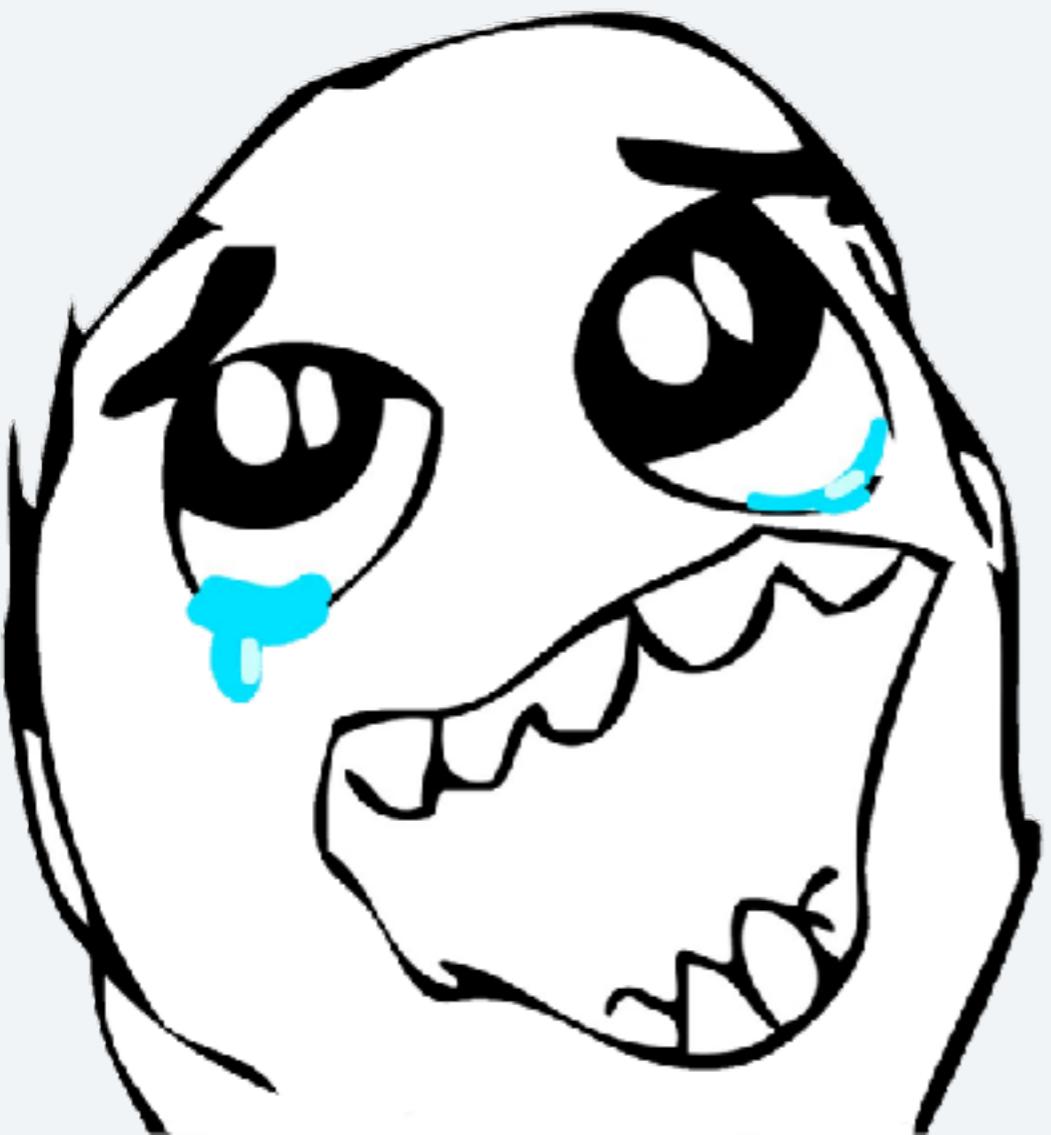
90/95% do tempo





# Training Pipeline





[P a s s o n P]

# Training Pipeline: Nvidia Digits

<https://developer.nvidia.com/digits>

# Nvidia Digits: Instalação

```
$ wget ...cuda-repo-ubuntu1404_7.5-18_amd64.deb  
$ sudo dpkg -i /tmp/cuda-repo-ubuntu1404_7.5-18_amd64.deb  
$ rm -f /tmp/cuda-repo-ubuntu1404_7.5-18_amd64.deb  
  
$ wget ...nvidia-machine-learning-repo_4.0-2_amd64.deb  
$ sudo dpkg -i /tmp/nvidia-machine-learning-repo_4.0-2_amd64.deb  
$ rm -f /tmp/nvidia-machine-learning-repo_4.0-2_amd64.deb  
  
$ sudo apt-get install digits
```

# Home

1/1 GPU available

No Jobs Running

Datasets (4)

Models (5)

New Dataset

New Model

Images ▾

Images ▾

Q Filter

Delete

name
kespry_walkthrough
mnist
dummy2
dummy1

DIGITS Image Classification Dataset shashank (Logout) Info ▾ None

Create DB (train)

Input File (before shuffling)  
train.txt

DB Creation log file  
[create\\_train\\_db.log](#)

Category	Count
0	4442
1	4500
2	4600
3	4500
4	4500
5	4500
6	4500
7	4500
8	4500
9	4500

Image Mean:

[Explore the db](#)

[Standard Networks](#)[Previous Networks](#)[Custom Network](#)

Caffe

Network	Details	Intended image size
<input type="radio"/> LeNet	<a href="#">Original paper [1998]</a>	28x28 (gray)
<input checked="" type="radio"/> AlexNet	<a href="#">Original paper [2012]</a>	256x256
<input type="radio"/> GoogLeNet	<a href="#">Original paper [2014]</a>	256x256

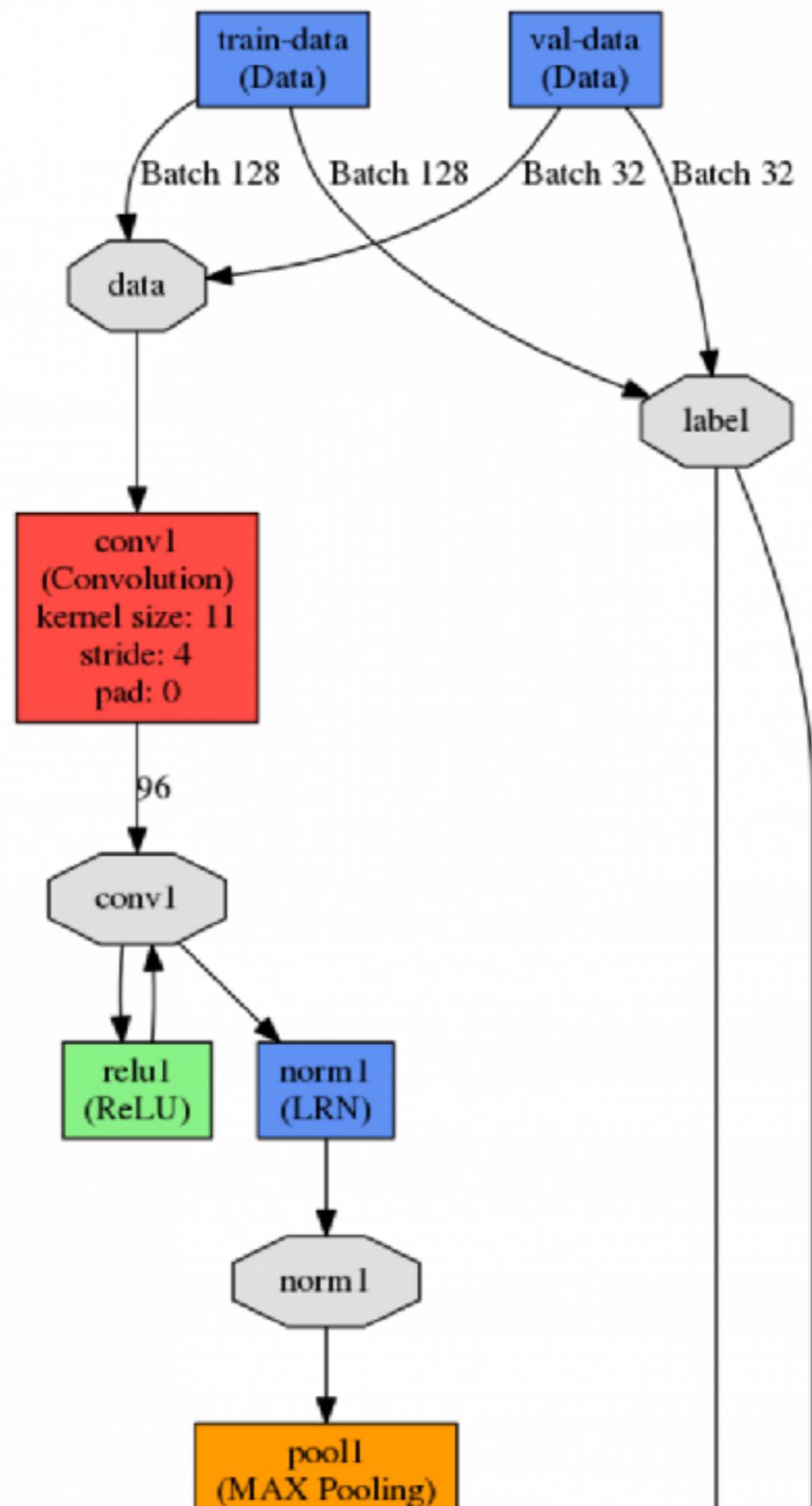
[Customize](#)[Standard Networks](#)[Previous Networks](#)[Custom Network](#)

Caffe

[Custom Network !\[\]\(32e690f510c20c9b52ef5257096d66a5\_img.jpg\)](#) [Visualize](#)

```
1 # AlexNet
2 name: "AlexNet"
3 layer {
4   name: "train-data"
5   type: "Data"
6   top: "data"
7   top: "label"
8   transform_param {
9     mirror: true
10    crop_size: 227
11  }
12  data_param {
13    batch_size: 128
14  }
15  include { stage: "train" }
16 }
17 layer {
18   name: "val-data"
19   type: "Data"
20   top: "data"
21   top: "label"
22   transform_param {
```

X



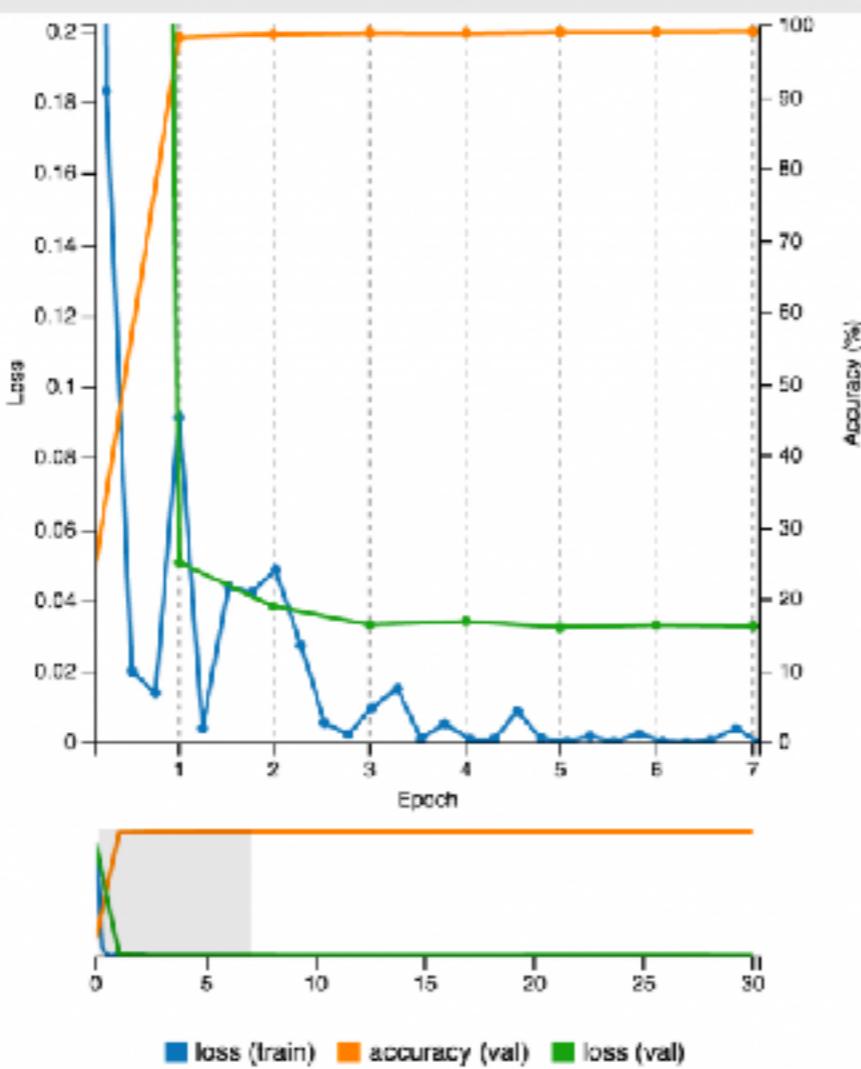
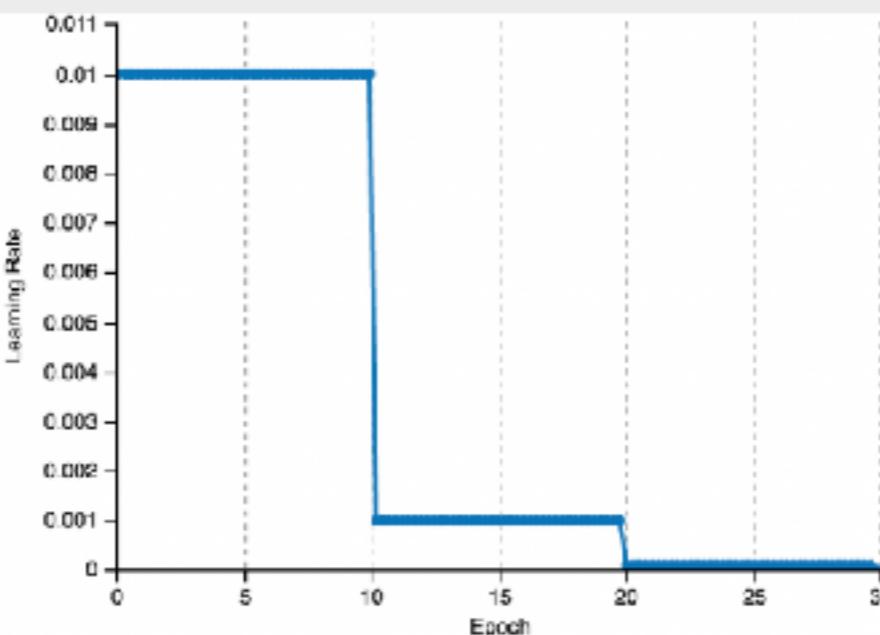
## Running Jobs (2)

 Filter Delete    Abort

name	submitted ↗	status	loss	progress
lenet_mnist_2	4:10 AM	Waiting		0%
kespry_walkthrough	4:09 AM	Running	 2.698	2%

[Datasets \(5\)](#)[Models \(5\)](#)[New Dataset](#)[New Model](#)[Images ▾](#)[Images ▾](#) Filter Delete

name	framework	status	elapsed	submitted ↗
lenet_mnist_1	caffe	Done	1m	2:45 AM

[View Large](#)

### Image Classification Dataset

mnist Done ▾

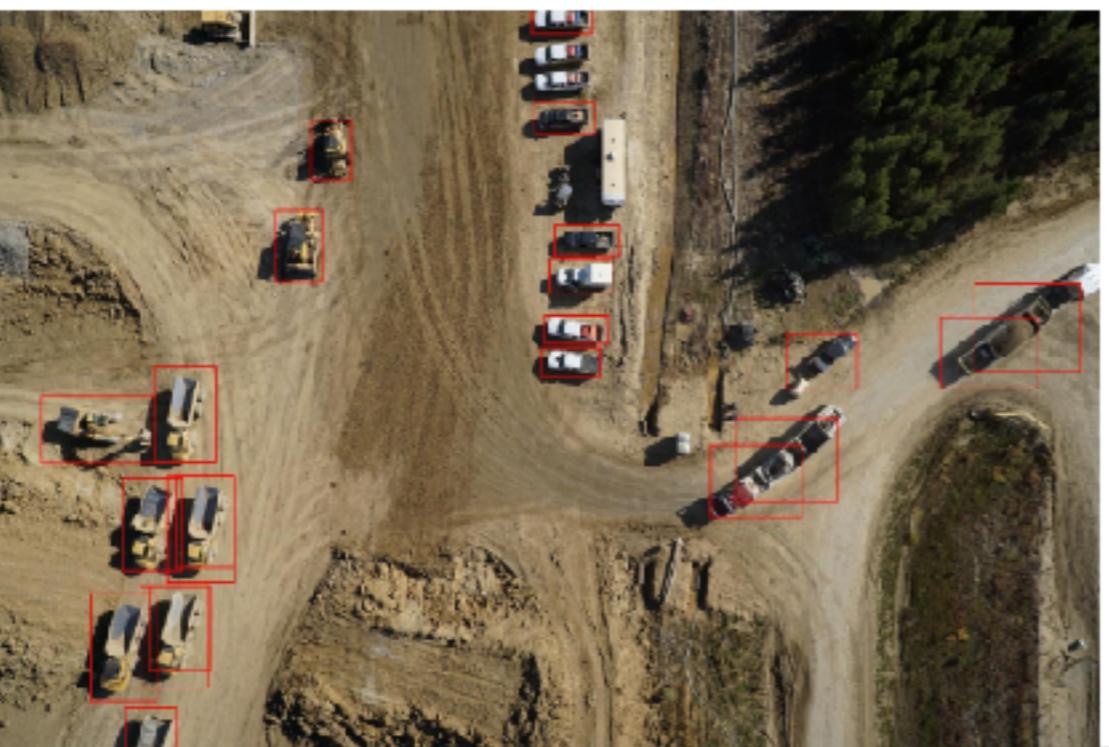
### Image Classification Model

lenet\_mnist Done ▾

### Notes

Test model

## Inference visualization

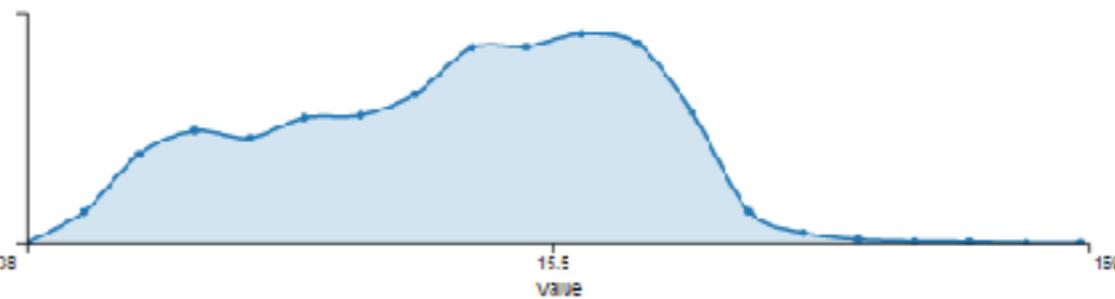


Description	Statistics	Visualization
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"data"

Activation

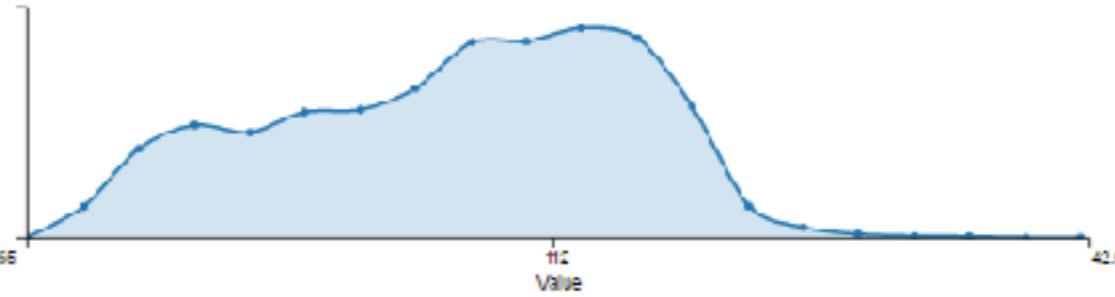
Data shape: [ 3 1024 1536]  
Mean: -11.0555  
Std deviation: 40.7560



"transformed\_data"

Activation

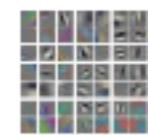
Data shape: [ 3 1024 1536]  
Mean: -130.950  
Std deviation: 48.7566



"conv1/7x7\_s2"

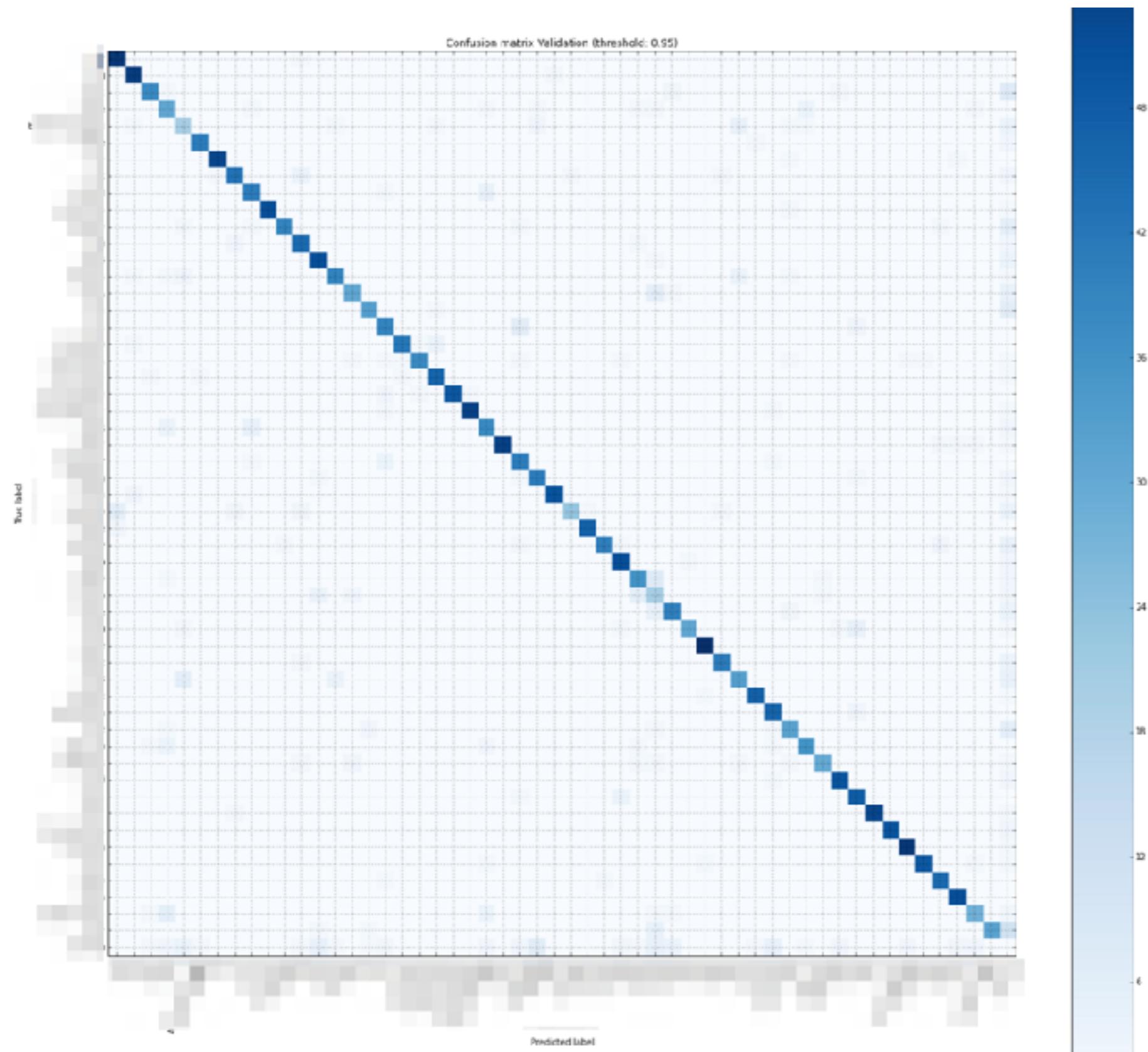
Weights (Convolution layer)

Data shape: [64 3 7 7]  
Mean: 2.47031e-05  
Std deviation: 0.196192





# Training Pipeline: Avaliação



# Problemas: A vida real

	Label certa	Label errada
Label Alvo	<b>0,99</b> x 1000	<b>0,01</b> x 1000
Outras labels	<b>0,01</b> x 999000	<b>0,99</b> x 999000

- 1000000 de imagens por dia
  - 1000 imagens com o label alvo
  - 999000 de outras labels

# Problemas: A vida real

	Label certa	Label errada
Label Alvo	990	10
Outras labels	9990	989010

**990/(990 + 9990) = 0,09%** das imagens na label alvo



# Soluções: A vida real

- Usar mais exemplos para a classe "unknown"
- Adicionar um "bias"
- Processar menos imagens: "spam filter"

# Não é bala de prata

- É difícil: existem métodos mais simples que também funcionam
- Requer bastante poder computacional e memória
- Caixa-preta: as vezes não conseguimos extrair conclusões a partir das características aprendidas



[www.fablabjoinville.com.br](http://www.fablabjoinville.com.br)

[www.facebook.com/fablabjoinville](http://www.facebook.com/fablabjoinville)

[contato@fablabjoinville.com.br](mailto:contato@fablabjoinville.com.br)

- [www.kaggle.com](http://www.kaggle.com)
- [www.labell.io](http://www.labell.io)
- [image-net.org](http://image-net.org)
- <https://www.microsoft.com/en-us/research/publication/stochastic-gradient-tricks/>
- <http://cs.stanford.edu/people/karpathy/convnetjs/>
- [http://rodrigob.github.io/are\\_we\\_there\\_yet/build/](http://rodrigob.github.io/are_we_there_yet/build/)
- <http://neuralnetworksanddeeplearning.com>
- <https://github.com/edobashira/speech-language-processing>
- <http://yclade.github.io/MachineLearning/>
- <http://jsfiddle.net/wybiral/3bdkp5c0/embedded/result/>
- <https://github.com/hangtwenty/dive-into-machine-learning>
- <http://www.mlyearning.org/>
- <https://github.com/kjw0612/awesome-deep-vision>
- <http://cs231n.github.io/convolutional-networks/>
- <http://www.asimovinstitute.org/neural-network-zoo/>
- <https://developer.nvidia.com/cudnn>
- <https://github.com/NVIDIA/DIGITS>

# Obrigado!

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