Tópico 03 – Deep Learning e CNNs

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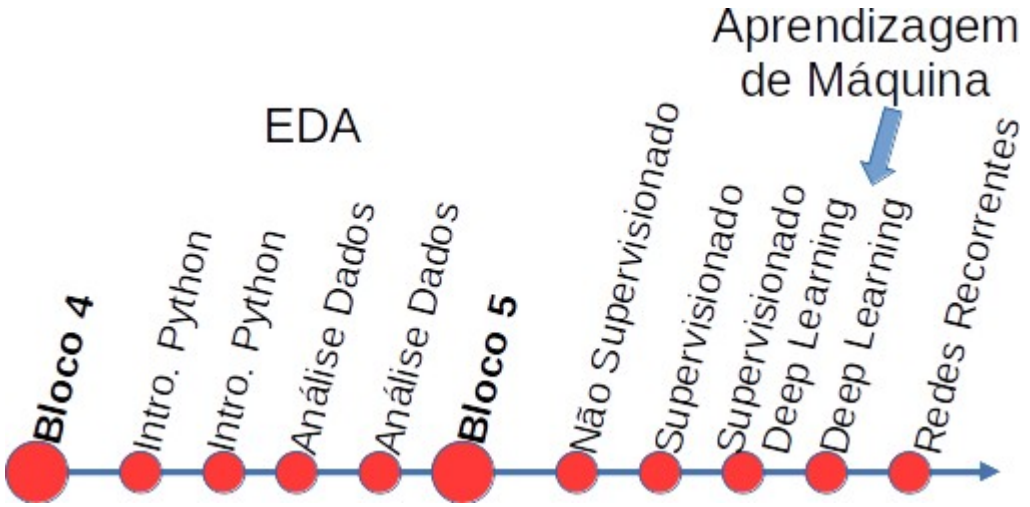
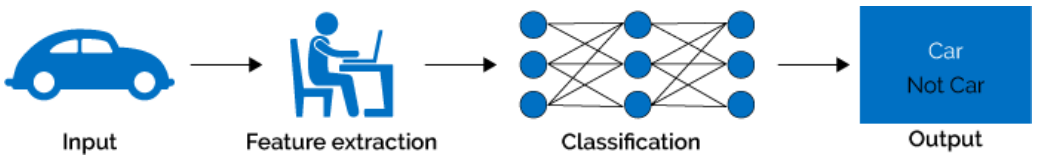
Tópicos

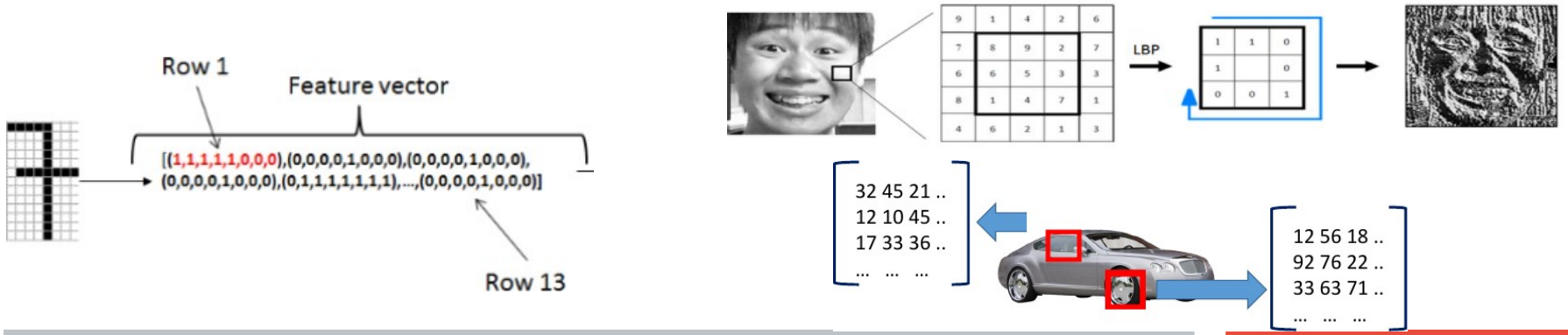
- Deep Learning
- Redes Neurais Convolucionais
- Overfitting
- Aumento de Dados
- Transfer-Learning



Antes do “deep”.....

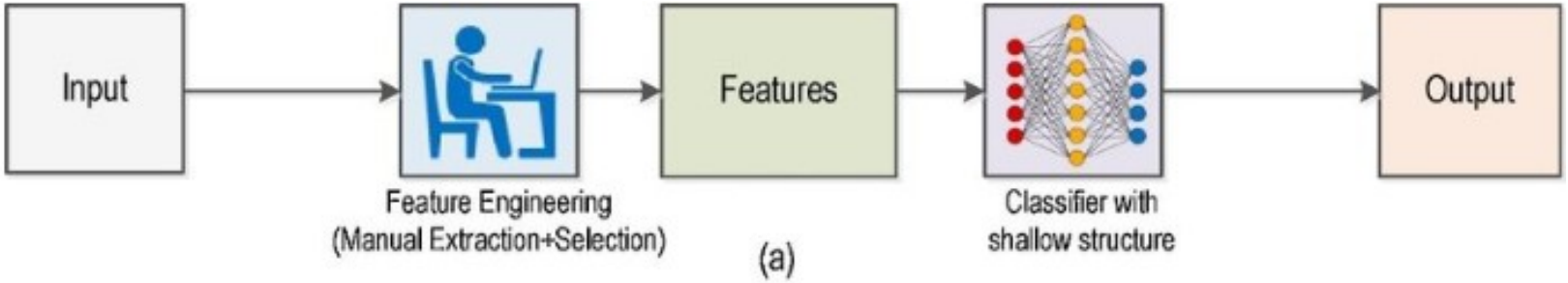
- Problema: Interpretar relações em altas dimensionalidades (i.e Imagens, Aúdios)
- Solução: Descritores de características
- Então, um modelo computacional aprende a representação
- Interpretação humana é limitada a baixas dimensionalidades



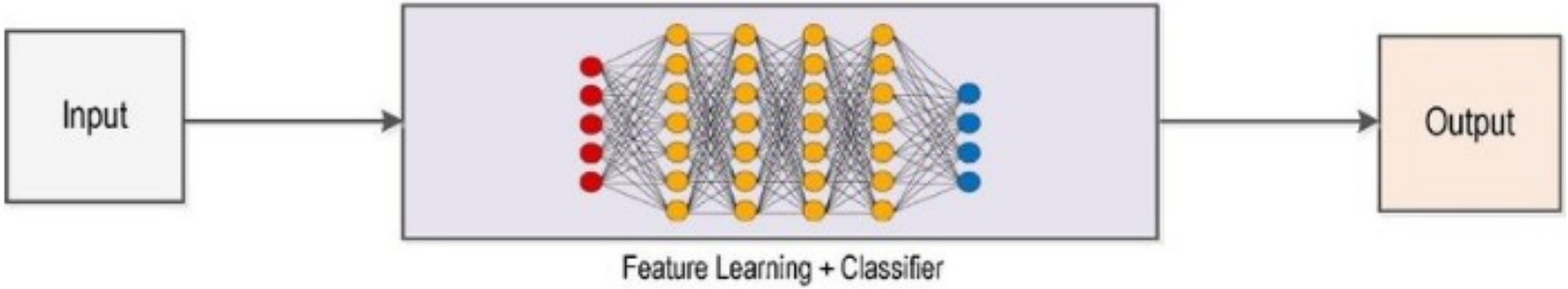


Tradicional vs Deep

- Tradicional

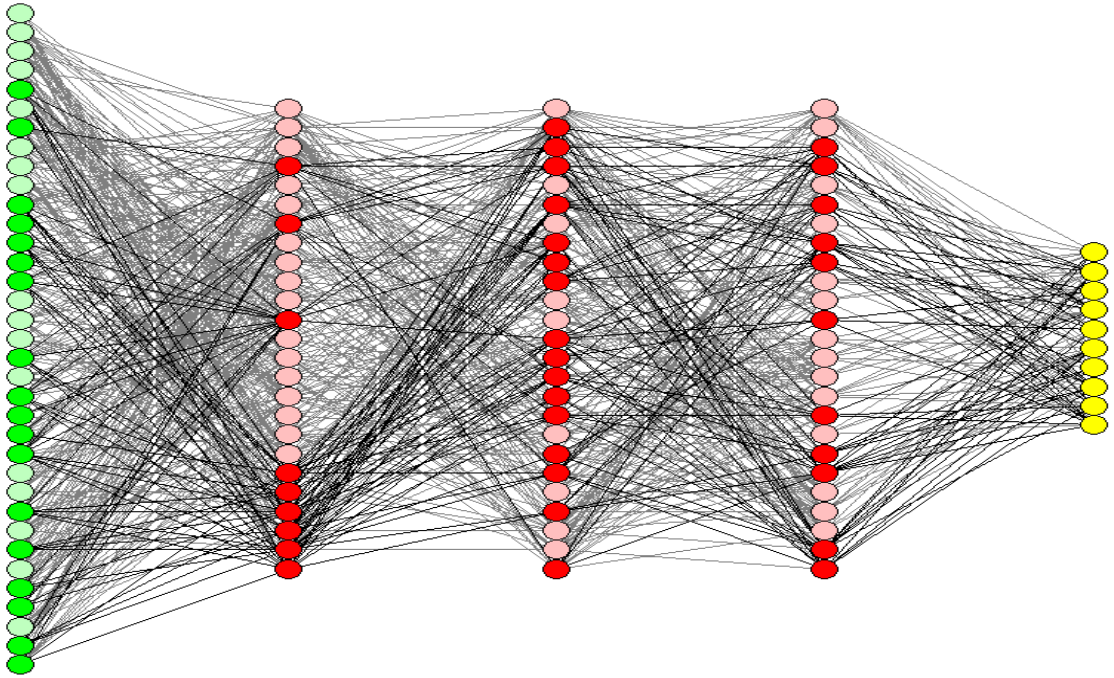


- Deep



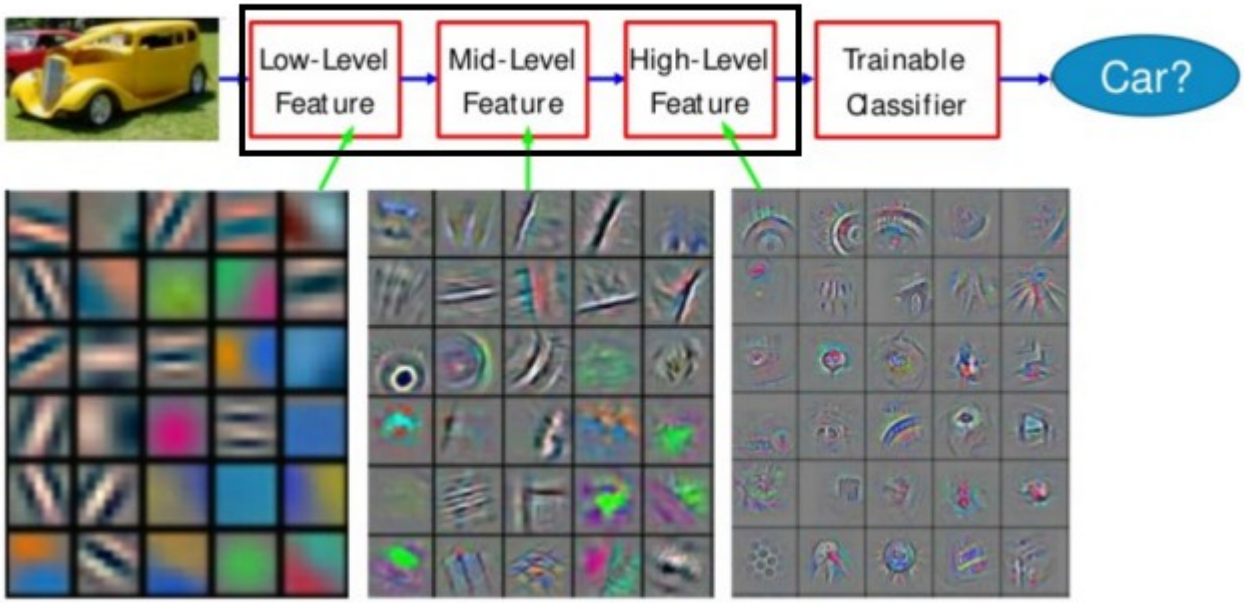
Deep Learning

- Rede com Múltiplas Camadas



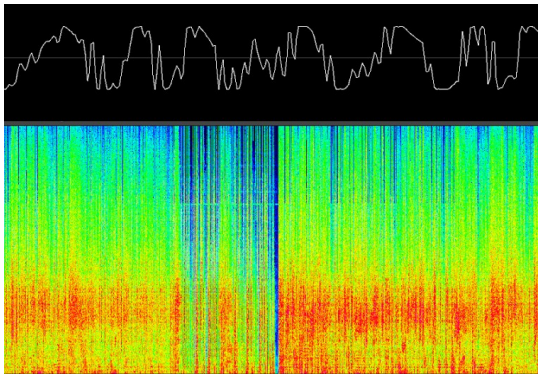
Deep Learning

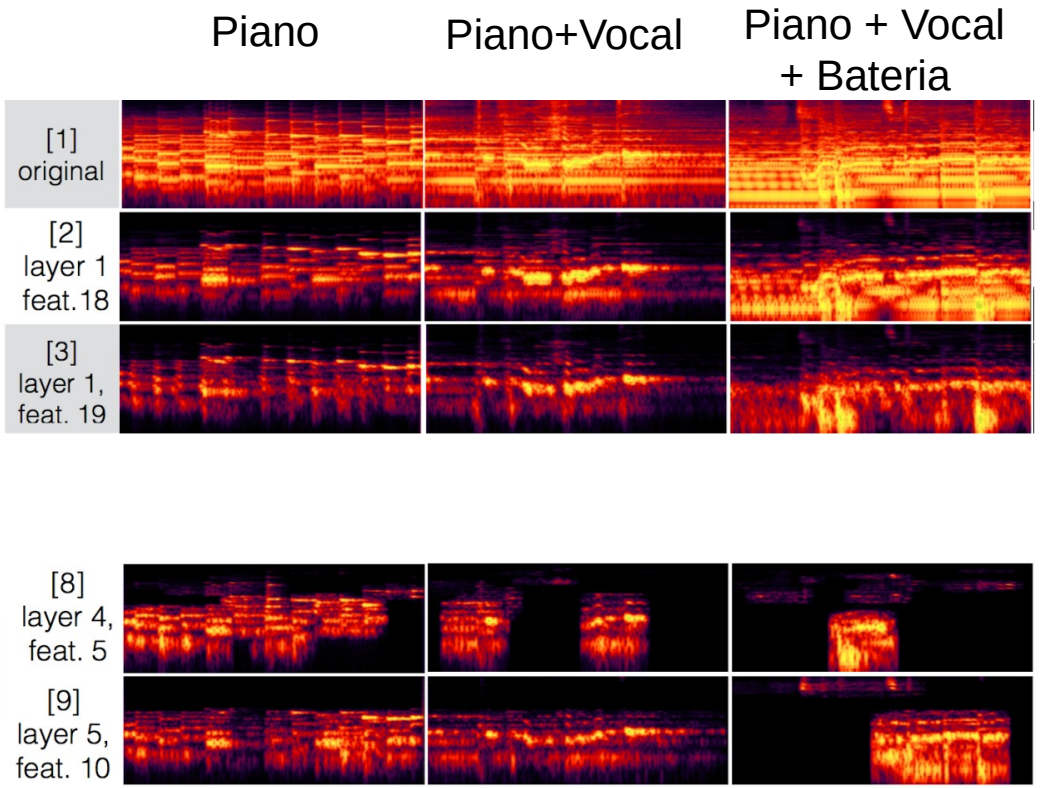
- Extração de Características é implícita
- Aprendizado de Filtros
- Abstração Profunda



Deep Learning

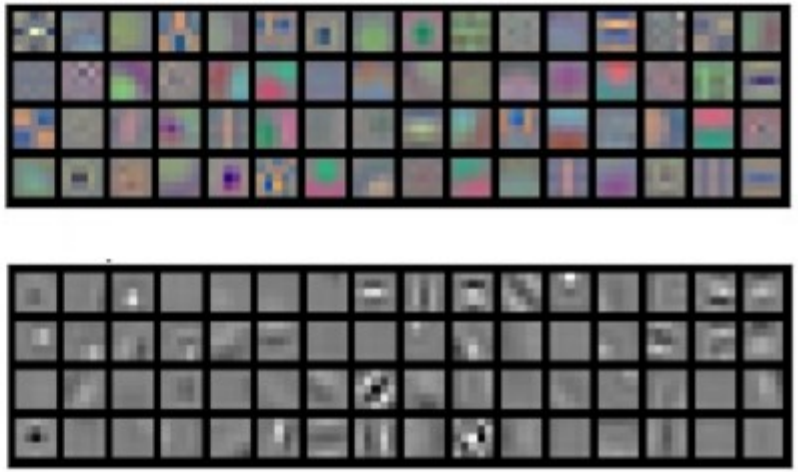
- Quebra de paradigma em problemas de visão computacional
  - (áudio, imagens, vídeo, etc.).





Deep Learning

- Classificação de Tecido
- Imagens Médicas



Deep Learning

- Face

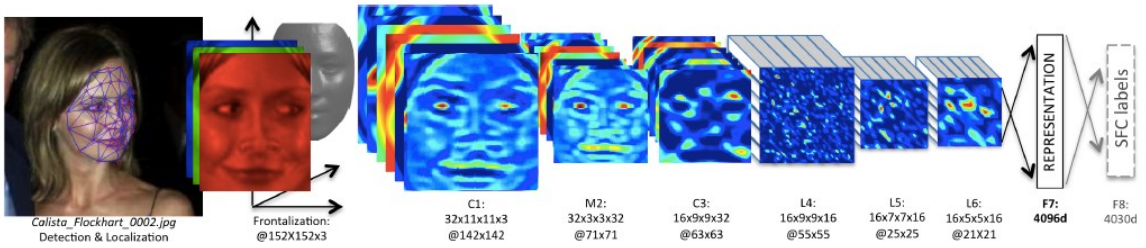
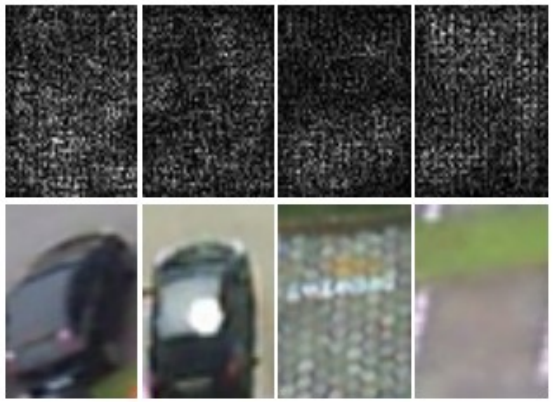


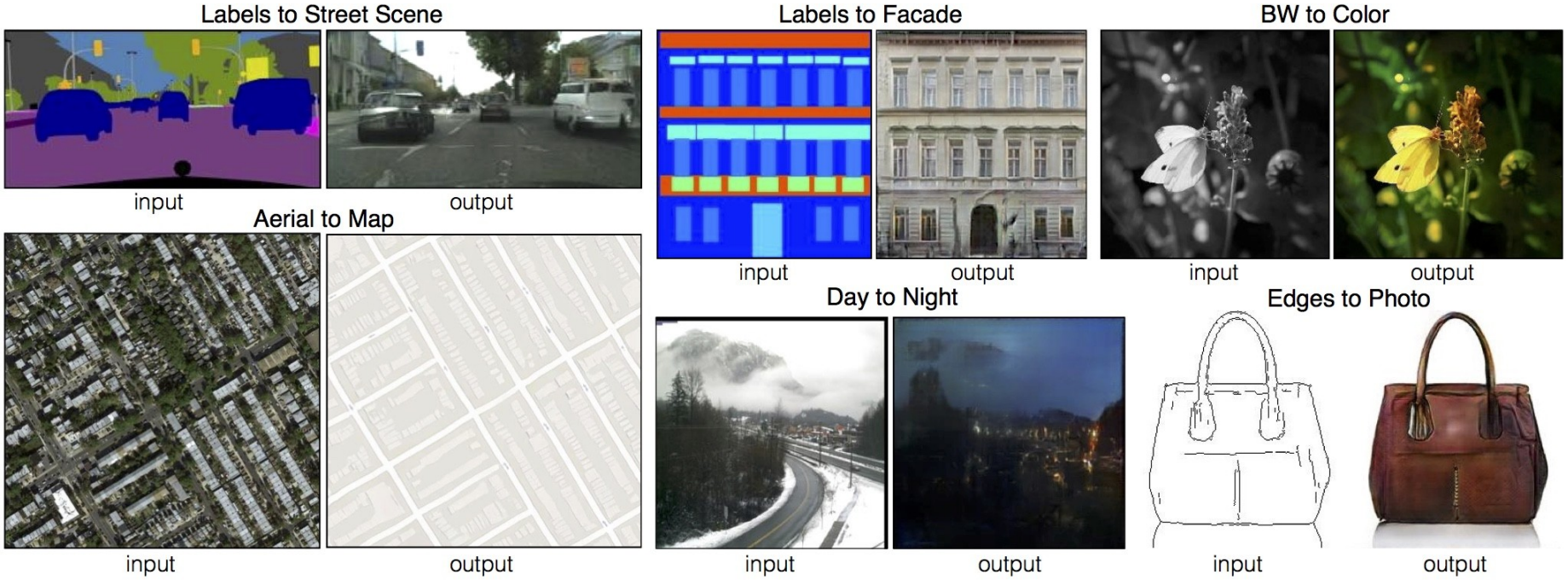
Figure 2. **Outline of the *DeepFace* architecture**. A front-end of a single convolution-pooling-convolution filtering on the rectified input, followed by three locally-connected layers and two fully-connected layers. Colors illustrate outputs for each layer. The net includes more than 120 million parameters, where more than 95% come from the local and fully connected layers.

- PKLot



Deep Learning

- Transferência de contexto (Image Translation)



Deep Learning

- Deep Fakes

https://www.youtube.com/watch?v=mUfJOQKdtAk

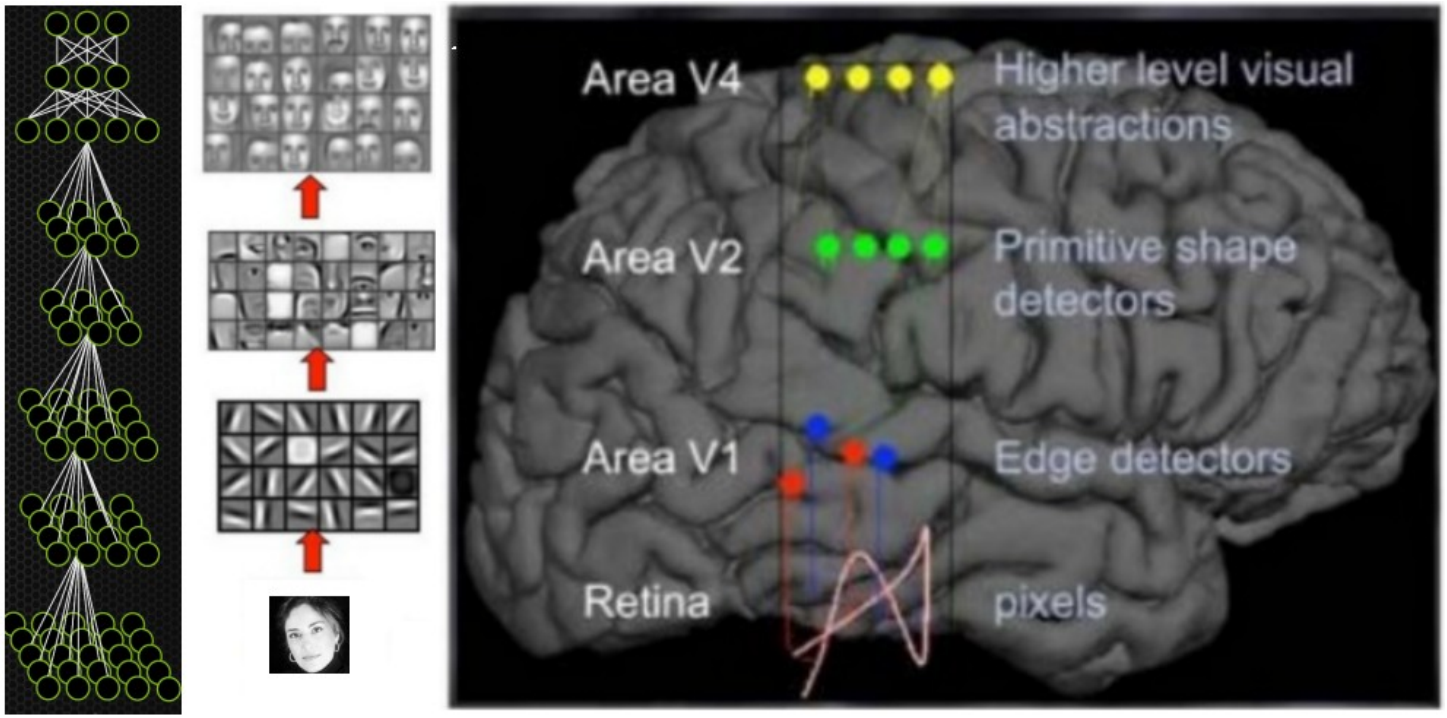
Deep Learning

- Vantagens:
  - Extração de Características é implícita
  - Abstração em alto nível
  - Altas taxas de reconhecimento
- Desvantagens:
  - Custo computacional
  - Datasets Números
  - Parametrização do Modelo e Ajuste-Fino

Redes Neurais Convolucionais

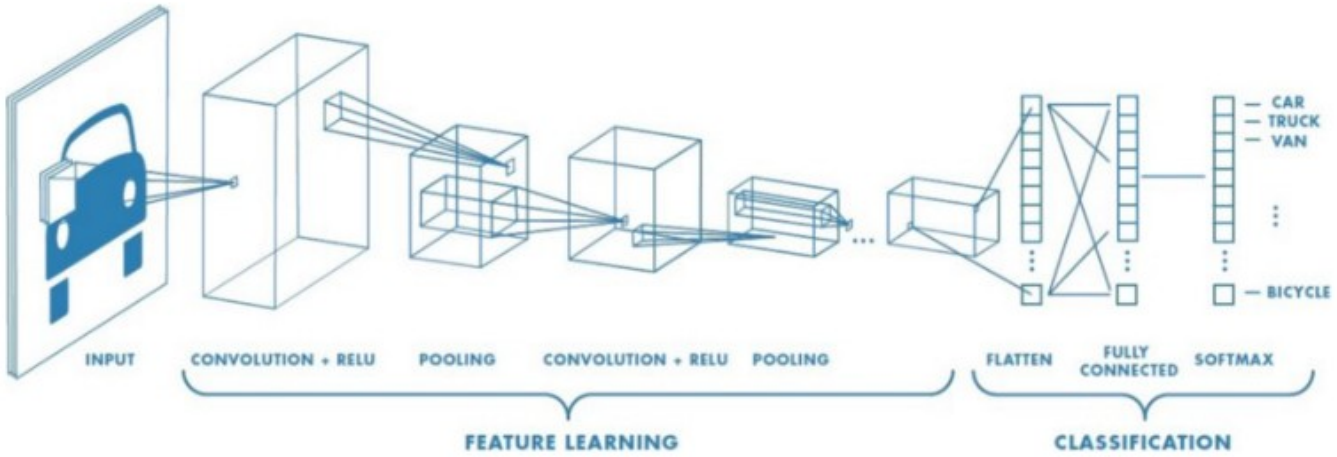
Redes Neurais Convolucionais

- Lecun 90´s



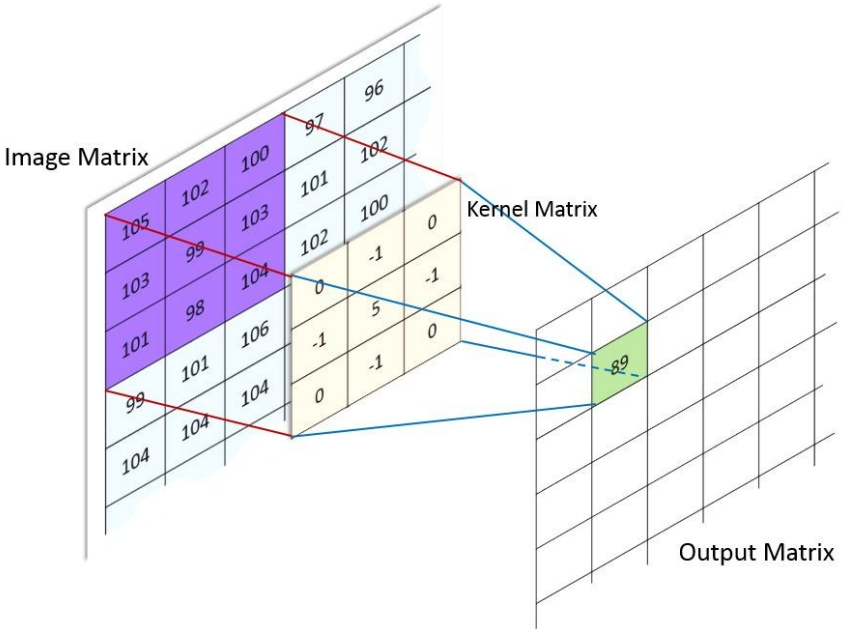
Redes Neurais Convolucionais

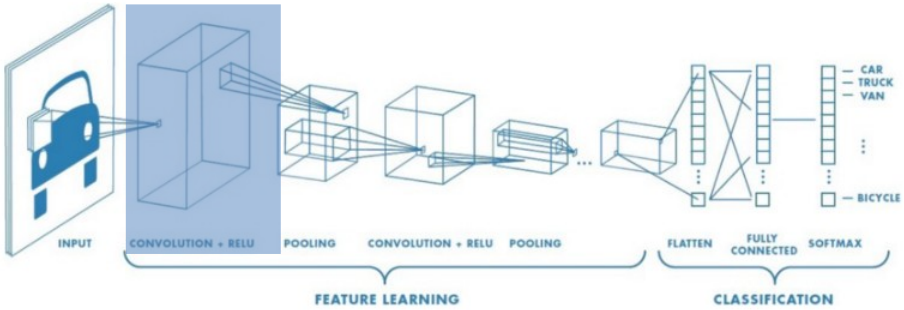
- Extração de Características (N-Dimensional)
  - Sequência de camadas convolucionais
  - Aprendizado de Filtros
- Classificação (1D)
  - RNA
  - SVM
  - .....

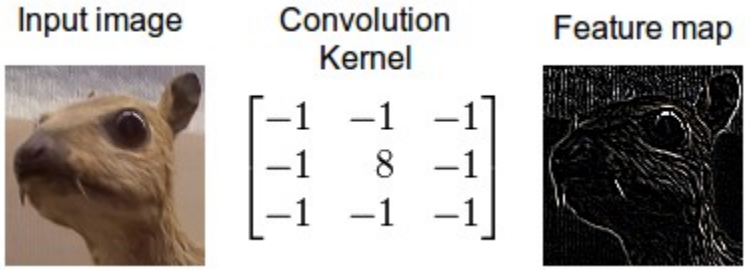


Redes Neurais Convolucionais

- Convolução



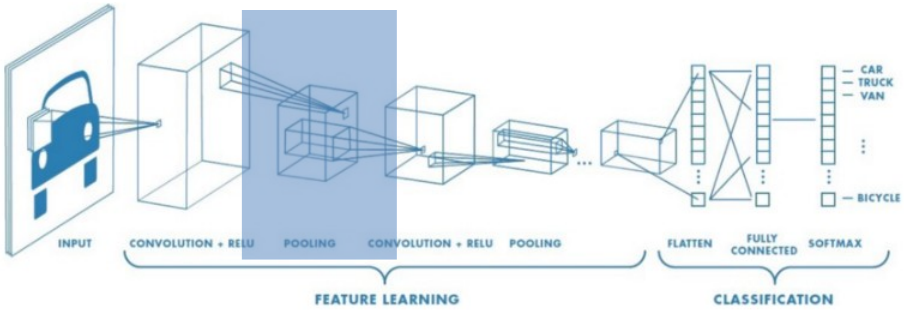


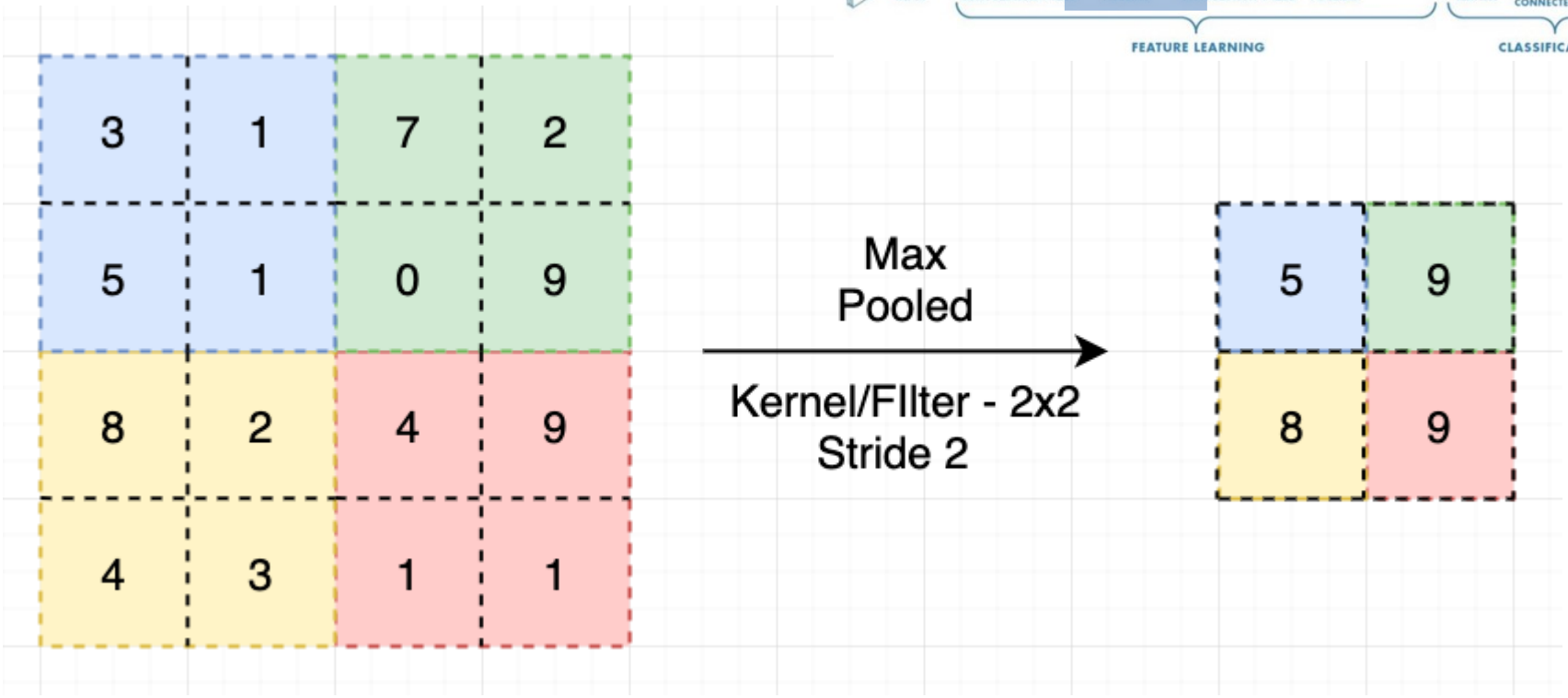


$$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

Redes Neurais Convolucionais

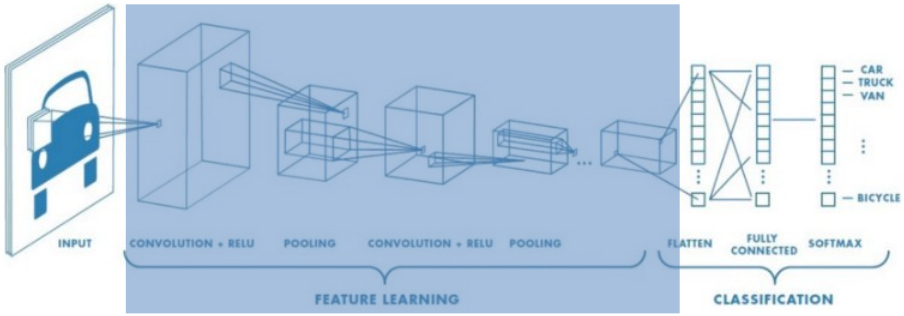
- Pooling Layer
  - Redução de Características

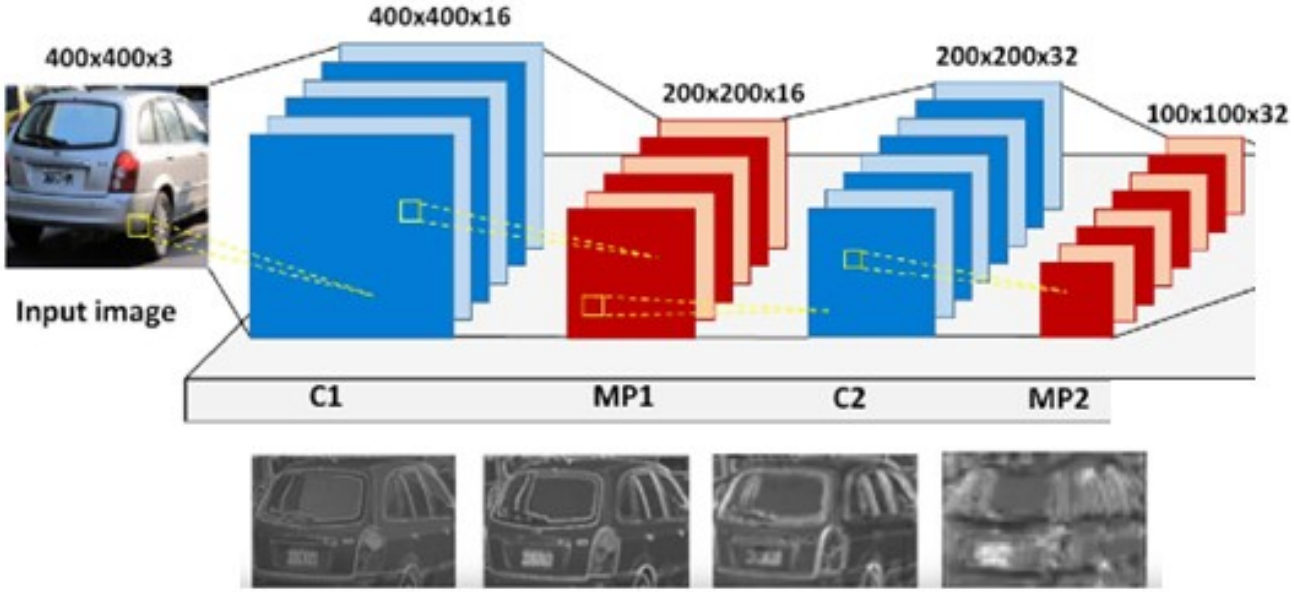




Redes Neurais Convolucionais

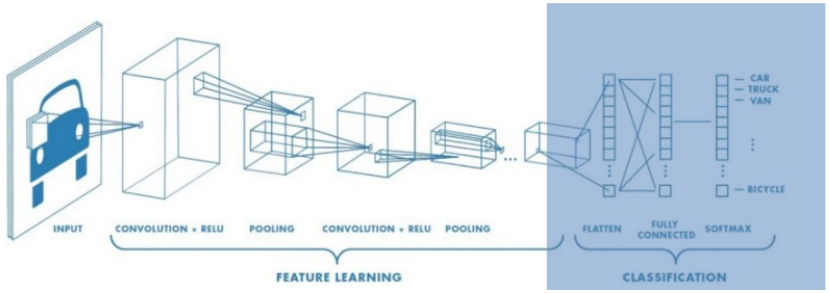
- Camadas Convolucionais
  - Convolução
  - Pooling

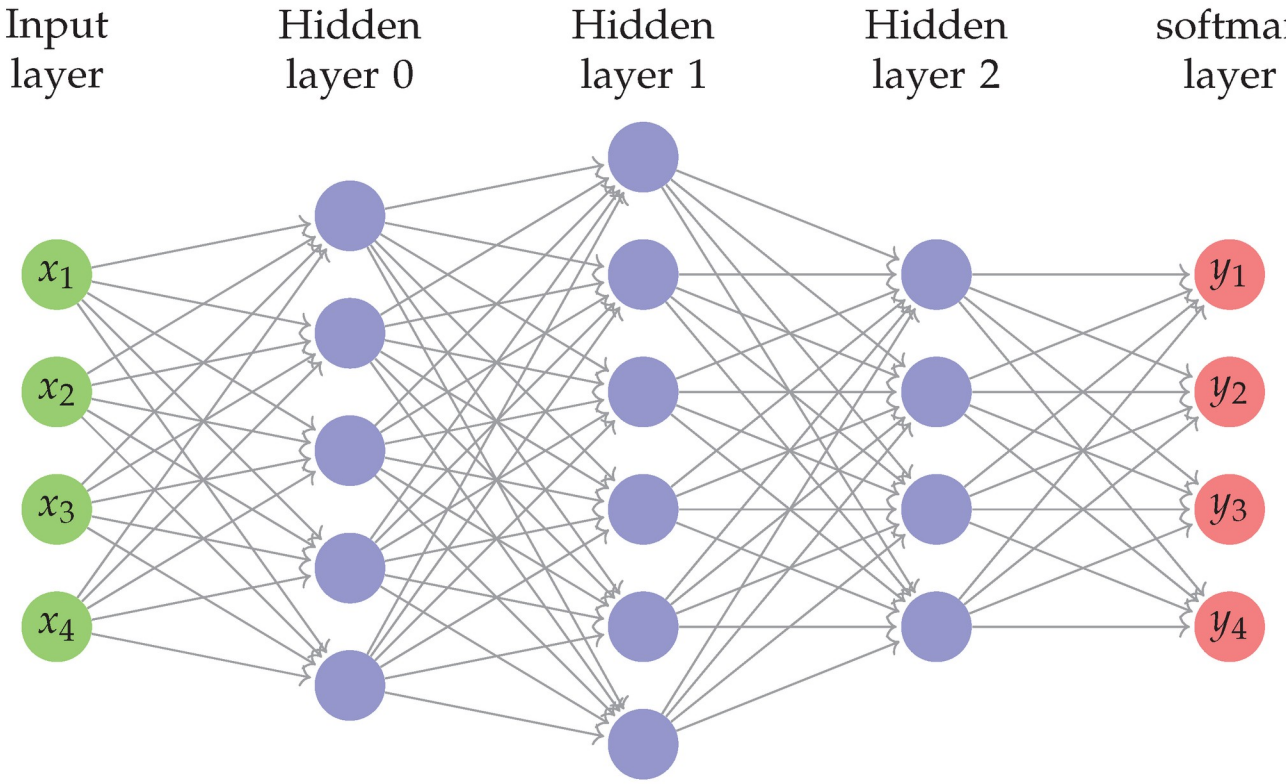




Redes Neurais Convolucionais

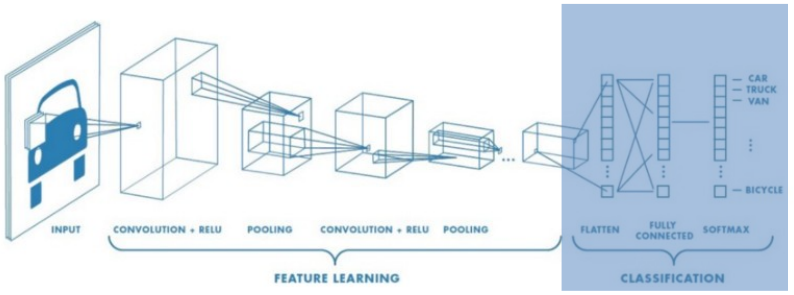
- Classificação
  - Rede Neural

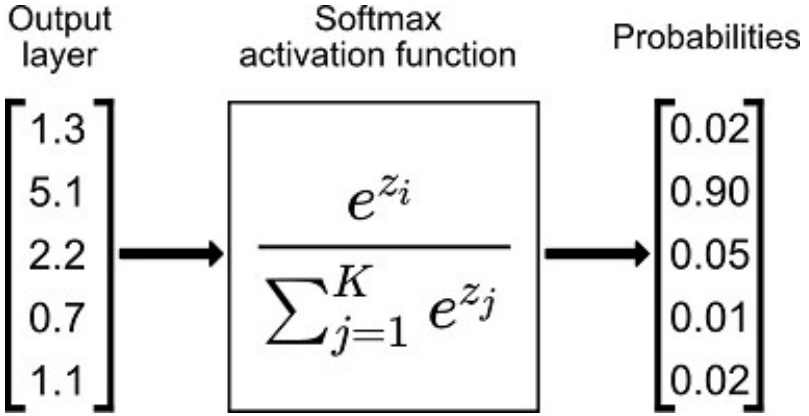


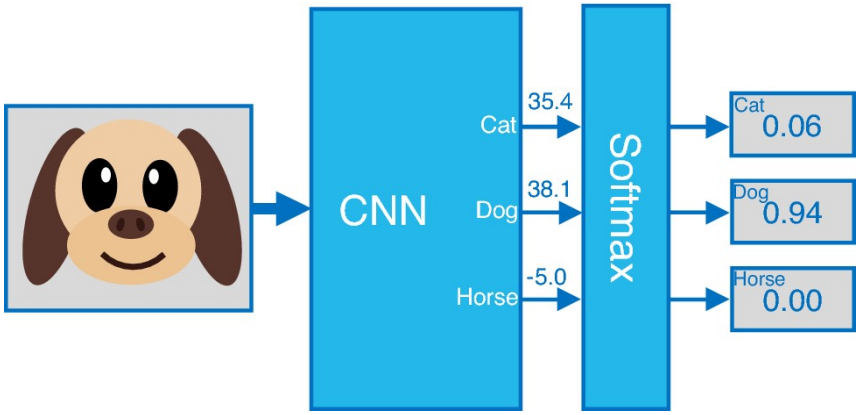


Redes Neurais Convolucionais

- Softmax

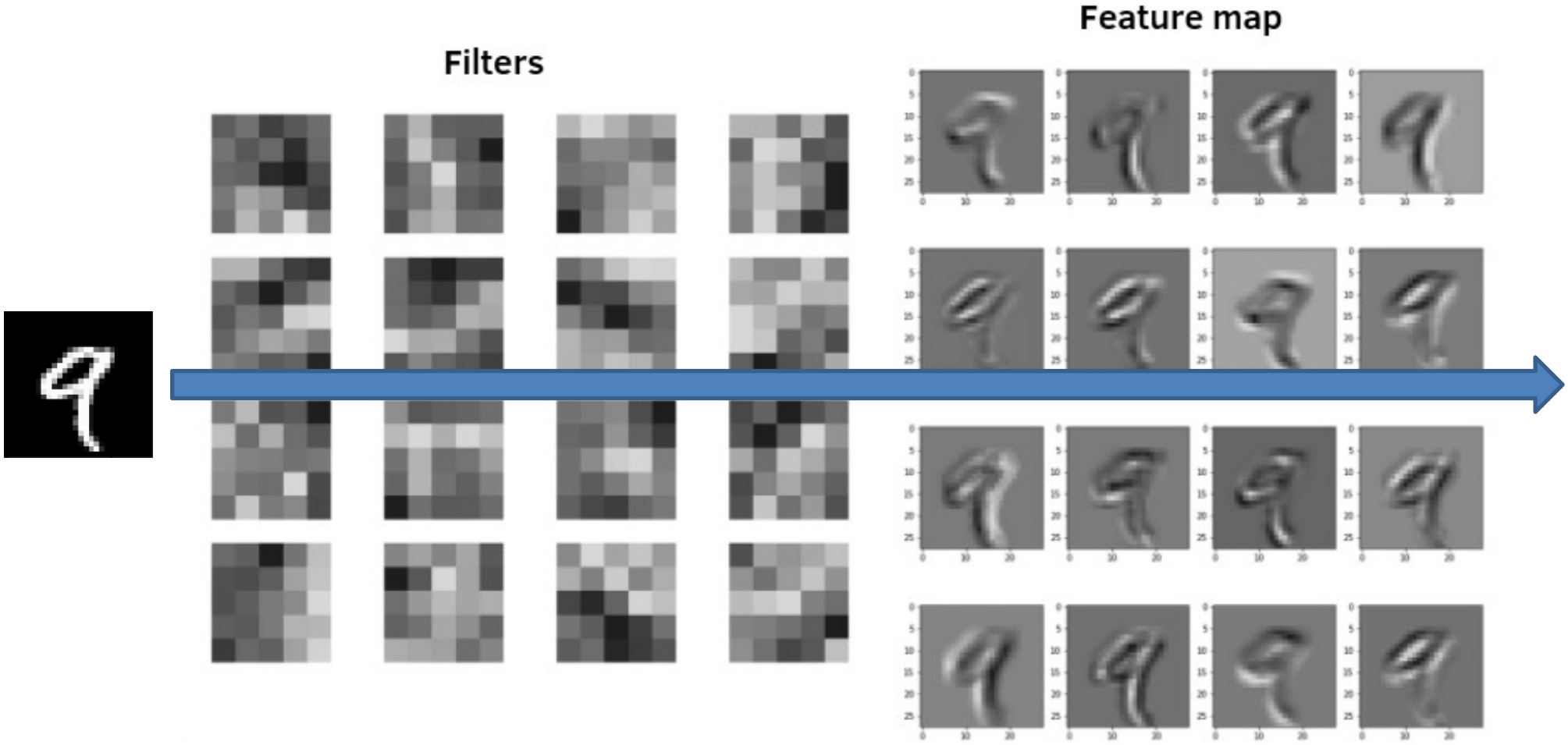






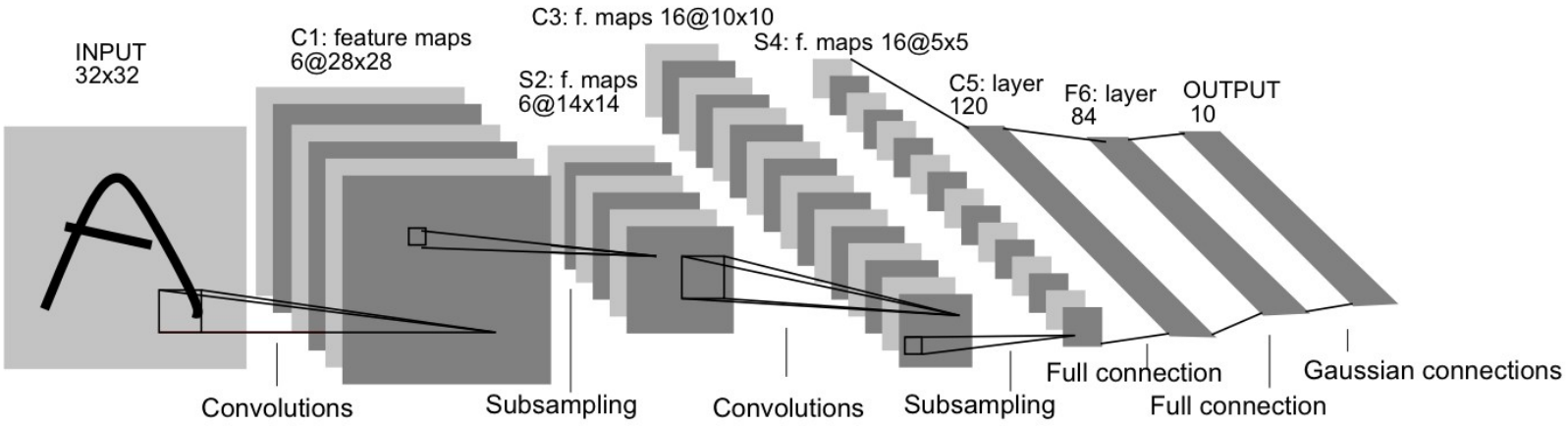
Redes Neurais Convolucionais

- Filtros e Características



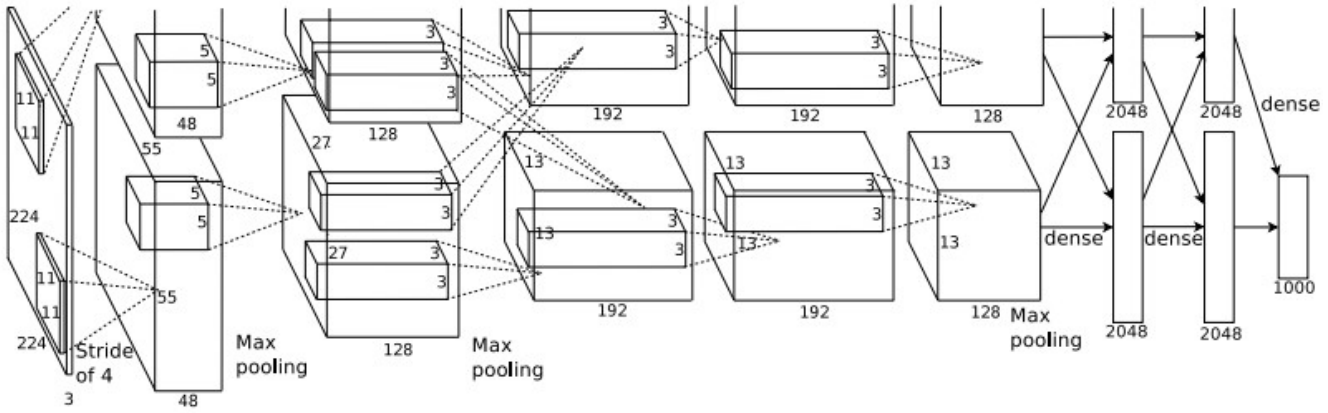
Redes Neurais Convolucionais

- Lenet
  - Yan Lecun – 90´s (Bell Labs / IBM / FACEBOOK)
  - Handwritten Digits
  - ~60 K Paramêtros
  - ~345 K Paramêtros



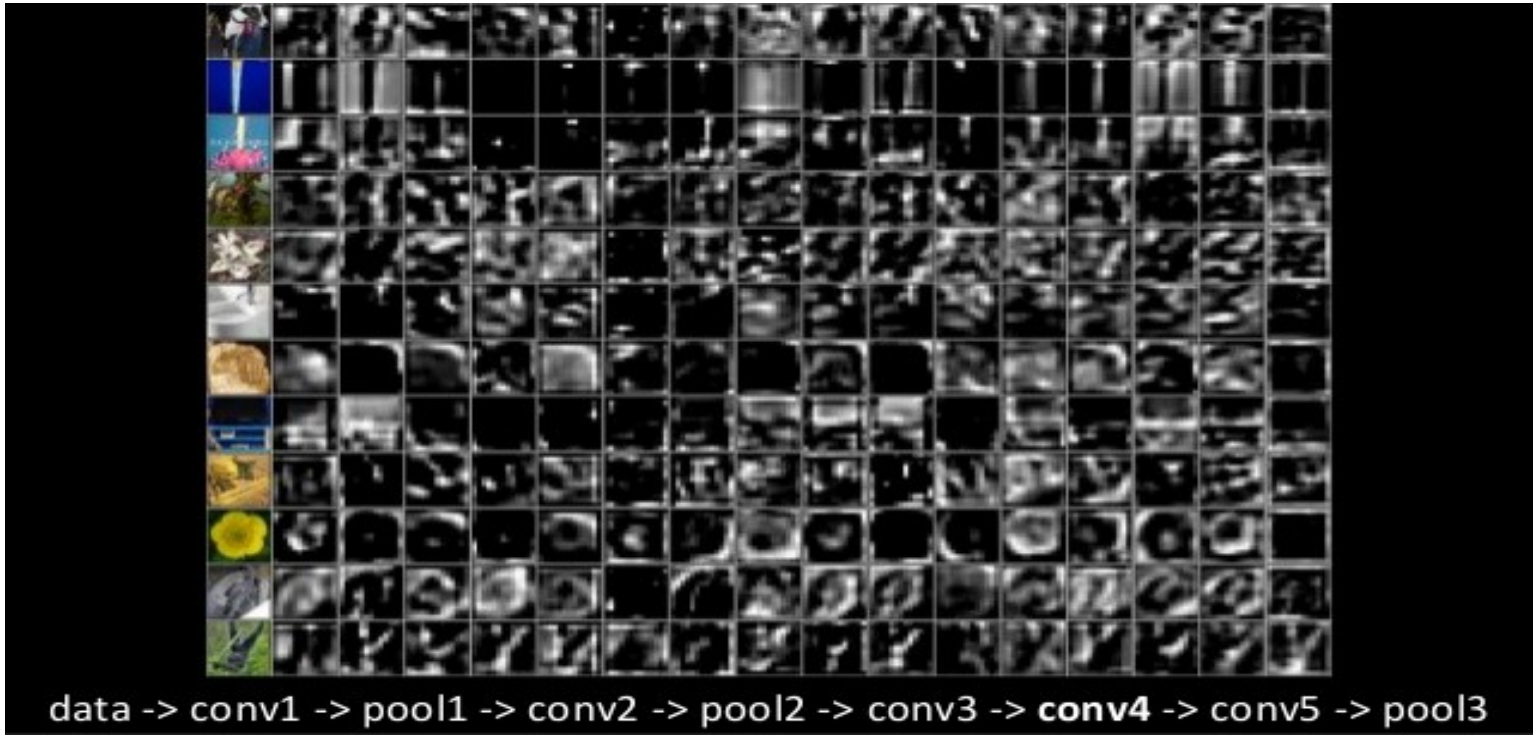
Redes Neurais Convolucionais

- AlexNet
  - Alex Krizhevsky – 2012 (Krizhevsky Net)
  - Imagenet 2012 Challenge (1000 classes)
    → 1.2 M Train, 50K Val, 150K Test
  - 2012 Winner (15.3% Error - Top 5)
    → 2° SIFT Based (26.2%)



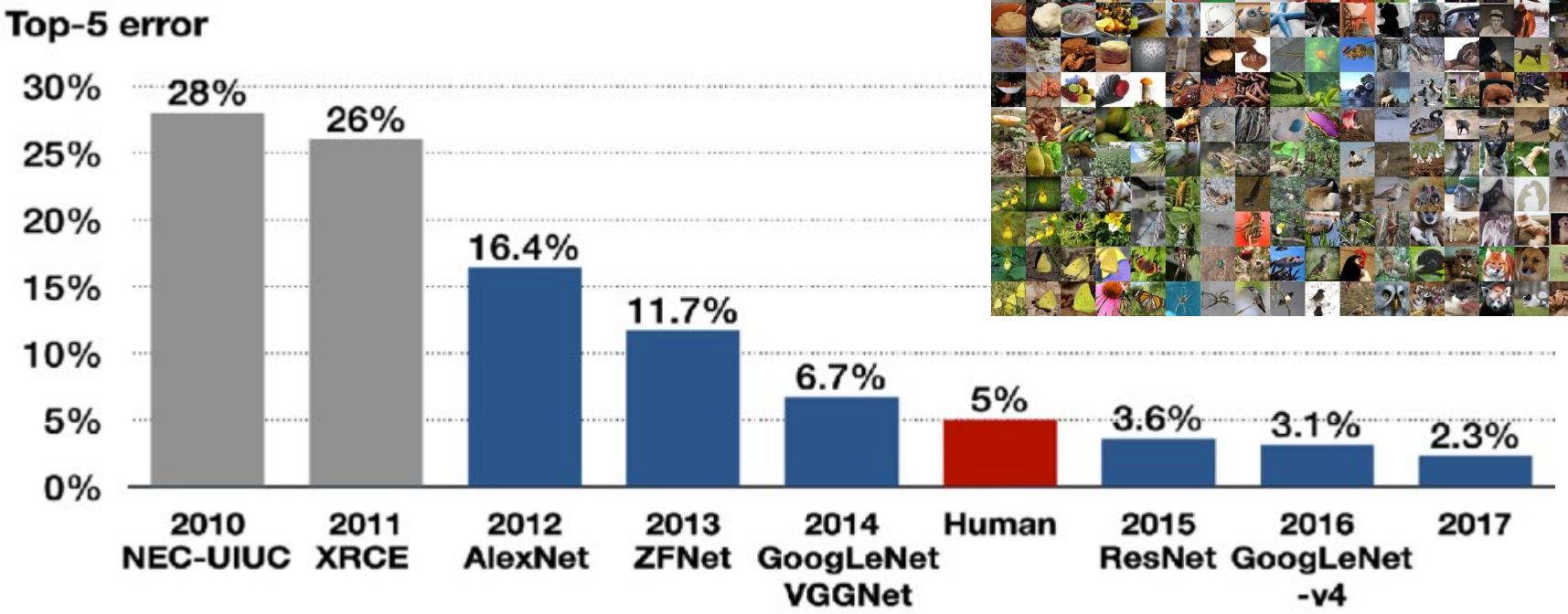
Redes Neurais Convolucionais

- Alexnet



Imagenet Challenge

- Imagenet 2012 Challenge
  - 1000 Classes
  - 1.2 M Imagens (Treino)
  - 50K Imagens (Validação)
  - 150K Imagens (Teste)
  - [LINK TO ACCs]

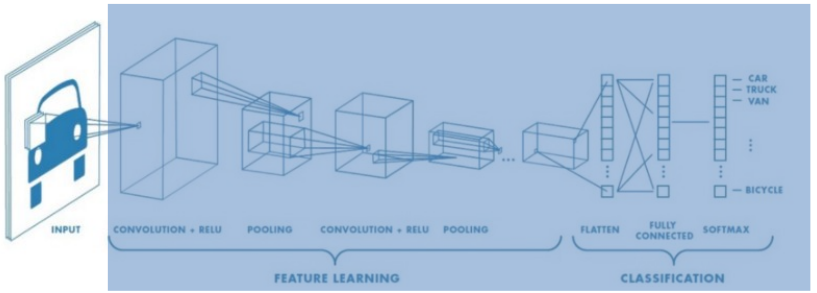


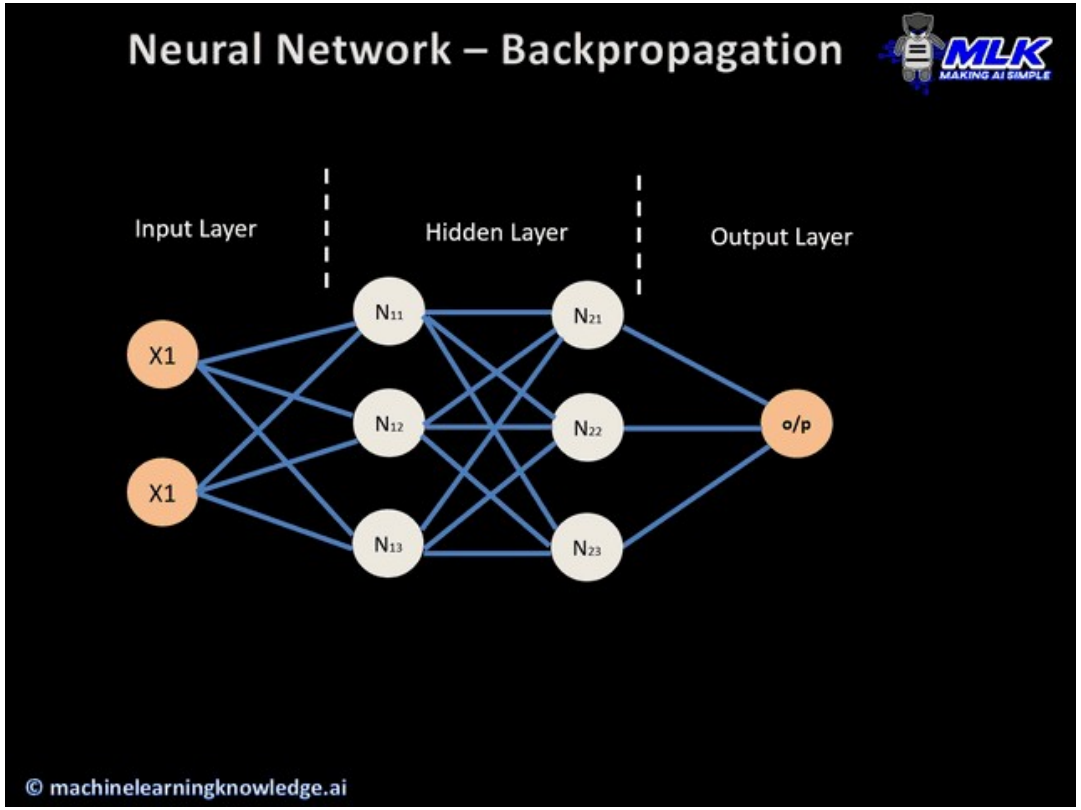
Codificação

- [LINK]

Overfitting, Aumento de Dados e Transfer Learning

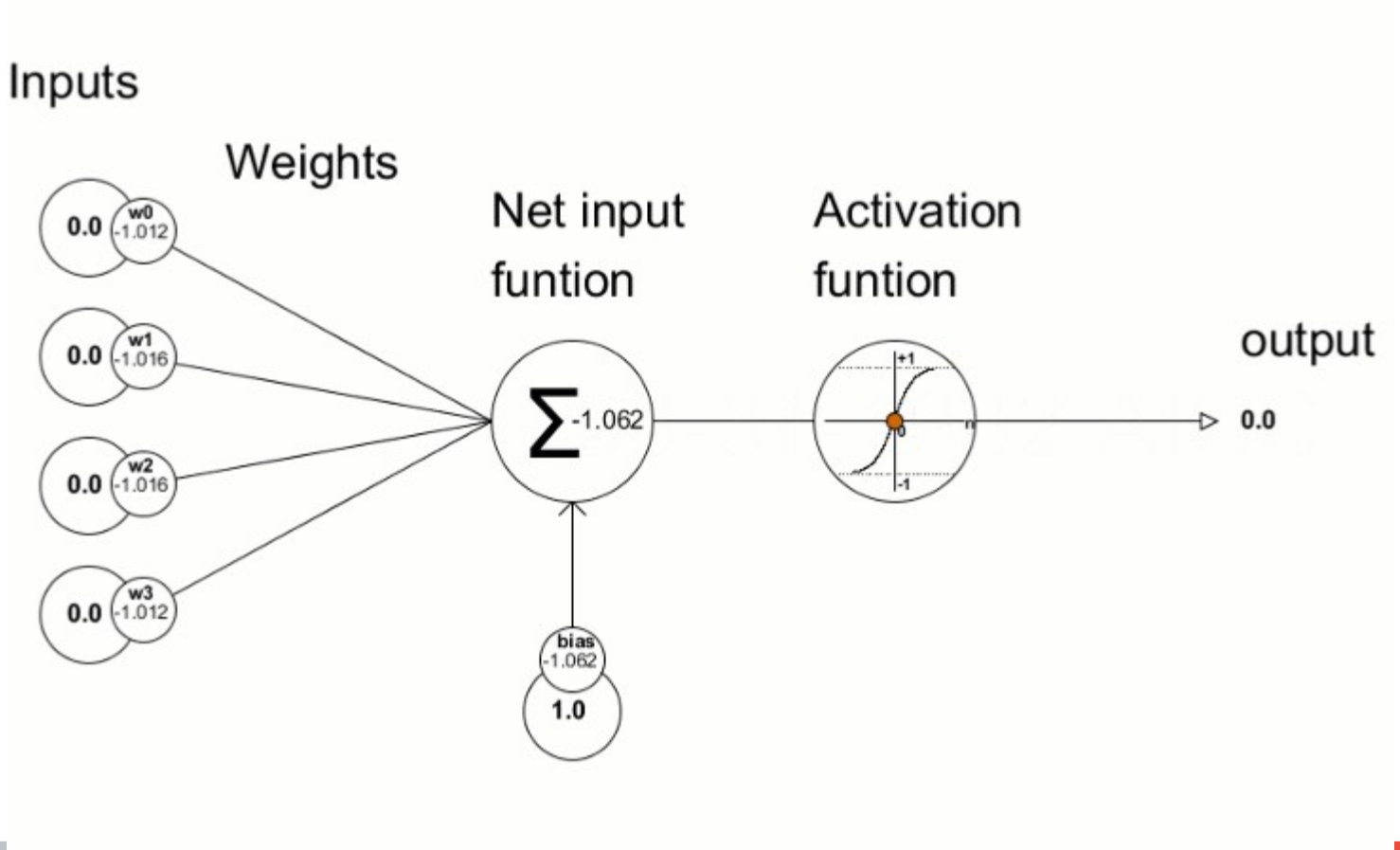
Feed-Forward e Back-Propagation





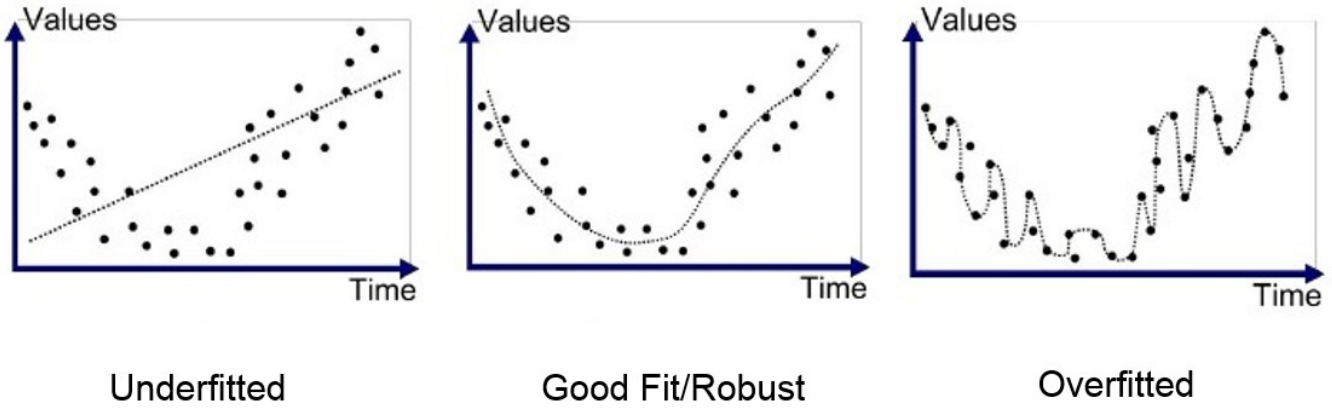
Feed-Forward e Back-Propagation

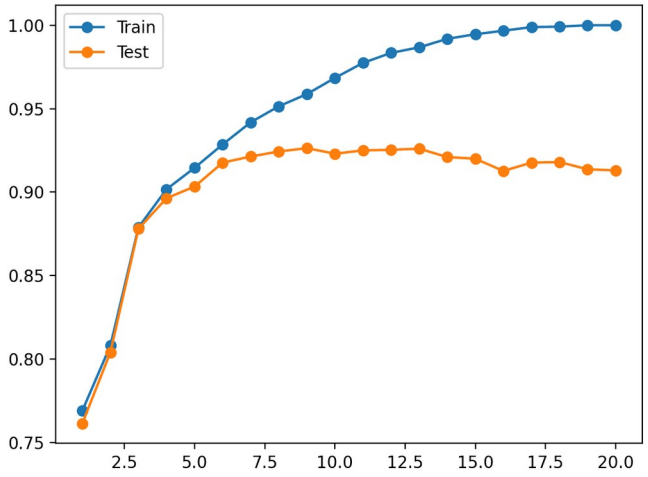
- Feed-Forward and Back Propagation



Sobre-Ajuste (Overfitting)

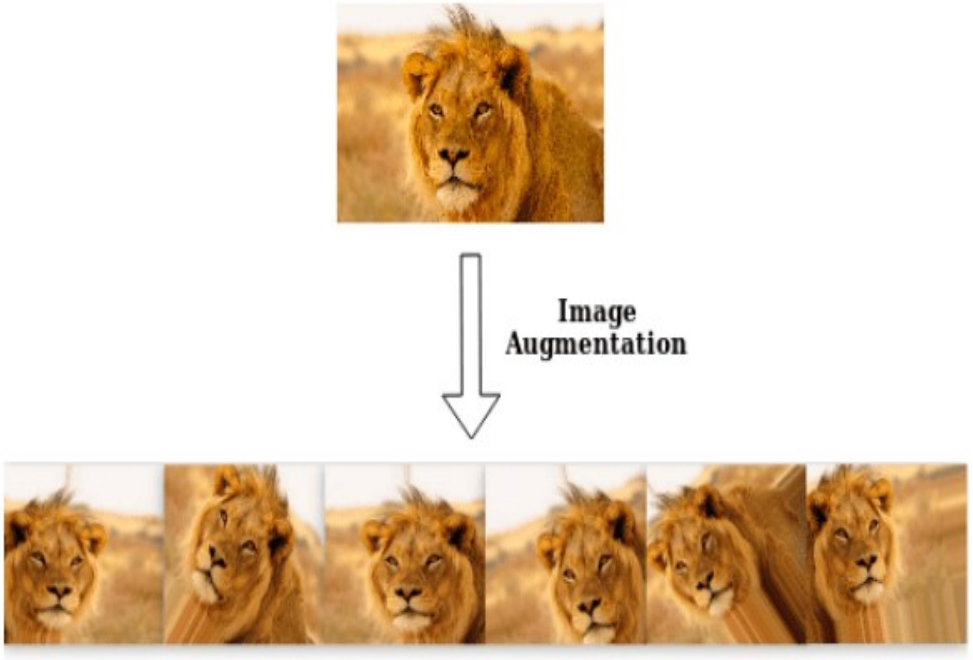
- Generalização





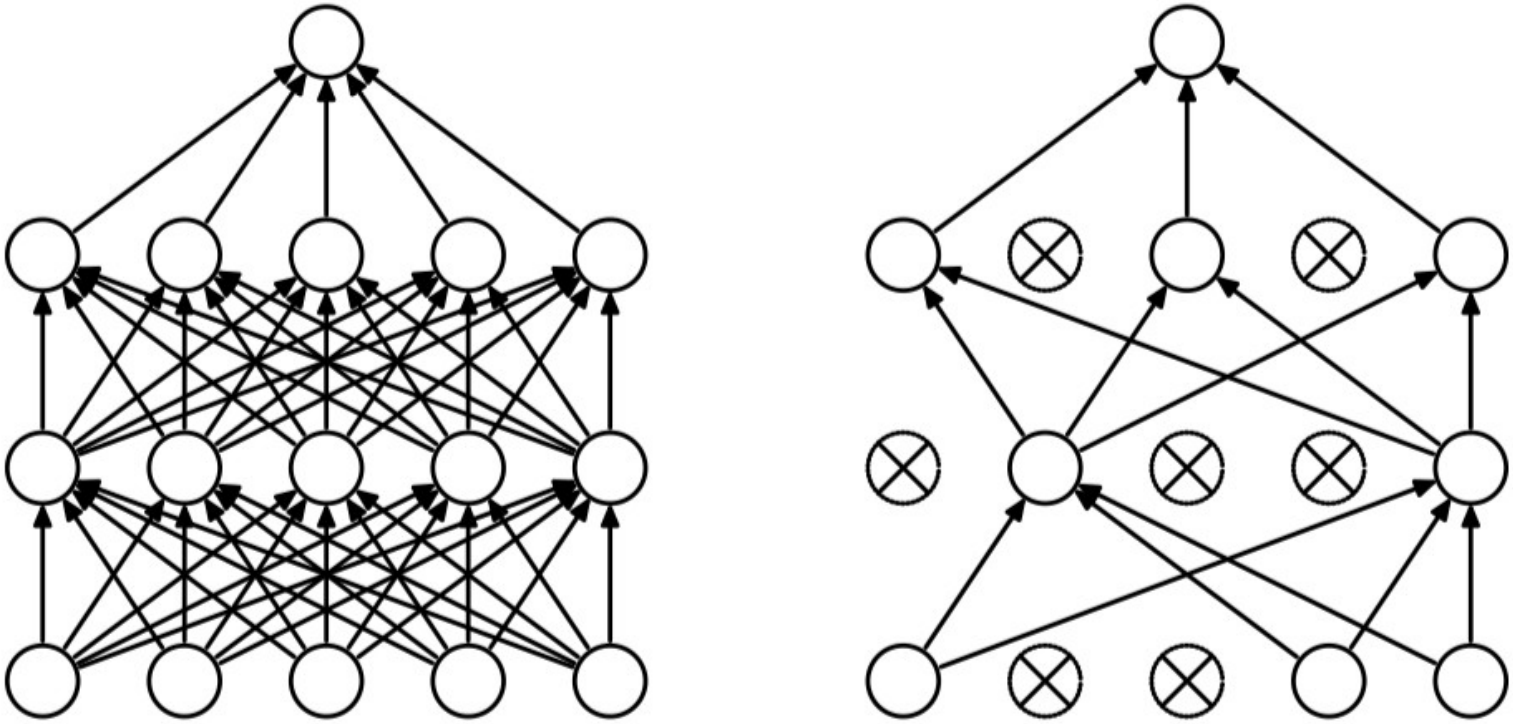
Data Augmentation

- Criação de dados sintéticos



Dropout

- Eliminação de Pesos e Neurônios

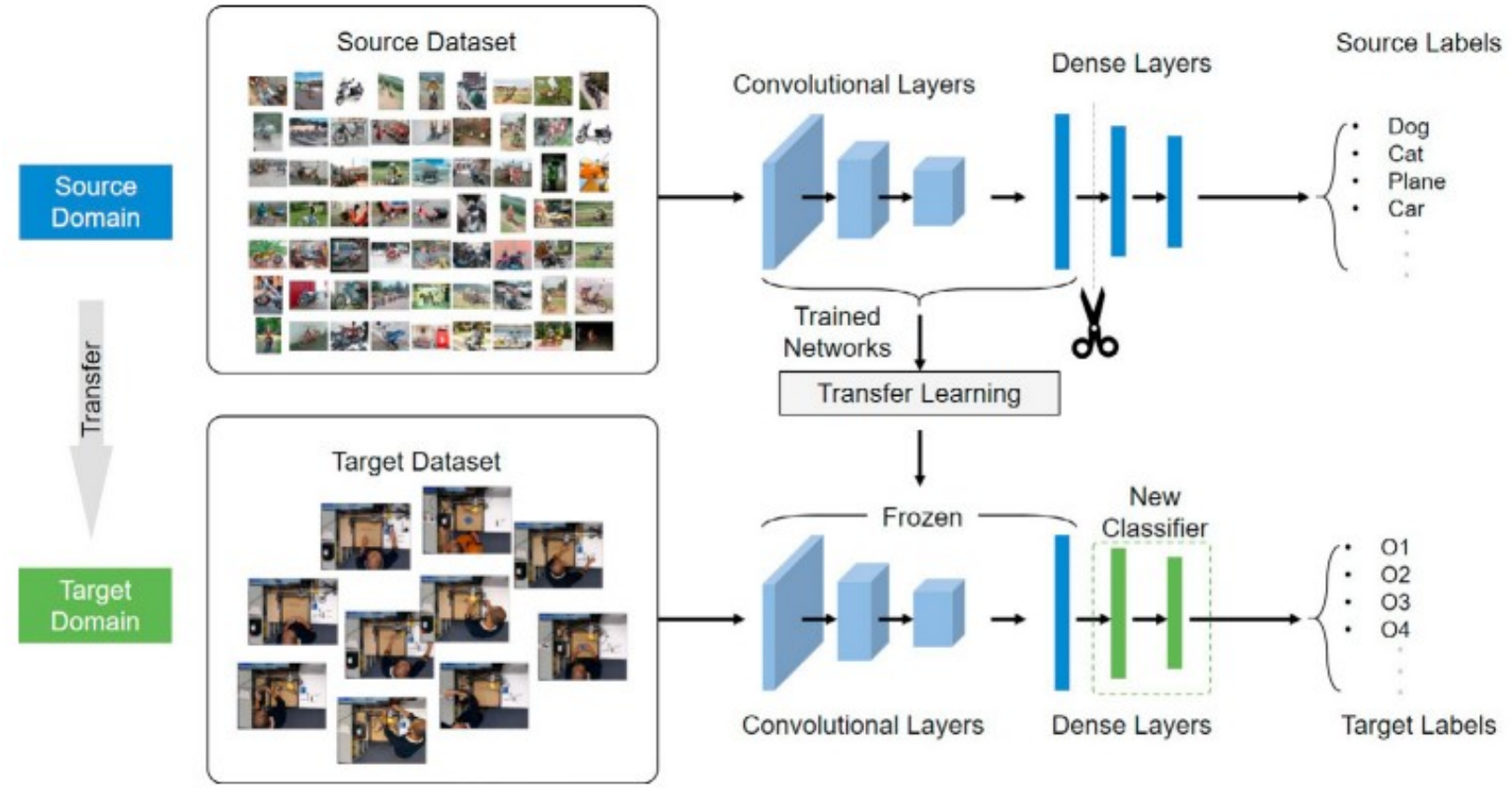


(a) Standard Neural Net

(b) After applying dropout.

Transfer Learning

- Compartilhamento de Pesos
- Pesos de Convolução são congelados (ou não) durante o treinamento



Let’s Code

- [LINK]