Lecture 17 – Convolutional Neural Networks

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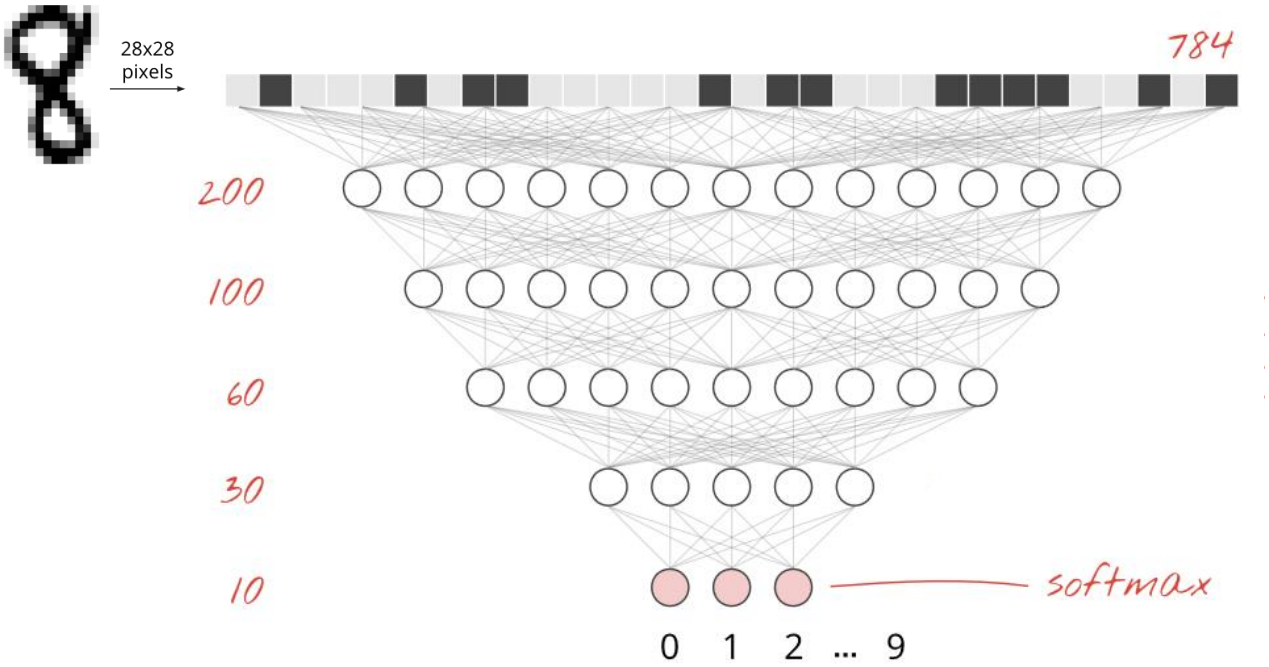
Agenda

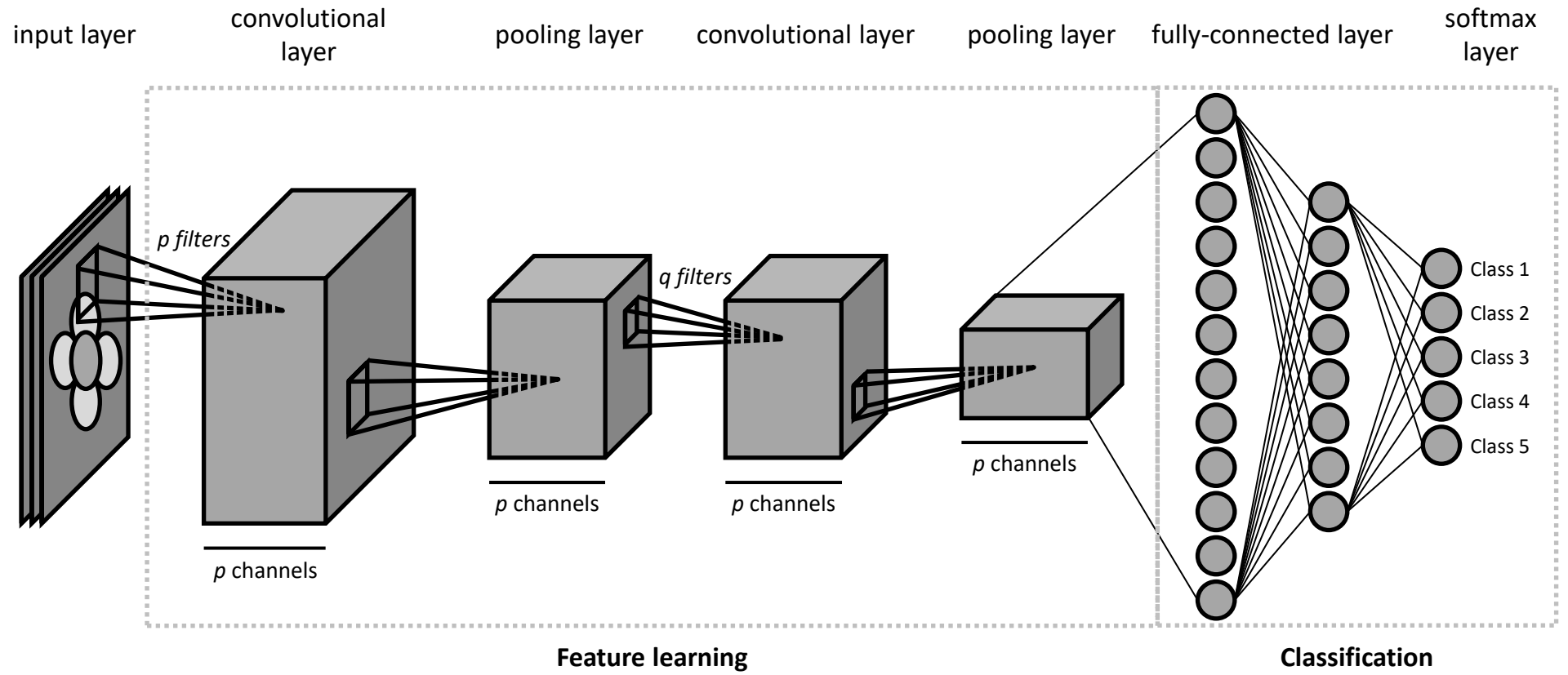
- Multi-layer Perceptron (MLP)
- Convolutional Neural Networks (CNNs)
- Convolutional layer
- Pooling layer
- Models
- Development and libraries
- Image datasets

Multi-layer Perceptron (MLP)

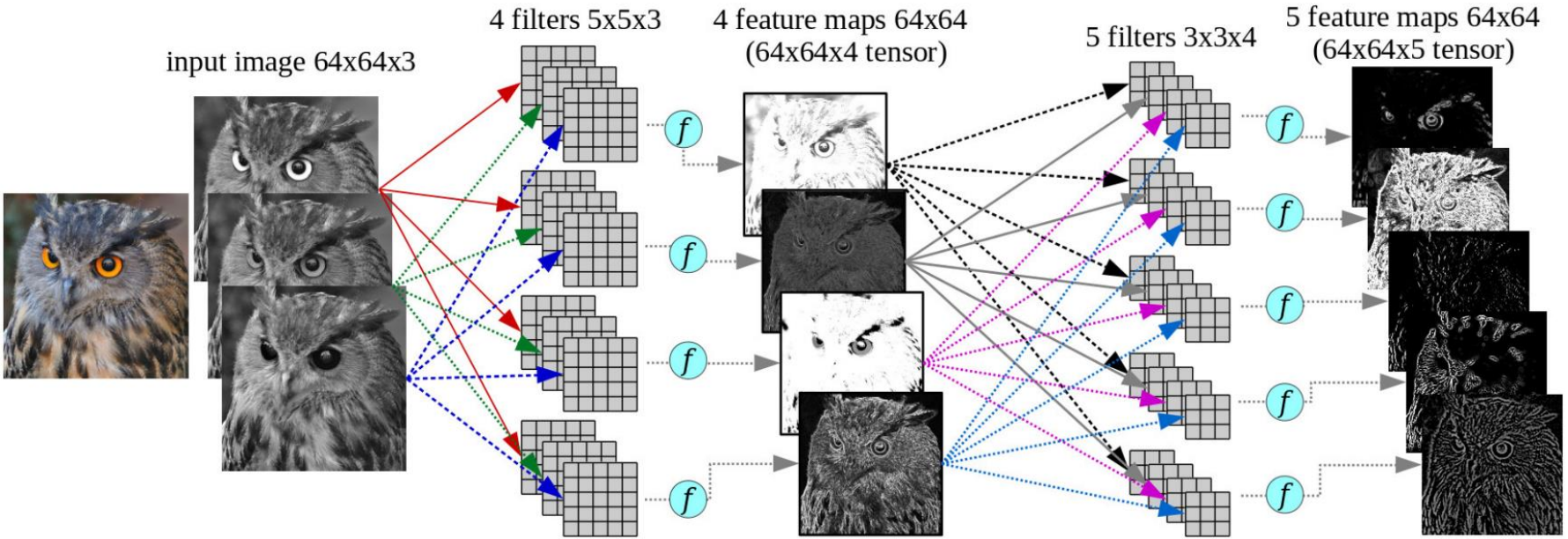


Learn TensorFlow and deep learning, without a Ph.D.

Convolutional Neural Networks (CNNs)

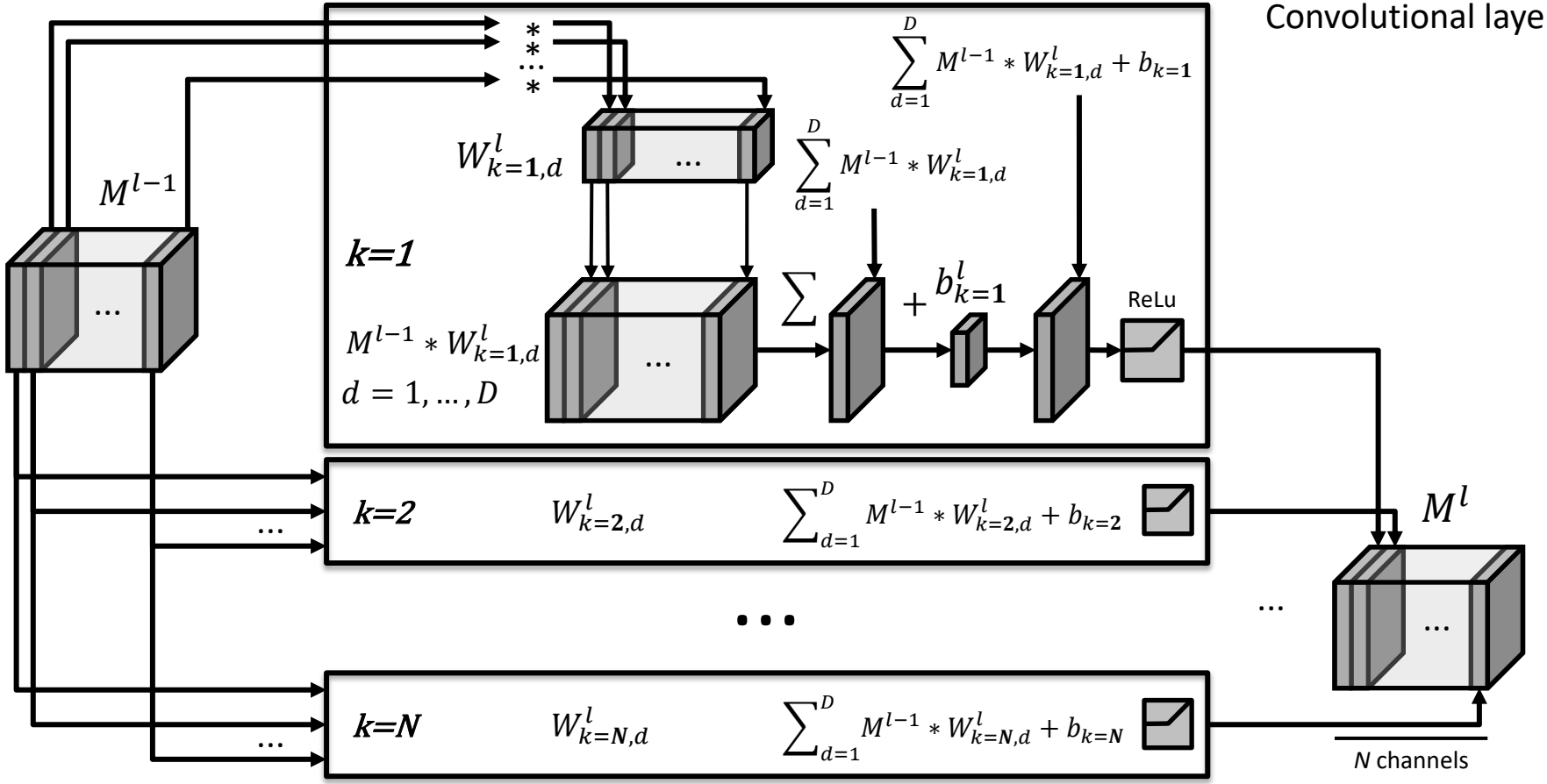


Convolutional layer

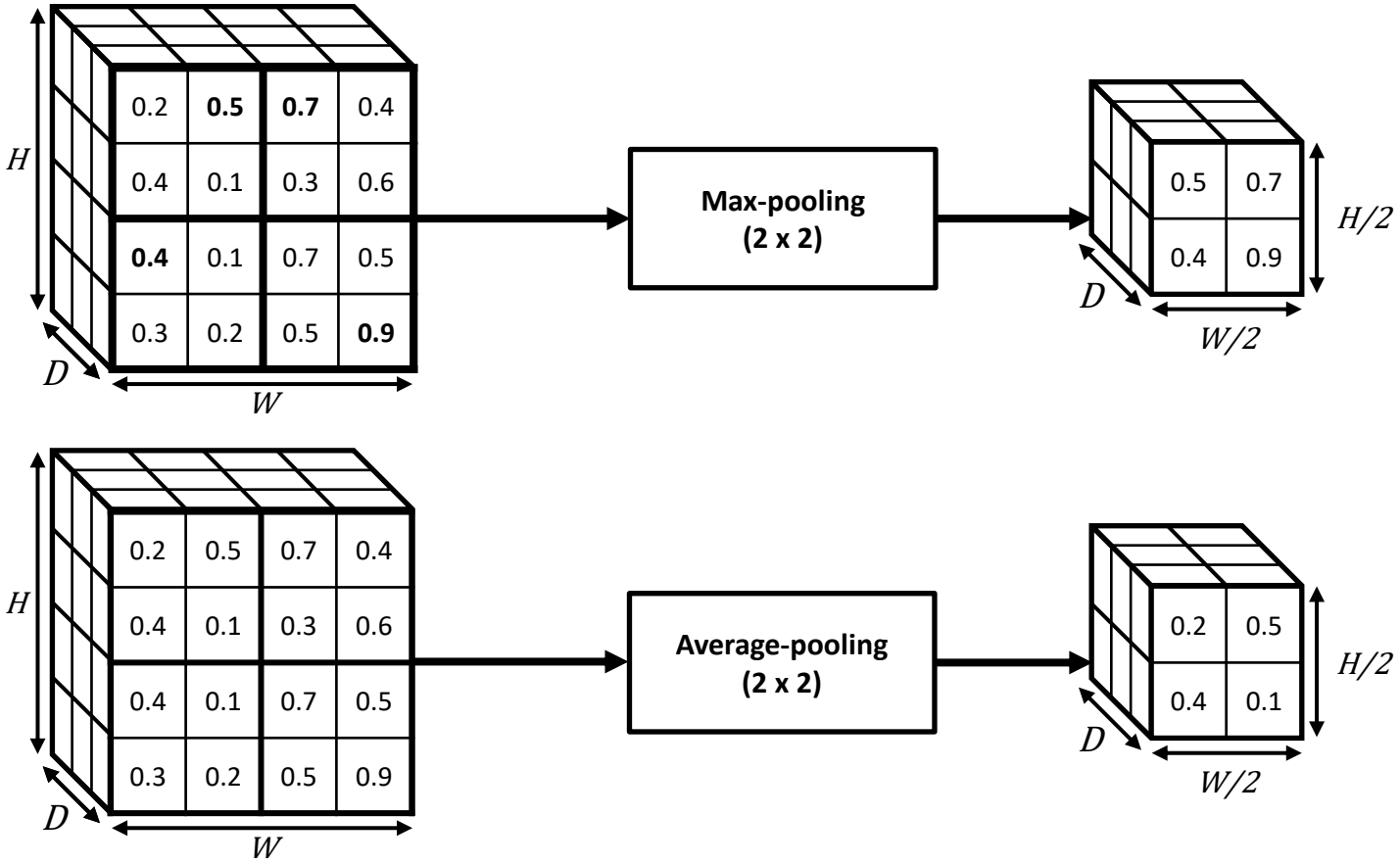


Ponti et al. Everything You Wanted to Know about Deep Learning for Computer Vision but Were Afraid to Ask. Sibgrapi 2017.

Convolutional layer

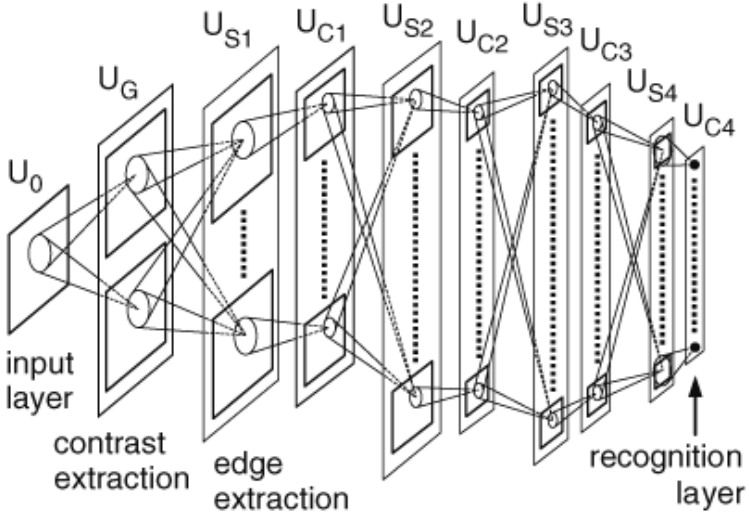


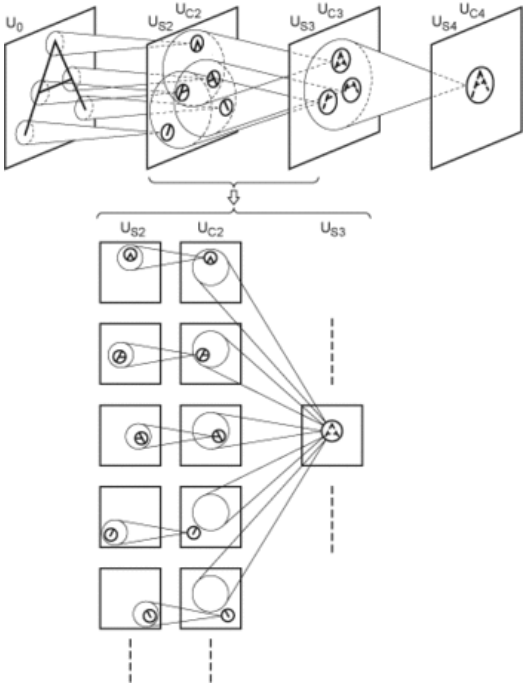
Pooling layer



MODELS

Neocognitron (1980)

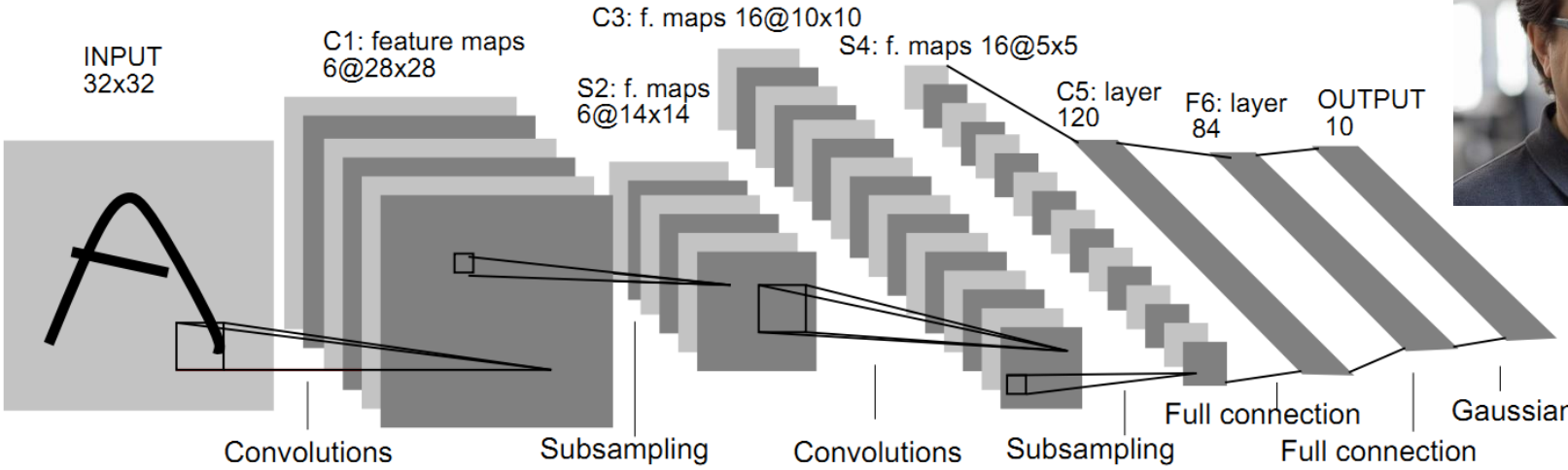




Kunihiko Fukushima

Fukushima, K. (1980). "Neocognitron: A self-organizing neural network model for a mechanism of pattern recognition unaffected by shift in position". Biological Cybernetics. 36 (4)

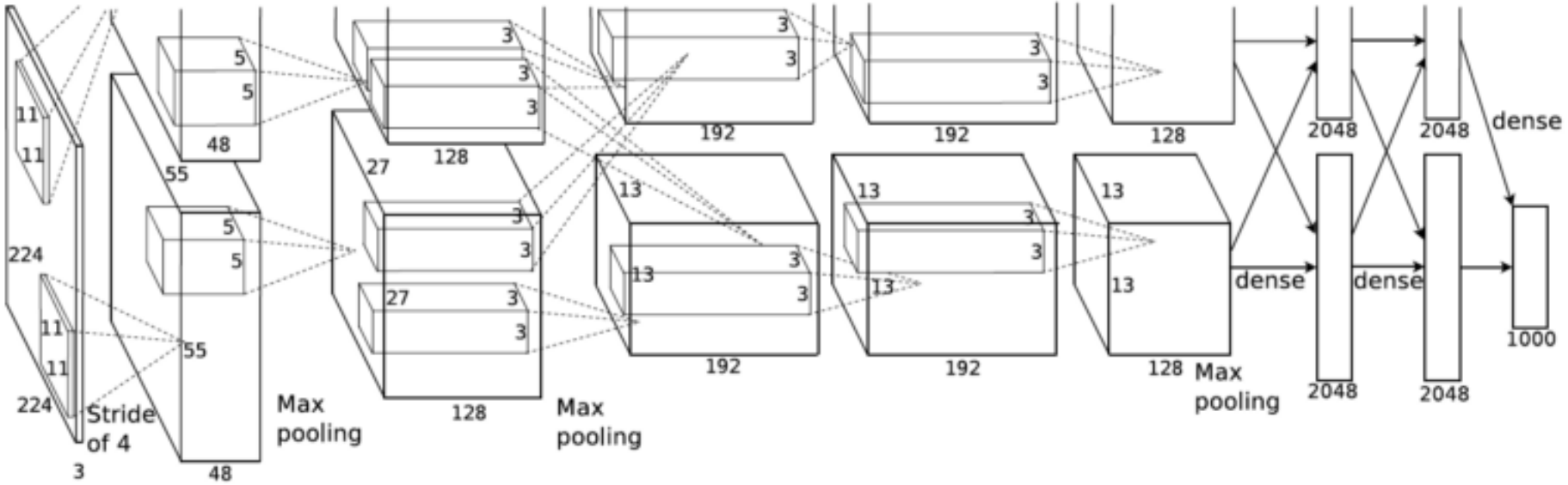
LeNet-5 (1998)



Yann LeCun

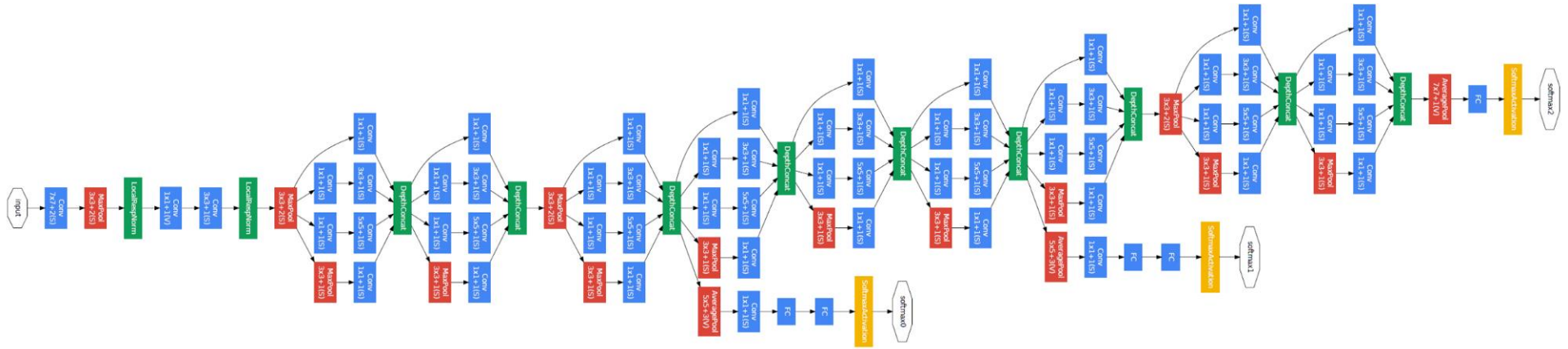
Lecun, Y. et al. (1998). "Gradient-based learning applied to document recognition". Proceedings of the IEEE. 86 (11): 2278–2324.

AlexNet (2012)



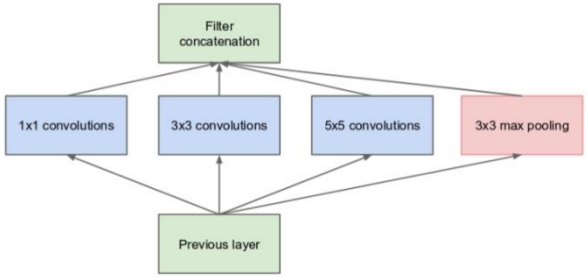
Krizhevsky, Sutskever e Hinton. ImageNet Classification with Deep Convolutional Neural Networks. NeuripIPS 2012

Inception (GoogLeNet) (2014)

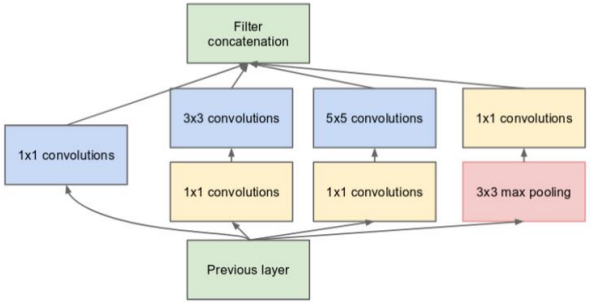


Szegedy, Christian (2015). "Going deeper with convolutions". CVPR2015.

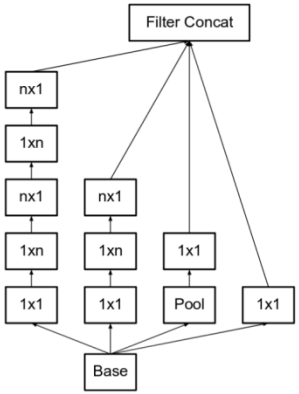
Inception modules

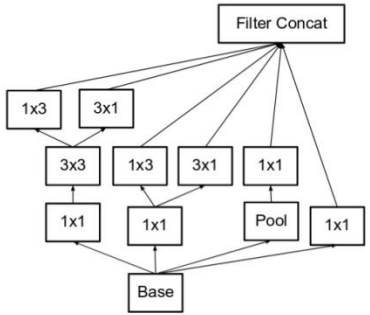


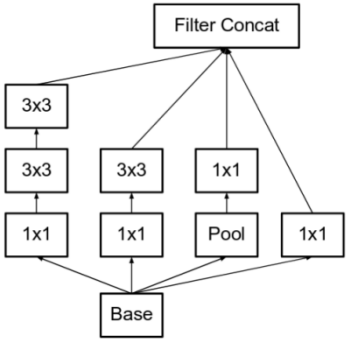
(a) Inception module, naïve version



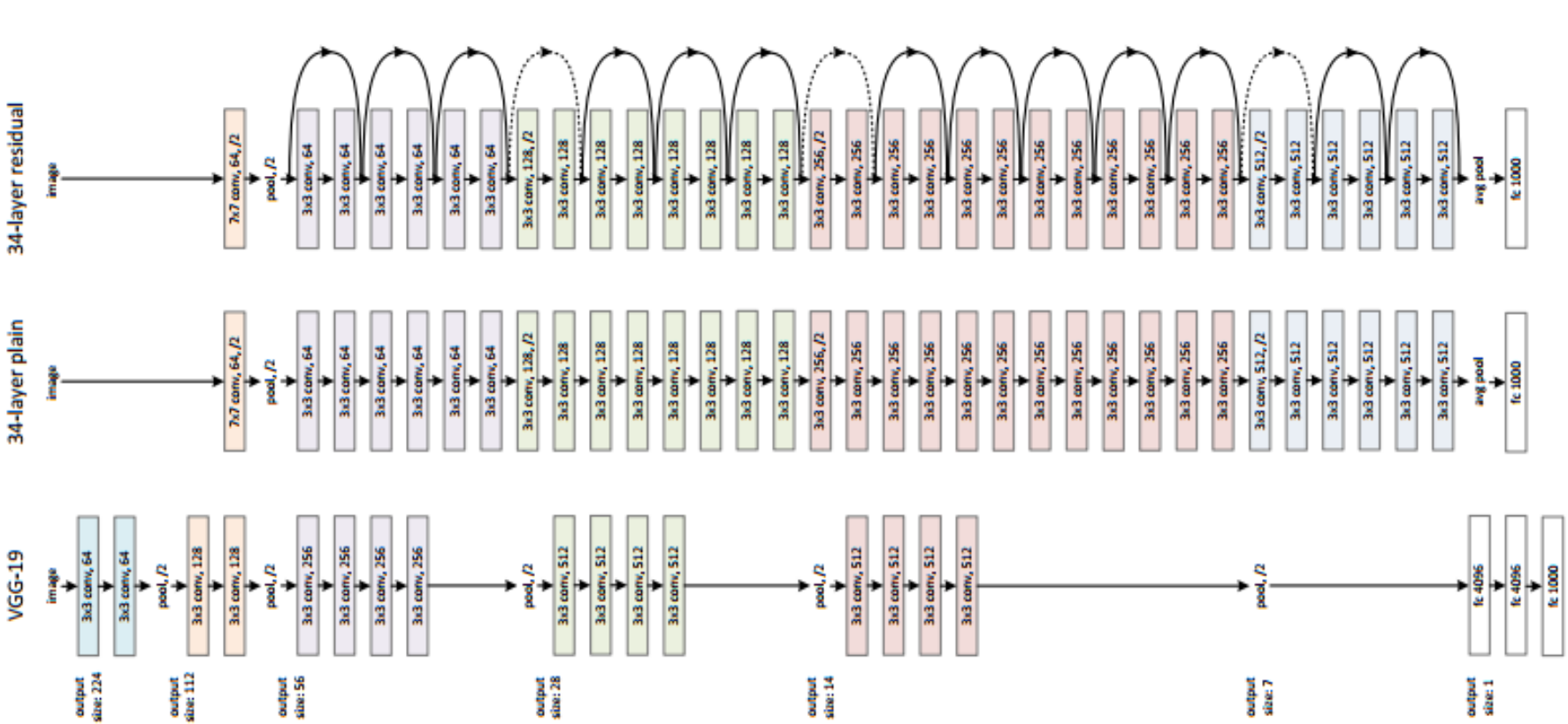
(b) Inception module with dimension reductions







VGG (2014) e ResNet (2015)



Simonyan e Zisserman. Very Deep Convolutional Networks for Large-Scale Image Recognition. 2014

He et al. Deep Residual Learning for Image Recognition. 2015.

DEVELOPMENT AND LIBRARIES

Development and libraries

- Training CNNs has a high computational cost.
  - These are recommended to be trained using GPUs.
  - Google Colab provides access to GPUs (with some restrictions).

Development and libraries

- Top libraries for Deep Learning and Convolutional Neural Networks
  - PyTorch
    - https://pytorch.org/
  - Tensorflow
    - https://www.tensorflow.org/

Development and libraries

- **Anaconda Distribution:**
  - Python distribution with support for major libraries
  - https://www.anaconda.com/products/distribution
- **Google Colab:**
  - Cloud execution environment with GPUs
  - https://colab.research.google.com

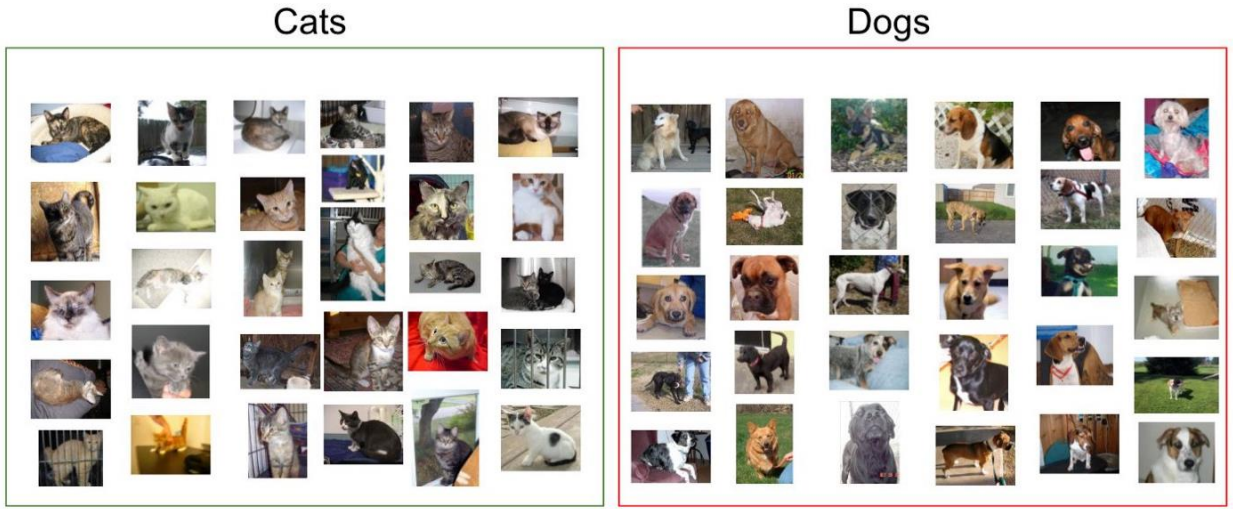
IMAGE DATASETS

Image datasets

- MNIST
  - http://yann.lecun.com/exdb/mnist/
  - 60,000 training images
  - 10,000 testing images
  - 28 x 28 pixels
  - Gray level

Image datasets

- **Cats vs. Dogs:**
  - https://www.kaggle.com/c/dogs-vs-cats
  - 25,000 training images
  - 12,500 testing images
  - 2 classes
  - Various sizes
  - RGB images



Sample of cats & dogs images from Kaggle Dataset

Image datasets

- **CIFAR10:**
  - https://www.cs.toronto.edu/~kriz/cifar.html
  - 50,000 training images
  - 10,000 testing images
  - 10 classes
  - 32 x 32 pixels
  - RGB

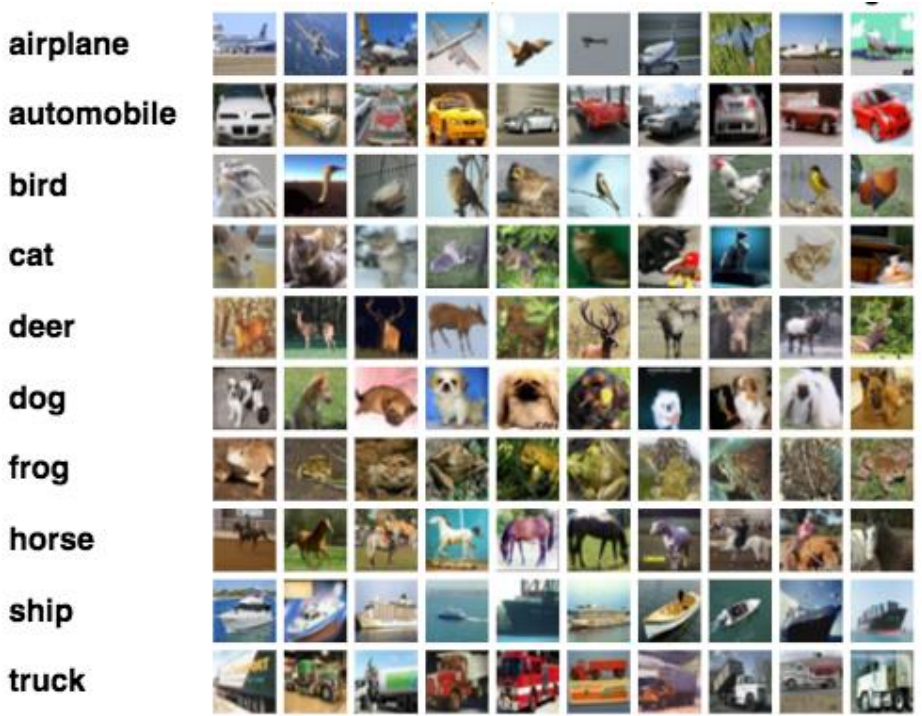


Image datasets

- **ImageNet:**
  - https://www.image-net.org/
  - ~1,000,000 images
  - 1,000 classes
  - RGB

Bibliography

- Ponti et al. **Everything You Wanted to Know about Deep Learning for Computer Vision but Were Afraid to Ask**. Sibgrapi 2017.
  - https://sites.icmc.usp.br/moacir/p17sibgrapi-tutorial/
- Moacir Ponti (ICMC-USP). **Material para o minicurso *Deep Learning***
  - https://github.com/maponti/deeplearning_intro_datascience
- Görner, M. **Learn TensorFlow and deep learning, without a Ph.D.**
  - https://cloud.google.com/blog/products/gcp/learn-tensorflow-and-deep-learning-without-a-phd
- CS231n: Convolutional Neural Networks for Visual Recognition
  - http://cs231n.github.io/
- Goodfellow, Bengio e Courville. **Deep Learning**. MIT Press, 2016
  - https://www.deeplearningbook.org/
- The MathWorks, Inc. **What is a Convolutional Neural Network? 3 things you need to know**.
  - https://www.mathworks.com/discovery/convolutional-neural-network-matlab.html

Bibliography

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  - https://doi.org/10.1016/j.compbiomed.2019.103542

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END OF THE COURSE!