Deep Learning: definition and remarks

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Overview

What is Computer Science?

Computer Science is defined as one that studies the design and construction of machines (computers) that solve problems, and the study of which of these problems are solvable[1].

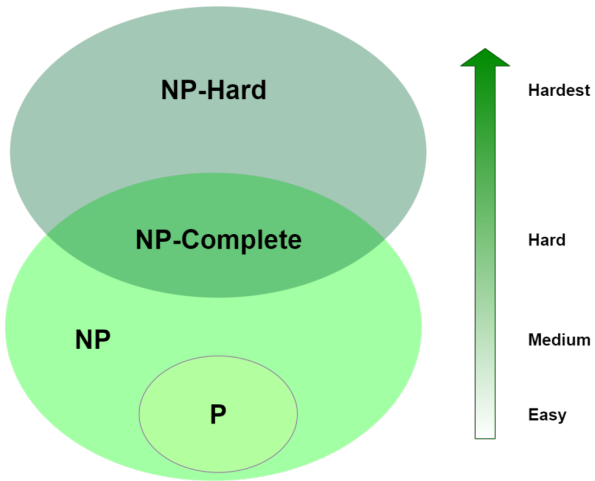

Figure: Problems can be P, NP, NP Hard or NP Complete

What is Machine Learning?(I)

This field of knowledge within Computer Science explores how computers can perform tasks on their own, rather than programming them with sets of rules about how to act[1].More specifically, Machine Learning studies what can be predicted through the data, with a series of modeling hypotheses, and with what reliability.

What is Machine Learning? (II)

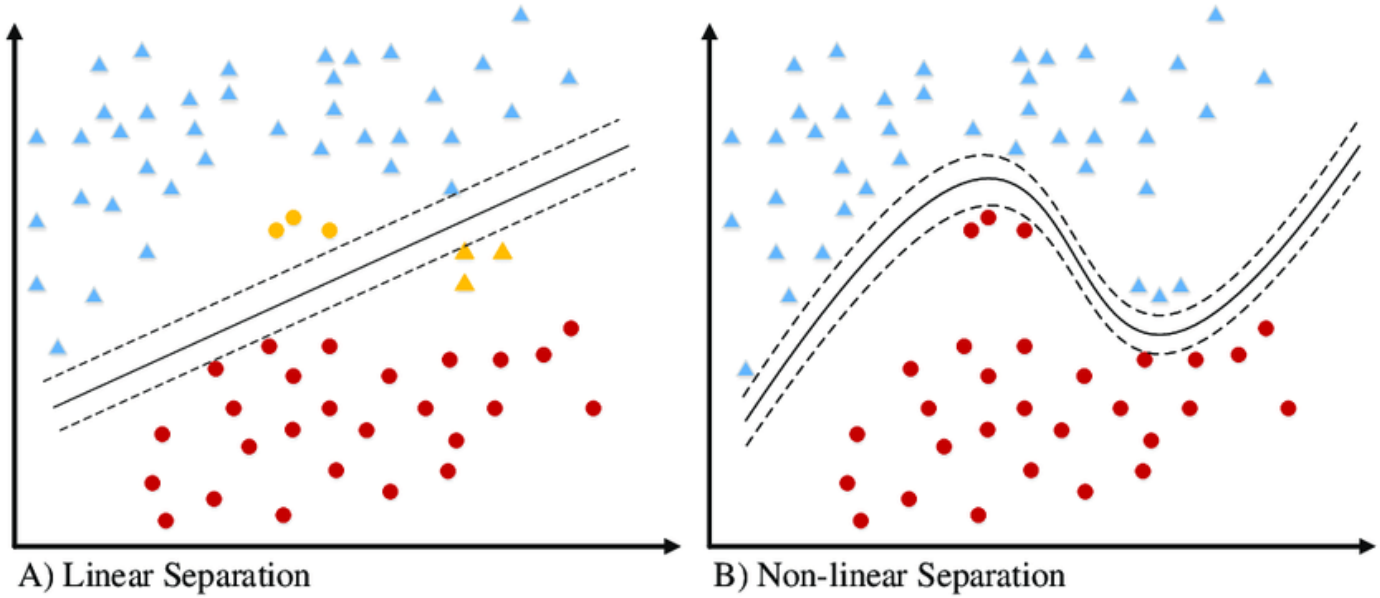

Figure: SVM linear and kernel for a binary classification problem

What is Deep Learning?

While Machine Learning task is to infer statistical rules from data, Deep Learning focus on extract features from the original data variables, in order to outperform classical machine learning algorithms.

Same, but different.

Machine Learning vs Deep Learning (I)

Is a Multilayer Neural Network already a Deep Learning architecture? Still controversy of what is Deep Learning and what is Mahcine Learning. Here is a proposal:

DEEP LEARNING IS FOCUSED ON FEATURES

Machine Learning vs Deep Learning (II)

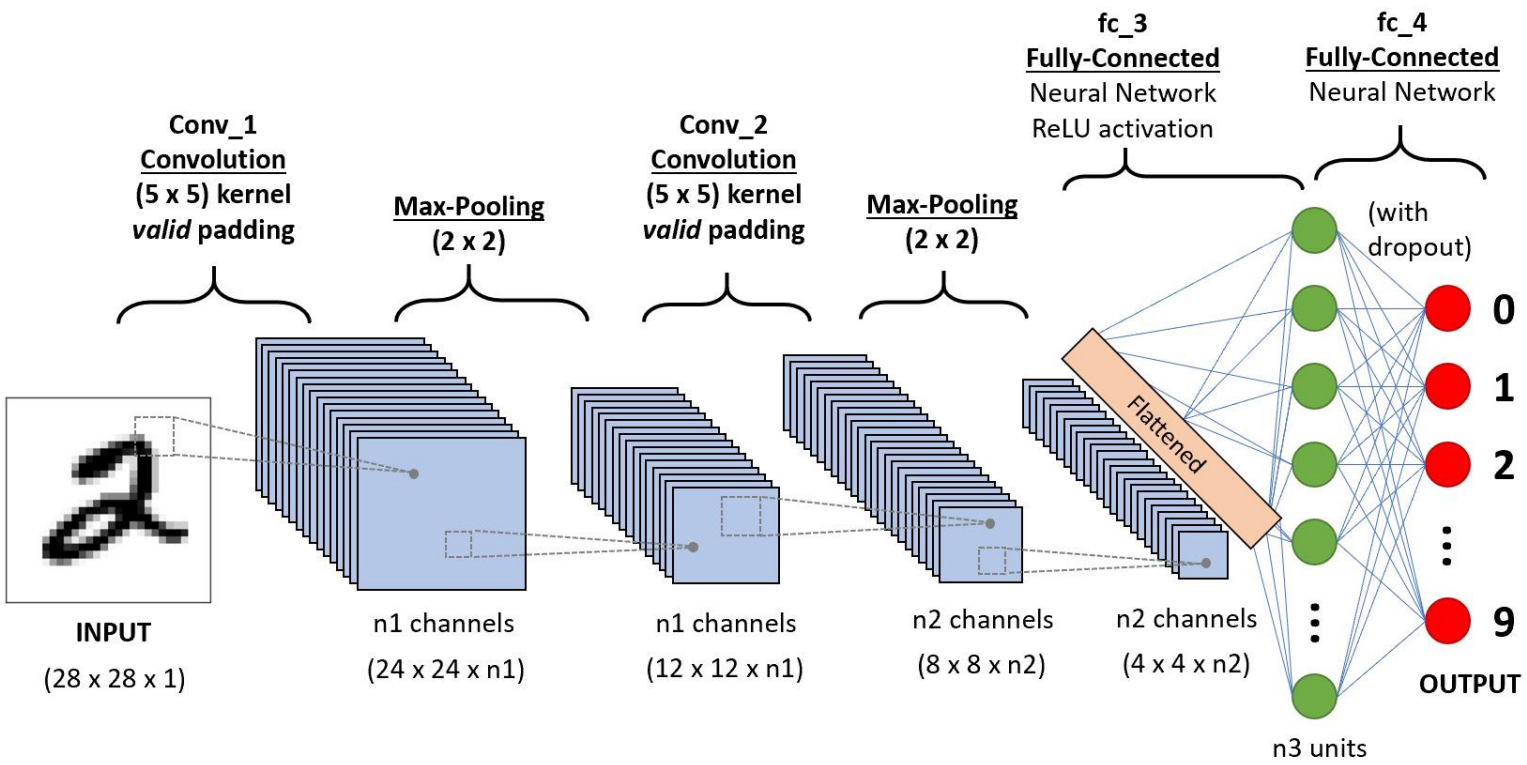

Figure: MNIST problem with Deep Learning

Machine Learning vs Deep Learning (III)

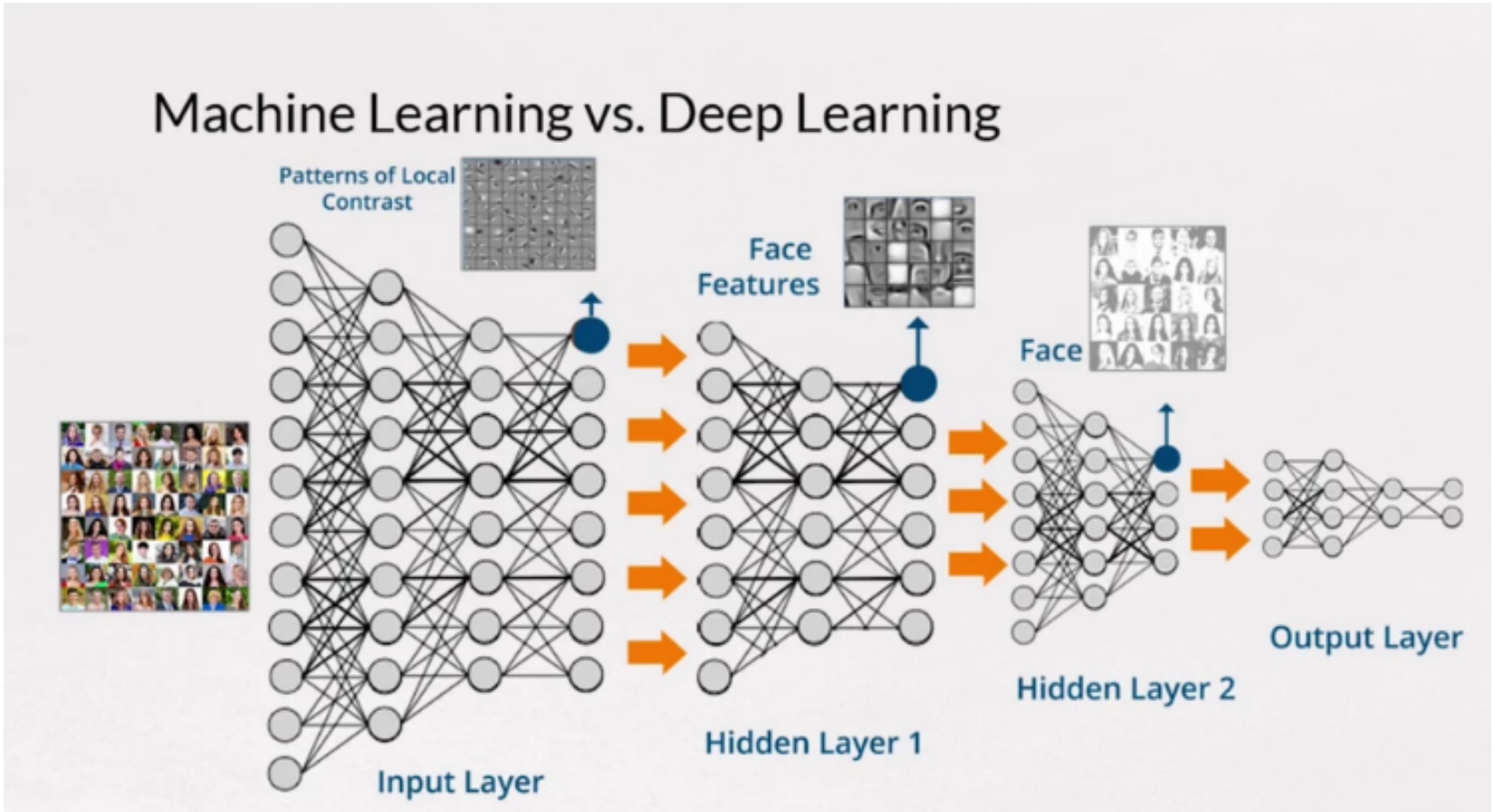

Figure: Multilayer Deep Learning

Machine Learning vs Deep Learning (IV)

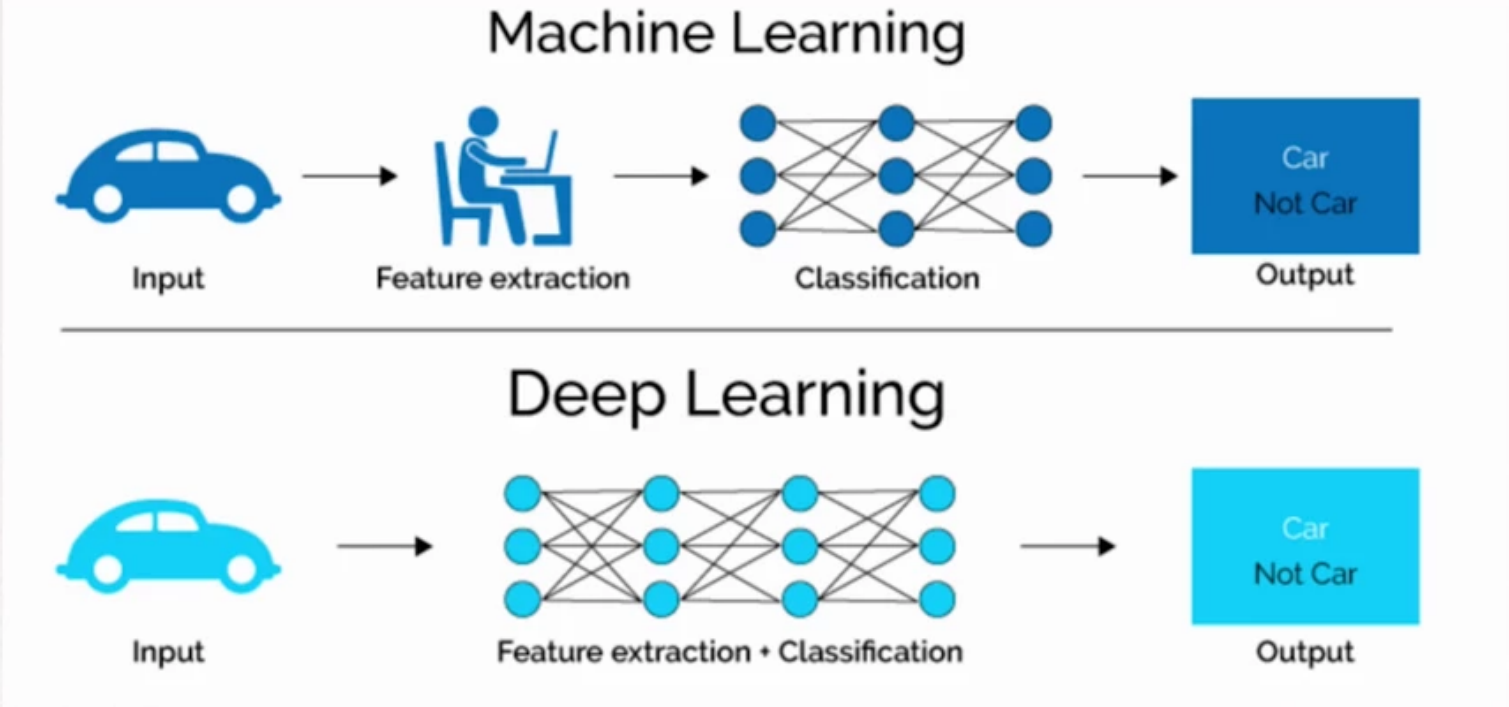

Figure: Machine Learning vs Deep Learning

Historical Advances

1. **1960s** Perceptron.
2. **1970s** Multilayer.
3. **1991** Autoencoder by Kramer et al.
4. **1997** Long short-term memory (LSTM), an RNN with feedback connections, Schmidhuber et al.
5. **1998** Convolutional Neural Networks by Yann LeCun et al.
6. **2012** Deep Convolutional Neural Networks (AlexNet) by Alex Krizhevsky et al.
7. **2014** Generative adversarial network by Ian Goodfellow.

Several languages, several libraries. **We will work in Python here**.

- **Mathematical representation** in Python, strong math libraries (*numpy*[2], *scipy*[3], ...).
- **Much work already done** in Python (*Sklearn*[4], *Tensorflow / Keras*[5], *PyTorch*[6], ...).
- **Object Oriented Programming** (OOP), more freedom to do stuff (*Have you worked with Sklearn?*).
- **APIs** for ulterior work (Twitter, Facebook, ...).

You already now this. So let's see some visual example

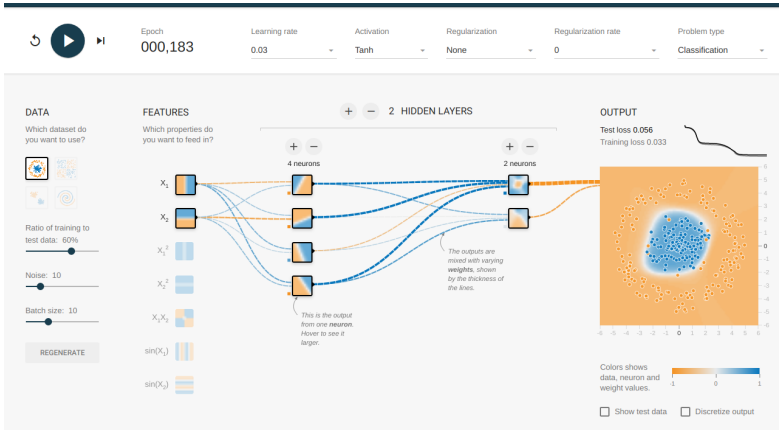

Figure: Playground of Tensorflow library

`https://playground.tensorflow.org/`

- The Jupyter Notebook is an open-source web application that allows you to create and share documents that contain live code.
- It saves the results of the code already run.
- It allows to mix real text, equations and code.

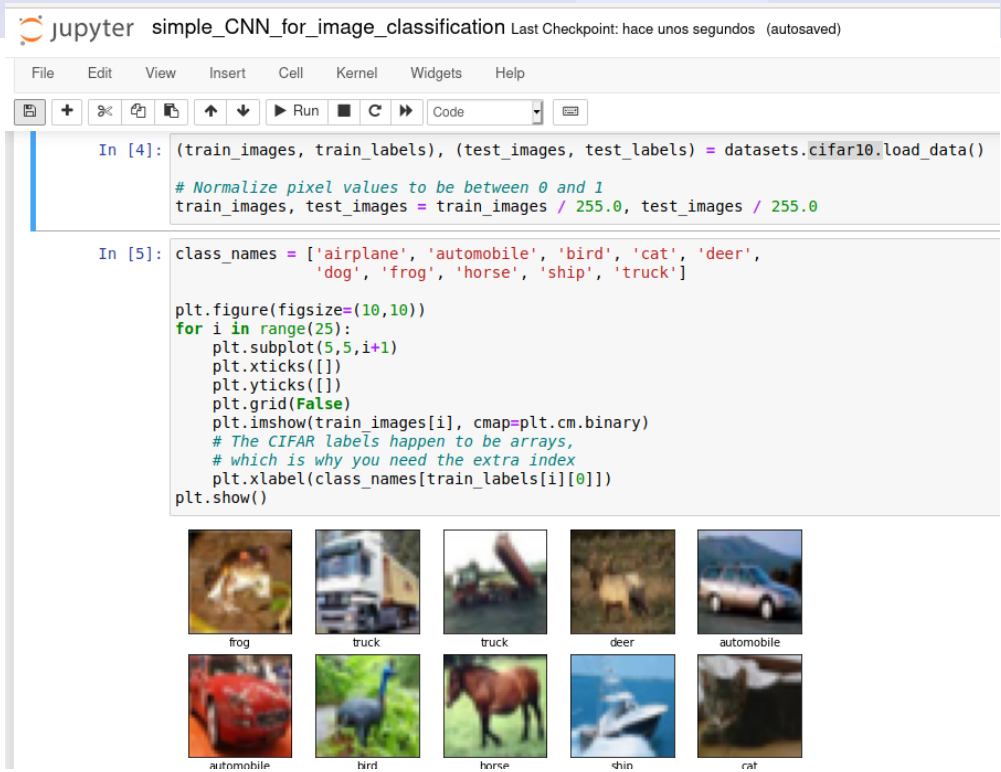

Figure: How Jupyter Notebook looks like.

Let's do some code!

- Create your own Python environment.
- Install Jupyter and Tensorflow.
- Explore example with *CIFAR10* dataset[7].

`https://github.com/cperales/tensorflow_examples`

MNIST dataset

- Create your own Python environment.
- Install Jupyter and Tensorflow.
- Download MNIST dataset.
- Play with Tensorflow.

Overview of datasets in Tensorflow:
`https://www.tensorflow.org/datasets/overview`

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