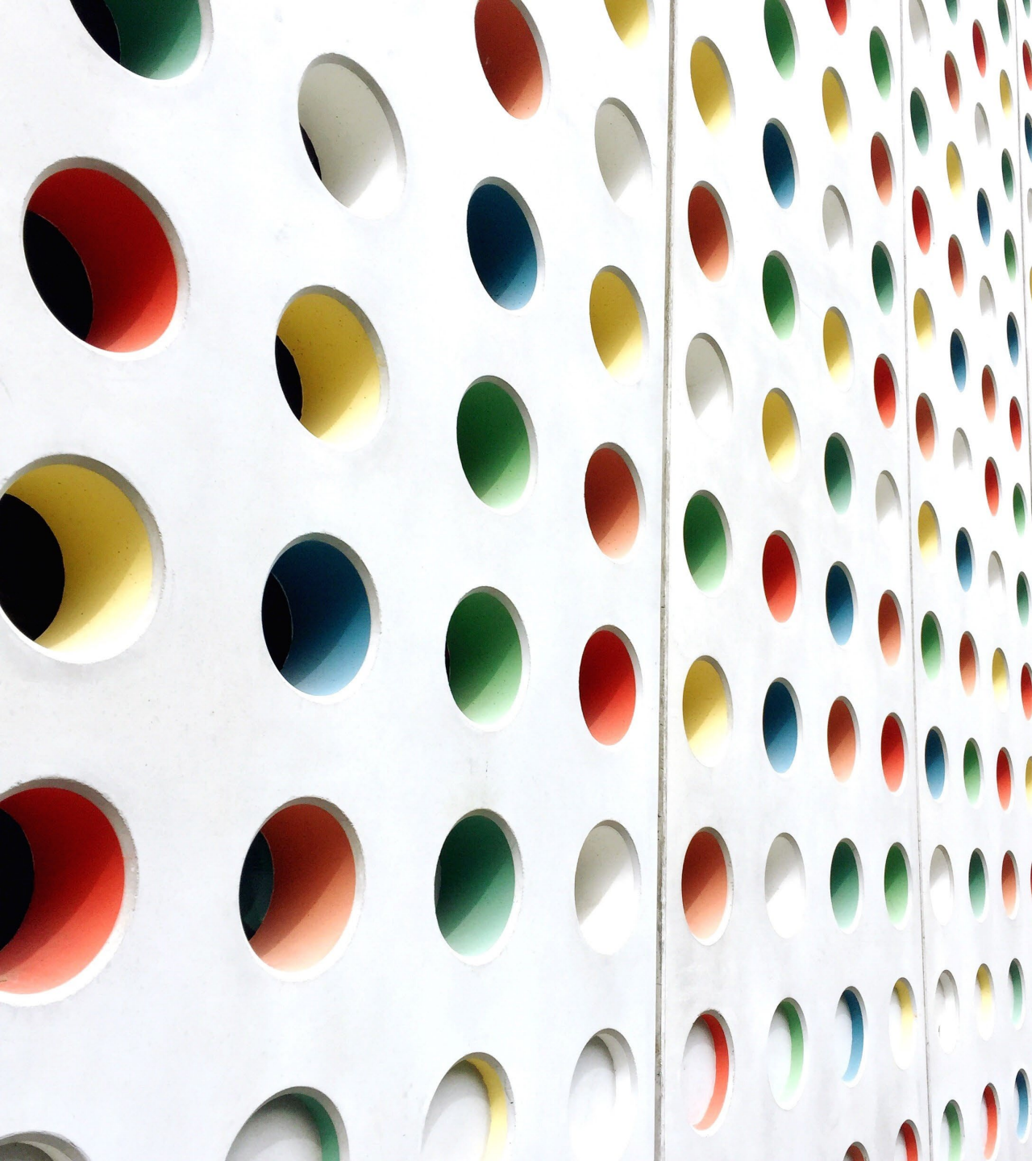

Intro to Machine Learning and Deep Learning with some Geospatial apps

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Machine learning definition

Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, and gradually improving its accuracy.

ALGORITHMS FOR DATA.

- Machine learning is an important component of the growing field of data science.
- Through the use of statistical methods, algorithms are trained to make **classifications** or **predictions**, and to uncover key insights in data mining projects.
- These insights subsequently drive decision making within applications and businesses, ideally impacting key growth metrics. As big data continues to expand and grow, the market demand for data scientists will increase.
- They will be required to help identify the most relevant business questions and the data to answer them.

Artificial Vision & Deep Learning

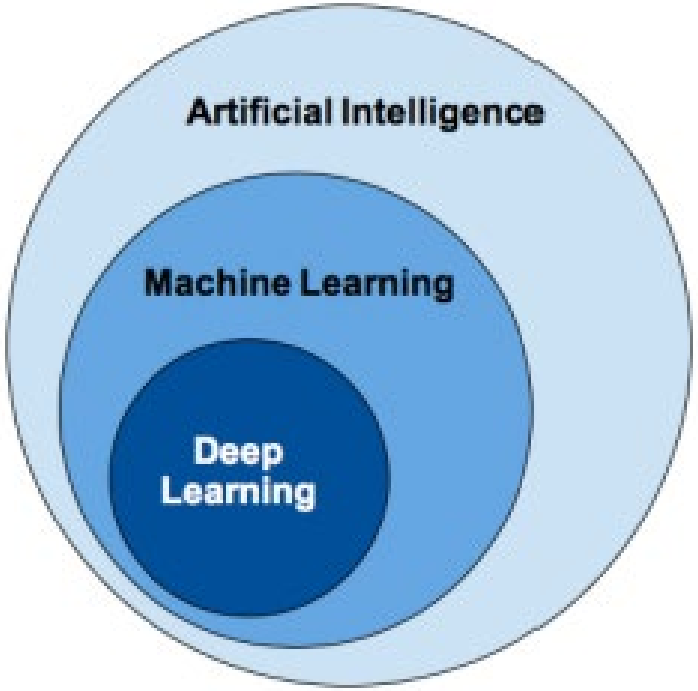
- Machine Vision (AV or MV) tries to obtain high-level information from images. This information can be the recognition of an object (car, boat, bridge, building detector...) or classifying regions (vegetation cover types, or scenes types(car,dogs,…, soil. types of soil , etc).

- Deep Learning is a sub-field of machine learning, which in turn can be considered a sub-field of artificial intelligence.

- Artificial Intelligence seeks to create systems that are capable of making "intelligent" decisions, emulating human capacity...

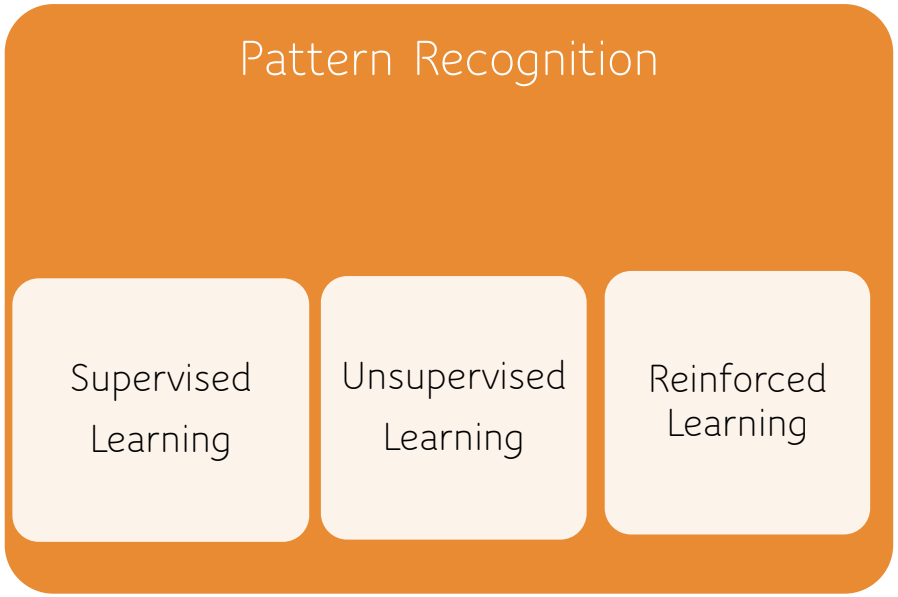
- Getting a computer to perform the tasks that a person performs, even simple tasks, is too complicated with classical declarative programming techniques. It is better for the computer to learn to perform them using strategies optimised for it. This is the core of Machine Learning techniques.

- In Deep Learning techniques (which are a subset of ML techniques), the aim is for the machine (and not the person) to discover or learn the distinctive features in the data that can lead it to learn how to solve a problem.



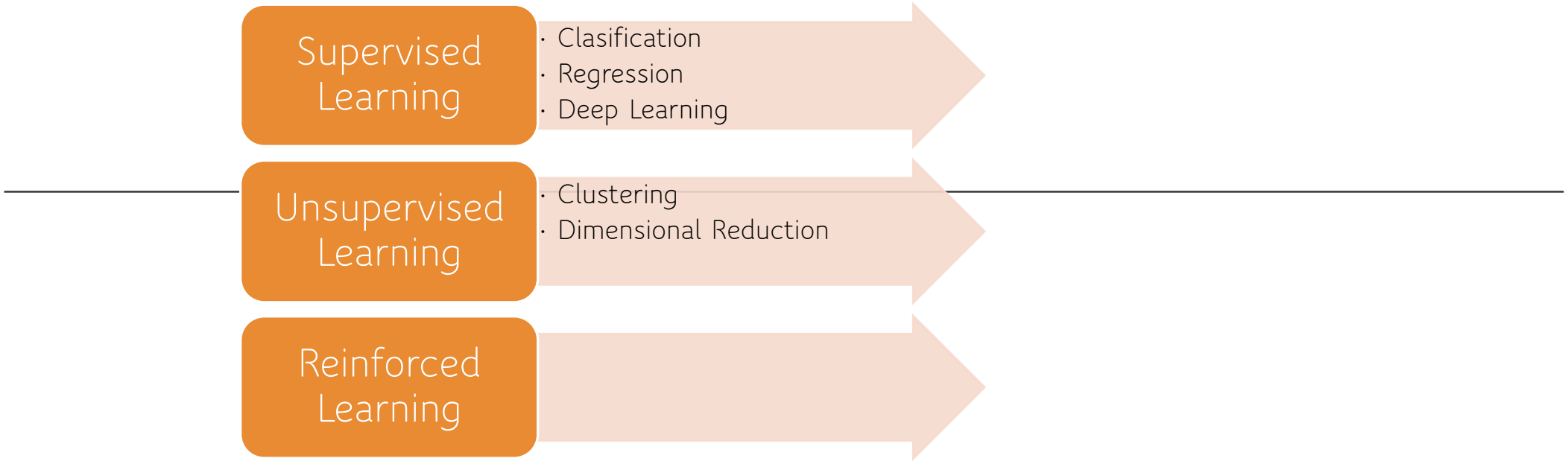
Machine Learning categories

- ML techniques are sometimes also referred to as Pattern Recognition.
- The three broad categories of ML techniques are Supervised, Unsupervised and Reinforced Learning.
  - In turn, the most salient features of each category are as follows:



Supervisado	No Supervisado	Reforzado
· Labelled data · Direct Feedback · Result Prediction	· No labels · No feedback · Hidden Pattern discovering	· Learning through a reward system · Learning series of actions

Machine learning Tasks



A) Clasification: The goal is to predict class (category) labels for new types of data based on past observations (training set).

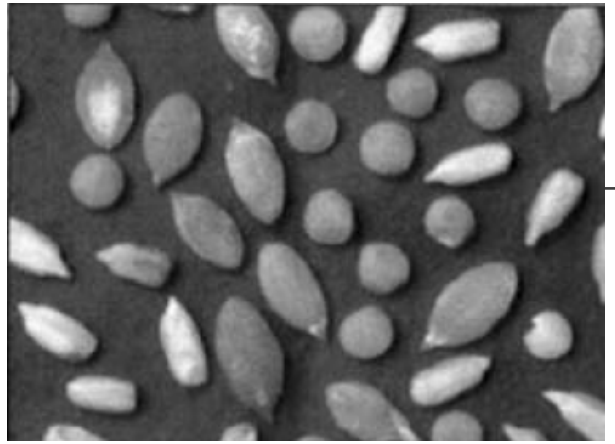
B) Regression: It looks for the relationship between a set of explanatory variables and a continuous response. Once the relationship between the two is found, we predict the outcome from the variables

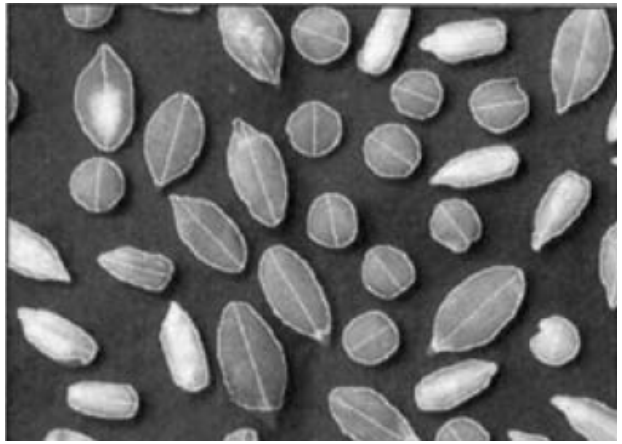
C) Clustering: We seek to find groupings of the data that allow us to organise them all into clusters without prior knowledge of the group.

D) Dimensional Reduction : The aim is to reduce the dimensions of the problem by trying to keep as much of the information as possible in the data itself, eliminating noise and redundant information.

E) Feature Extraction: Learning techniques for the extraction of descriptor representations (or features), useful for the task to be learned. These representations are acquired hierarchically, and the implementation techniques are based on neural networks.

ML Classification





Descriptor or feature selection (descriptors)

Low dispersion | cheap, uncorrelated,

Clasificator construction (with training data)

Medida similitud | Elección de métrica para Distancia

Decision Border calculation

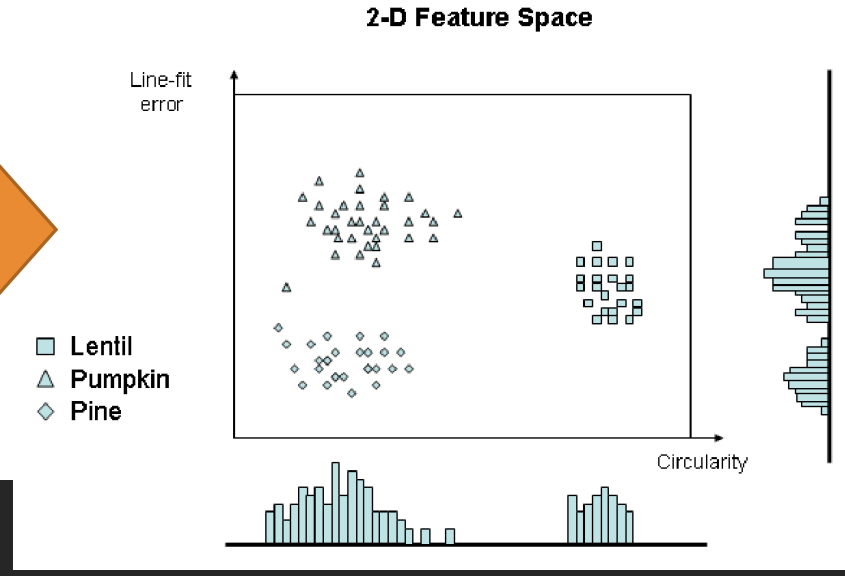
Classifier validation and prediction

With validation data (not training data)

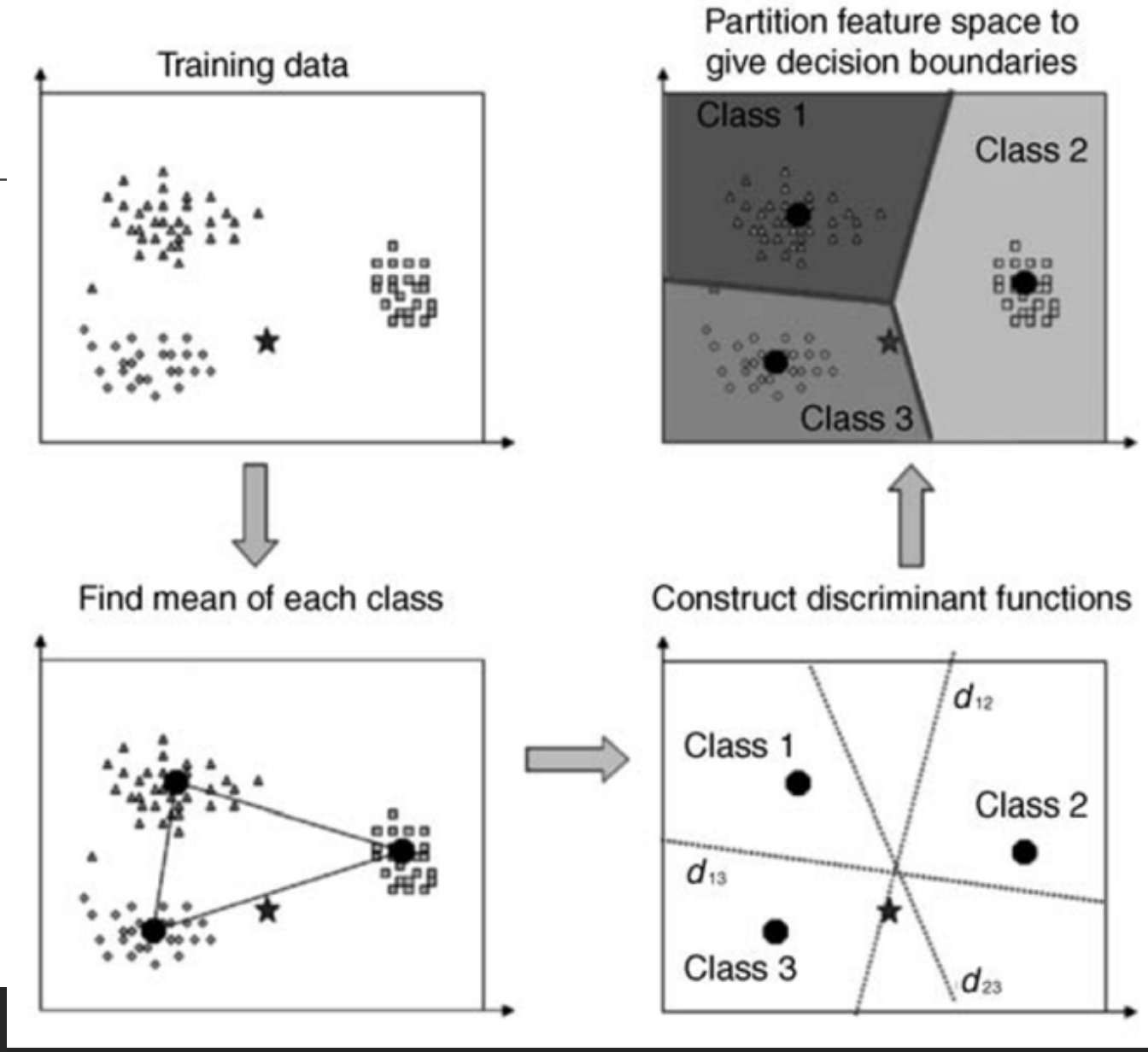
Pattern:

x=[Circularity,

Line fit error]



Supervised learning Workflow: training, decission, class prediction



Deep Learning characteristics

- It is implemented using neural networks that are layered (hierarchically). Deep Learning is referred to when there are hidden layers.
- As the information moves through the layers to deeper layers, the representations become more and more abstract (hierarchical approach).
- Deep Learning models make use of distributed representations, i.e. it is not necessary for each model to learn representations but they can be shared, at least partially for other applications.
- In fact, it is common to use the first layers of a trained model with large datasets to extract representations that can be used to perform a different task.
- Image tasks are a poor fit for ML techniques because of their high dimensionality, they contain a lot of redundant information and also information that is irrelevant to a particular task.
- Some image processing algorithms are easily applicable to feature extraction. For example filters in convolutional networks.
- After processing images in this way, you have image representations that are concretised into feature vectors that have a much lower dimensionality than the original image.