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U0. Introduction to Machine Learning

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Learning objectives

- Define Machine Learning
- Explain classification paradigm
- Explain old-fashioned and current structures of classifiers
- Show examples of learning methods
- Know ML applications

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1 Definitions of Machine Learning (ML)

[[Samuel, 1959](#)]: ML is a field of study that gives computers the ability to learn without being explicitly programmed.

[[Mitchell, 1997](#)]: A system learns from experience E with respect to a class of tasks T and a performance measure R , if its performance at T , as measured by R , improves with E .

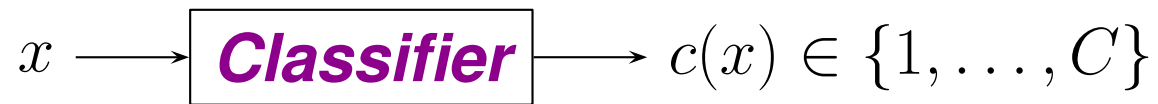
[[Jordan and Mitchell, 2015](#)]: ML enables us to create systems that improve automatically with experience.

[[Murphy, 2022](#)]:

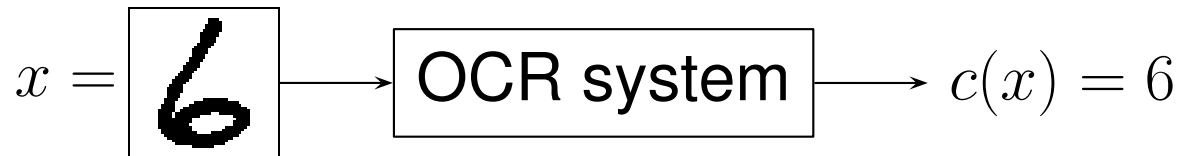
- Many types of ML depending on the nature of T , R and E
- Most ML conveniently treated from a probabilistic perspective
- The probabilistic approach is optimal for decision making under uncertainty

2 The classification paradigm

Most ML systems follow the *classification paradigm*: an object x needs be (correctly) classified into one of C possible *classes*:

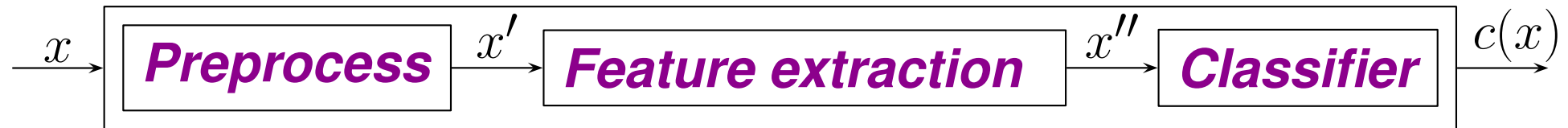


Example: OCR (*optical character recognition*) to classify 6 and 9



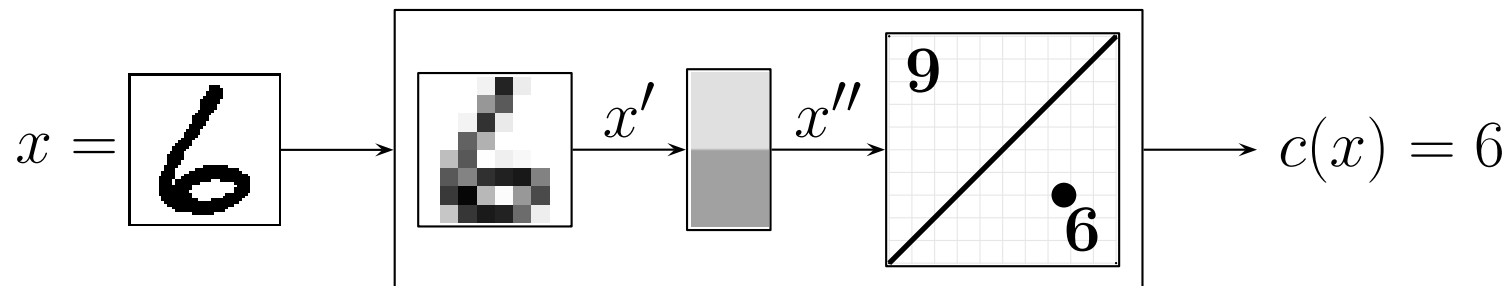
3 Old-fashioned structure of a classifier

An old-fashioned classifier consists of three modules:



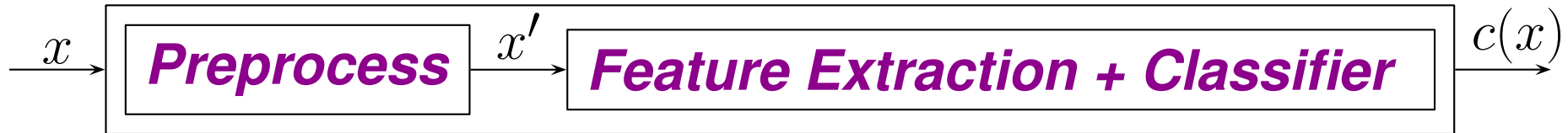
- **Preprocess:** signal acquisition and filtering
- **Feature extraction:** computing feature vector
- **Classification:** classification of the feature vector

Example: OCR for 6 and 9



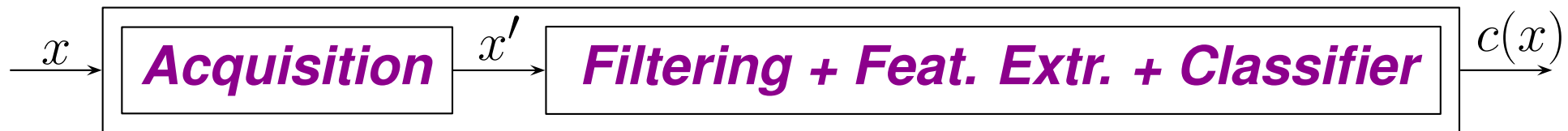
4 Current structure of neural-based classifiers

Two-module classifier:



- **Preprocess:** signal acquisition and filtering
- **Feature extraction + classification:** neural net

Two-module classifier:



- **Signal acquisition**
- **Filtering + Feature extraction + classification:** neural net

5 Learning methods

Supervised: The system learns from (human) ***labeled*** samples

Unsupervised: The system learns from ***unlabeled*** samples

6 Applications



Text classification

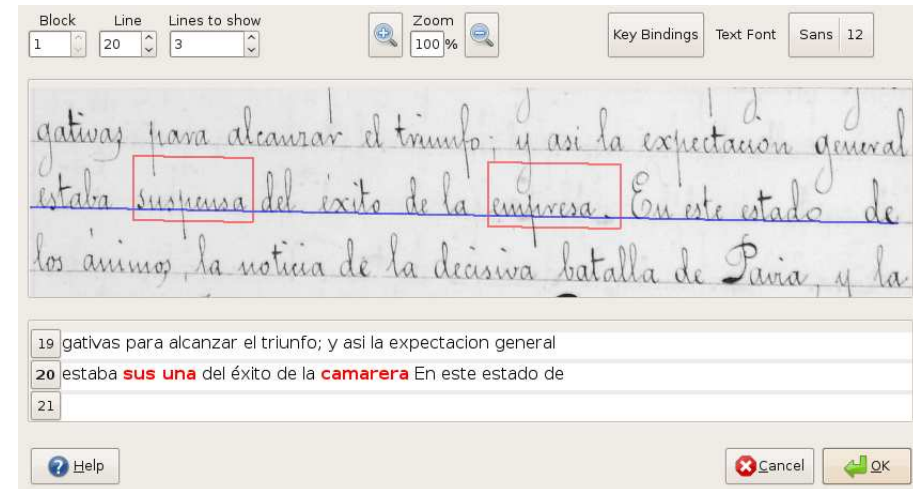
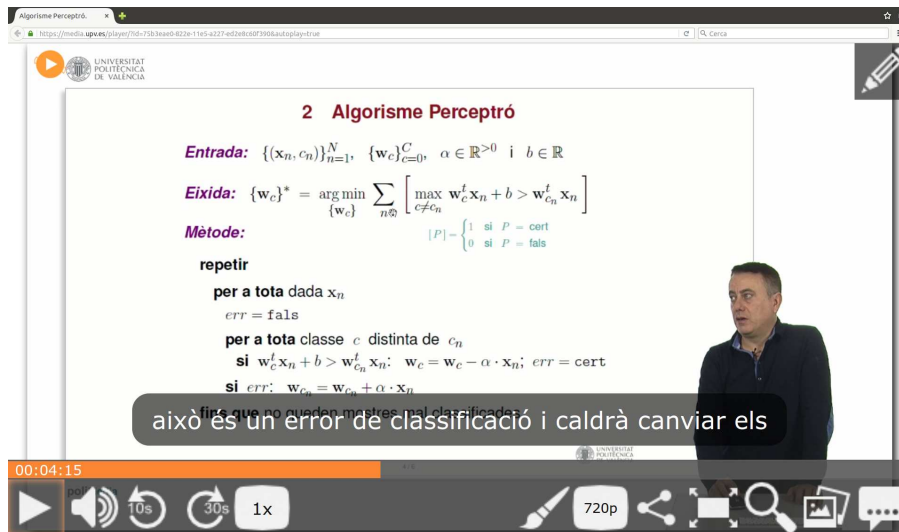
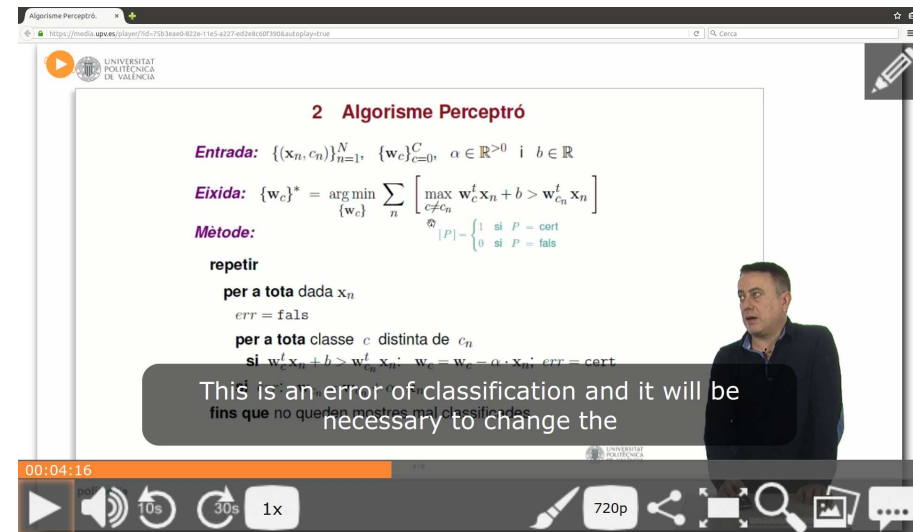


Image recognition



Speech recognition



Machine translation

References

- [Jordan and Mitchell, 2015] Jordan, M. I. and Mitchell, T. M. (2015). Machine learning: Trends, perspectives, and prospects. *Science*, 349(6245):255–260.
- [Mitchell, 1997] Mitchell, T. (1997). *Machine Learning*. McGraw Hill.
- [Murphy, 2022] Murphy, K. P. (2022). *Probabilistic Machine Learning: An introduction*. MIT Press.
- [Samuel, 1959] Samuel, A. (1959). Some studies in machine learning using the game of checkers. *IBM Journal of Research and Development*.