

# Machine Learning: Fundamentals (AA1)

*Master Degree in Computer Science*  
**Code: 320AA ECTS: 6 Semester: 1 Tag: AA1**

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# Learning & Machine Learning

“The problem of *learning* is arguably at the very core of the problem of *intelligence*, both biological and artificial”

[Poggio, Shelton, AI Magazine 1999]

- *"Machines that learn by itself"*: Luxury or necessity?
  - Growing availability and need for analysis of empirical data
  - Difficulty of providing intelligence /adaptivity via programming
- *Self-learning* as the only way for the future development
- Automatized learning by the system of the experience (set of examples) to address a computational task

# Machine learning in Master Degree in Computer Science



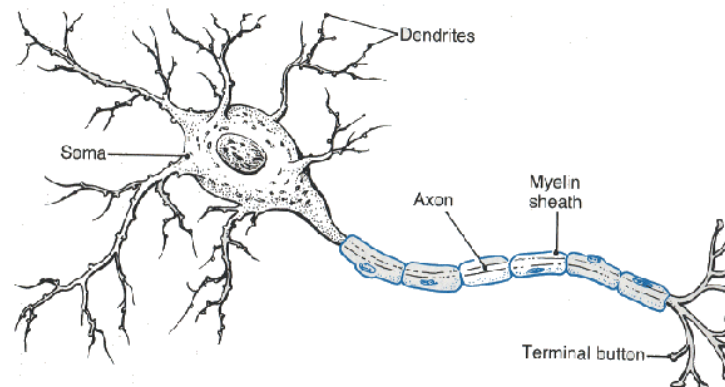
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Opening the area of *Machine Learning (ML)*

- To know the basic principles of learning processes (computational aspects)
- To know new computing paradigms

e.g. natural inspired models: **Neural Networks**

- Studied as computing paradigms since the 40`s
- Neurobiological inspiration
- Nowadays: set of powerful computing models for function approximation and with predictive capabilities supported by a rigorous theoretical ground (*learning theory*)



# Machine learning in Master Degree in Computer Science



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- As AI methodology → [Build Intelligent/Adaptive Systems](#)
- As statistical learning (inference of hypothesis within math. principles)  
→ [Build powerful predictive system for Data Analysis](#)
- As computer science method for innovative application areas  
→ [Using models as a tool for complex \(interdisciplinary\) problems](#)

Applicative areas:

- Real-World systems (pervasive)
- New interdisciplinary area, encompassing:
  - Pattern Recognition (face and speech recognition), Robotics, Computer Vision, Language Processing, Data Mining, Analyses of complex data (Med, Bio, Chem, Web), Adaptive Systems and Filters, Financial forecasting, Personalized components, ...
- Extend the class of problems addressed in Computer Science and AI

# AA1: Aim synthesis

- Introduction to the machine learning principles and to the main paradigms (models and algorithms) for learning from data
- Method
  - The concepts are progressively introduced starting from simpler approaches up to the state-of-the-art models
  - Models include **Neural Networks, SVM, Graphical models, ...**

A specific focus to

- general conceptual framework of modern machine learning
- critical analysis of the characteristics for the design and use of the algorithms for real problems
- rigorous experimental evaluation
- **Competition: AA1 CUP**



# More Information

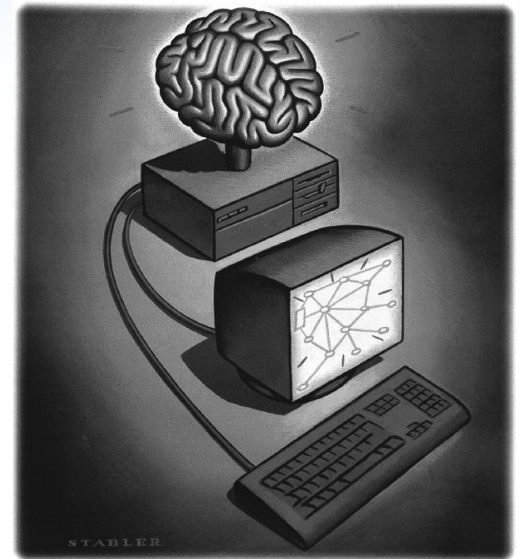
- **Program:** see Master Degree site

- **“What is ML?”**

Introductory enjoyable reading, see:  
**<http://www.di.unipi.it/~micheli/DID/>**

- Other courses: IIA, AA2

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Comm. ACM 1994



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