



## **VI Escuela de Verano en Sistemas Complejos**

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### **Abstract**

Course

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### **From Machine Learning to Neuroscience: some Information Processing Principles:**

- \*Unsupervised learning and the cortex
- \*Supervised learning and the cerebellum
- \*Associative learning and the hippocampus

Machine Learning proposes a large set of algorithms to process data sets and extract knowledge from their regularities, among which some are based on Artificial Neural Networks. Today, these models are no more viewed as bio-inspired; they are rather described along the kind of learning they perform, depending on the nature of data and on the architecture of the networks.

In a completely separate way, neuroscience has also proposed a taxonomy of learning principles and has given some possible links to memory systems in the brain and to candidate neuronal structures to implement such adaptive properties.

Though both views of learning are not directly compatible, it is possible to show some links between the kinds of learning in both domains. More interestingly, fundamental common properties can be exhibited on the structure of artificial and biological neural networks, which give very interesting information for bio-inspired modeling.

Particularly, we will study how self-organizing maps perform unsupervised learning in the cortex; layered networks perform supervised learning in the cerebellum and recurrent networks perform associative learning in the hippocampus. To be more complete, we will also quickly evoke temporal dimensions of learning and mention reinforcement learning and the basal ganglia as well as conditioning and the amygdala.

Such a study will perfectly illustrate one of the fundamental principles of Computational Neuroscience, which is to develop calculation methods to understand the complex structure/function links in the brain.



## **Articles related**

(Download at [www.iscv.cl](http://www.iscv.cl))

- "Numerical processing for cognitive tasks" is very general about numerical tools for cognitive modeling - "What are the computations..." compares biological and artificial neural networks - "Biological inspiration..." evokes the collaboration of different kinds of memory in bio-inspired robotics (PDF at [www.iscv.cl](http://www.iscv.cl))

Else, the goal for the students is to be familiar with classical models of artificial neural networks:

[http://en.wikipedia.org/wiki/Category:Neural\\_networks](http://en.wikipedia.org/wiki/Category:Neural_networks)

and particularly with:

Hopfield networks:

[http://en.wikipedia.org/wiki/Hopfield\\_net](http://en.wikipedia.org/wiki/Hopfield_net)

Perceptrons:

<http://en.wikipedia.org/wiki/Perceptron>

CMAC model:

[http://en.wikipedia.org/wiki/Cerebellar\\_Model\\_Articulation\\_Controller](http://en.wikipedia.org/wiki/Cerebellar_Model_Articulation_Controller)

Self-Organizing Maps:

[http://en.wikipedia.org/wiki/Self-organizing\\_map](http://en.wikipedia.org/wiki/Self-organizing_map)