Description of the Lecture

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Unique choice box:

- introductory course;

Title: Control and Machine Learning

Short description/abstract:

In this series of lectures we shall present some recent results on the interplay between control and Machine Learning, and more precisely, Supervised Learning and Universal Approximation.

We will adopt the perspective of the simultaneous or ensemble control of systems of Residual Neural Networks (ResNets). Roughly, each item to be classified corresponds to a different initial datum for the Cauchy problem of the ResNets, leading to an ensemble of solutions to be driven to the corresponding targets, associated to the labels, by means of the same control.

We present a genuinely nonlinear and constructive method, allowing to show that such an ambitious goal can be achieved, estimating the complexity of the control strategies.

This property is rarely fulfilled by the classical dynamical systems in Mechanics and the very nonlinear nature of the activation function governing the ResNet dynamics plays a determinant role. It allows deforming half of the phase space while the other half remains invariant, a property that classical models in mechanics do not fulfill.

The turnpike property is also analyzed in this context, showing that a suitable choice of the cost functional used to train the ResNet leads to more stable and robust dynamics.

Number of sessions: 6 (1 hour per session > Total : 6 Hours).

o Domain from Arxiv: **Optimization and Control**

o MSC (ex. 35K57 & 35R30): 93B05, 68T05, 93B47

o Keywords (separated by #): control, supervised learning, residual neural networks, turnpike