AI and Complex Dynamical Systems Course Planning

This graduate course aims at applying Machine Learning (ML) tools in Complex Systems (CS). We do not assume any previous knowledge of ML or CS theory however we do require some experience with computational techniques. Use of Python is essential for the course but we will note require extensive coding. Thus, a motivated student can learn the basics of the language in the first few weeks of classes. After the successful completion of this course the students will have the capability of applying basic tools of ML both in certain types of CS but also more generally to scientific problems. The course will be intensive and will be structured approximately as follows:

AI and Complex Dynamical Systems

Week	Topics	
Feb 6	Intro ML	General Introduction to Machine Learning and use of Python code
Feb 13	ML Tools I	Supervised learning, regression, trees and forests, SVM
Feb 20	ML Tools II	Artificial neural networks, CNNs, RNNs, Reservoir computing
Feb 27	ML Project I	Use ML for classification and prediction- Project I
Mar 6	ML Project II	`Use ML for classification and prediction-Submission of Project I
Mar 13	Intro CS	What is a complex system. Chaos, solitons and fractals
Mar 20	Chaos	Use ML in chaotic systems
Mar 27	Chaos	Chaotic time series analysis through ML
Apr 3	Solitons	Coherent modes: Solitons and Breathers-Project II
Apr 10	EASTER	
Apr 17	EASTER	
Apr 24	Project ML-CS	ML-CS-Project II submission
May 1	Spatiotemporal	Chimeras
May 8	Phase transitions	Ising model and Spin glasses
May 15	Project ML-CS	ML-CS- Project III

The testing procedure involves three projects that need to be completed and delivered in the allocated time. There will also be a final exam in a form to be discussed in the course. Depending on the number of students enrolled in the course, the projects will be done in small groups while the final exam will be individual. This is a graduate course and thus it assumes basic knowledge of physics and some computer experience. **Undergraduate students that might be interested to take the course should first consult with me. In any case undergraduates must have good physics background and good knowledge of English.**

The basic ML will be done during the second and third week of the course. During this period we will have extra classes in order to cover the material. You will need a laptop in order to follow this course.

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