Machine Learning for Physics and Astronomy PHYS 555

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Outline

This graduate course is designed as an introduction to the concepts and essential tools of Machine Learning, which are making huge inroads in many fields of research in physics and astronomy. Emphasis is placed on concepts and hands-on applications, with examples drawn from diverse areas of physics. The course content is divided in two parts:

1. Machine Learning Fundamentals
   Learning Concepts. Probability and Statistics. Data Mining.
   Supervised Learning. Classification and Regression. Linear Models. Optimization and Regularization. Evaluation Metrics. Non parametric Models. Decision Trees. Kernel Methods. Dimensionality Reduction. Clustering techniques.

2. Deep Learning
   Neural Networks. Deep Learning Concepts. Convolutional Architectures. Learning with Sequential Data. Transformers. Generative Models. Uncertainty. Graphs.

Lectures will cover the essential concepts of each topic, and with hands-on exploration using state-of-art computing machine learning software libraries.

Prerequisites

We have designed the course so that there are no strong prerequisite courses needed. Our aim is to make this course broadly accessible to all the graduate students in our department. However, moderate proficiency with linear algebra, probability and statistics and with scientific python programming will be very helpful.

Evaluation

 A total of 100 for this class will be splitted in the two main sections:
   1. Machine Learning Fundamentals = 50 marks
   2. Deep Learning = 50 marks
The marking will consist of homeworks (60), a presentation (10) and a final project (30).