

PY 895: Machine Learning for Physicists

Instructor: Pankaj Mehta

Time: TTh 9:30-11:00

Office Hours: Th 11-noon.

Room: TBD

Prerequisites: PY 541 or permission of instructor

Description: Machine Learning is one of the most exciting and interesting areas of modern statistics and “big data” research. This special topics class will introduce the basics of machine learning to graduate students in physics using language and ideas from statistical physics. The class will cover fundamental conceptual topics such as bias/variance tradeoff, overfitting, model selection, Bayesian Inference, basic Information theory. It will illustrate these general ideas in a wide variety of settings including penalized regression, expectation maximization, generative graphical models, dynamic programming, neural networks, high-dimensional statistics, Monte-Carlo methods, and deep learning. An emphasis will be on building an intuition for machine learning using ideas from statistical physics. There will also be coding assignment in addition to a final project.

Recommended Textbooks:

- Abu Mustafa et al. [Learning from data](#) (online course [here](#))
- Christopher Bishop. [Pattern Recognition and Machine Learning](#).
- David MacKay. [Information Theory, Inference, and Learning Algorithms](#)
- Michael Neilsen. [Neural Networks and Deep Learning](#) (online textbook)
- Ian Goodfellow, Yoshua Bengio and Aaron Courville. [Deep Learning Book](#).

Grading: There will also be a final group project in teams of 3. The grade will be based 50% on HWs and 50% on the final project.

HW: The class will have a mix-of more theoretical problems and practical programming assignments (Python is recommended but any programming language is acceptable). There will be HW every two weeks.

Final Project: The final project must be chosen in consultation with the instructor by the beginning of November. The final project will be a group project (teams of 2-3 members) and must have a significant practical programming/data analysis component.