Course

Professor: Keith W. Ross, keithwross@nyu.edu
Office Hours: 11:00-12:00 on Wednesdays, Room 1415

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Room: 712, 7th floor, Computer Science Lab

Time: Monday, 9:45-11:00 AM
Wednesday, 9:45-11:00 AM
Friday, 9:45-11:00 AM

Prerequisites:

Introduction to Computer Programming (Python)
Calculus
Probability and Statistics (Co-requisite)

Course Description:

Machine learning is an exciting and fast-moving field at the intersection of computer science, mathematics, probability and statistics, and optimization with many recent consumer applications (e.g., Microsoft Kinect, Google Translate, iPhone Siri, digital camera face detection, Netflix recommendations, Google self-driving car). In this class, students will learn about the theoretical foundations of machine learning and how to apply these to solve real-world data-driven problems. We will apply machine learning to numerical, textual, and image data. In addition to two quizzes, the course will have six or seven homework assignments and a final project. The final project, as well as many of the homework assignments, will involve mathematics and programming.

There is no textbook for the course. The course will draw from a number of sources, including

- David Sontag's Machine Learning and Computational Statistics (NYU)
- Andrew Ng's Coursera Machine Learning Course (Stanford)

The mathematical level will be higher than Andrew Ng's course.

Topics:

We will be covering the following topics, roughly in the following order:

- Overview of Machine Learning

- Perceptron Algorithm
- Regression
- Gradient descent and Stochastic Gradient Descent
- Support Vector Machines
- Kernels for Support Vector Machines
- Recommendation Systems
- Decision Trees and Random Forests
- Maximum Likelihood Estimation and Logistic Regression
- Neural Networks: Forward Propagation
- Neural Networks: Back Propagation Algorithm and Derivation
- Convolutional Networks
- Recurrent Neural Networks
- Bayesian analysis and Naive Bayes
- Unsupervised Machine Learning: - Clustering: K-means, Latent Dirichlet Allocation (LDA)
- Reinforcement Learning: MDPs
- Reinforcement Learning: Policy Gradient Algorithm and Q-learning
- Dimensionality Reduction and Principle Component Analysis

Concepts:

Some of the concepts we'll cover in the course include:

- Supervised versus unsupervised learning
- Discriminative versus generative approaches
- Bias versus variance tradeoff
- Overfitting
- Constrained optimization and convexity
- Linear vs. non-linear discriminators
- Maximum likelihood estimation
- Optimal sequential decision making
- Learning thru exploration
- Principle component of a data set

Programming Language:

All programming will be done in Python.

Grading:

- Quizzes: 25%
- Homework assignments (x7): 5 * 7 = 35%
- Final project: 35%
- Participation: 5%

Final Project:

For the final project, you are to apply one or more of the machine learning techniques introduced in this course to some data set of your choosing. You are to work in teams to two. You may apply Machine Learning to just about any domain except for Finance. See the Final Project page for more details.

FINAL PROJECTS FOR 2016 ARE HERE