MAT 180 Special Topics Fall 2022

Title: The Mathematics of Machine Learning
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Topic and Objectives: Machine learning is a rapidly expanding area of study combining tools from linear algebra, statistics, and optimization. It aims to develop algorithms to make predictions based on input data. The goal of this course is to provide a mathematically rigorous introduction to the theory behind machine learning algorithms while gaining intuition and experience through completing concrete assignments and a group project.

Prerequisites: MAT 22A and familiarity with a programming language (ideally Python).

Textbooks: There are no required textbooks but we will be following readings from:

1. Strang, Gilbert. Linear Algebra and Learning from Data.

2. James, Witten, Hastie, Tibshirani. An Introduction to Statistical Learning with Applications in R.

3. Goodfellow, Bengio, Courville. The Deep Learning Book.
   https://www.deeplearningbook.org/

Plan: We will mostly follow The Deep Learning Book, using the other two for reference and exercises. At the very least, we will cover the following topics. If there is extra time, we may proceed with topics according to class interest.

1. Background in Linear Algebra, Statistics, and Optimization

2. Linear and Logistic Regression

3. Multilayer Perceptron (Deep Feedforward Neural Networks)

4. Regularization

5. Convolutional Neural Networks

6. Recurrent and Recursive Neural Networks (Sequence Modeling)

7. Applications

Grade: The final grading criteria for this course is still to be determined, but your grade will depend on both homework and a group project.

Homework: You will have weekly homework assignments. These will be a combination of theoretical problems and coding problems using python in jupyter notebooks.

Project: The project takes the place of what would have been the last three homework assignments for the course. You can work in groups of two or three. *You must submit a proposal for a project before Wednesday November 9 and the project is due before the last day of class December 2.* More information will be provided in a separate document.

Message from Student Disabilites Center: Any student with a documented disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) who needs to arrange reasonable accommodations must contact the Student Disability Center (SDC). Faculty are authorized to provide only the accommodations requested by the SDC. If you have any questions, please contact the SDC at 530-752-3184 or `sdc@ucdavis.edu`.