Gies College of Business
FIN 553: Machine Learning in Finance
Section V3

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Class Hours: T/Th 12:30-1:50pm
Office Hours: Tuesdays 4-5 pm, by Appointment
Office: 4032 Business Instructional Facility

Credits: 4 hours

Course Description

Machine Learning includes the design and the study of algorithms that can learn from experience, improve their performance, and make predictions. In this course, students will learn the foundations of Machine Learning and explore state of the art algorithms and tools. Topics include supervised learning (neural networks, support vector machines), unsupervised learning (clustering, dimensionality reduction), and reinforcement learning (dynamic programming, Q-learning, SARSA, policy gradient methods). Applications include option pricing, portfolio selection, and credit card fraud detection. Students will gain practical experience implementing these models in Python with frequently used packages such as JAX.

Course Objectives

Successful students will:

1. Become familiar with the mathematical foundations of Machine Learning.
2. Be able to implement state of the art algorithms with modern tools.
3. Be capable of applying Machine Learning to real world problems.

Prerequisites

Basic computer science principles and skills. Multivariate calculus, linear algebra, familiarity with probability and statistics.

References

- Goodfellow, Bengio and Courville. *Deep Learning*
  - https://www.deeplearningbook.org/
- Sutton and Barto. *Reinforcement Learning: An Introduction*
  - http://incompleteideas.net/book/the-book-2nd.html

Course requirements

Grades will be determined as follows:

- Midterm Exam 1 **20%** - September 27
- Midterm Exam 2 **20%** - November 8th
- 4 Group projects **40%**
- 1 Individual project **20%**
- Homework assignments **0%**

The maximum group size is five persons.

Course Policies

Request for Special Accomodations

We are commited to providing a learning environment where our students succeed. If you require special accommodations, please contact me and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak Street, Champaign, call 217.333.4603, or email disability@illinois.edu. We will try to meet all accommodations once the process has started. Please note accommodations are not retroactive to the beginning of the semester, but begin the day you contact your professor with a current letter of accomodation from DRES.

Academic Integrity

The Code of Policies and Regulations Applying to All Students will be aapplied in all instances of academic misconduct committed by students. This applies to all exams, presentations, assignments and materials distributed or used in this course. You can review these policies at the following web site: https://studentcode.illinois.edu/

Schedule

The schedule is tentative and subject to change.

Week 01

- Introduction
- Review of Linear Algebra
- Introduction to Python Programming
- Linear Regression with a single variable

Week 02

- Multivariate Linear Regression
- Logistic Regression

Week 03

- Overfitting and Regularization

Week 04

- Neural Networks
- Backpropagation

Week 05

- Introduction to TensorFlow
- Optimization algorithms

Week 06

- Hyperparameter tuning
- Model Selection

Week 07

- Support Vector Machines

Week 08

- Unsupervised Learning

Week 09

- Introduction to Reinforcement Learning
- Markov reward processes / Markov decision processes

Week 10

- Dynamic Programming

Week 11

- Monte-Carlo Learning
- Temporal difference Learning

Week 12

- Q-learning
- SARSA

Week 13

- Reinforcement Learning with function approximation

Week 14

- Policy Gradient Methods

Week 15

- Review

Due to the COVID-19 pandemic, this class will be recorded by the instructor and may be made available to the class, individual students, and/or Gies faculty and administrators. Your instructor will communicate whether and how you can access the recordings. Student capture or posting of course recordings of the class are not allowed without instructor permission.