

FRE 7773
Machine Learning for Finance
Fall 2021
Fridays 6-8:30p

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Office Location/Hours: By appointment

Section Leader: tbd
Email: tbd
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Course Description:

This course is an introduction to Machine Learning concepts and its practical application to the financial industry. Leveraging the professors' collective experience in academia and industry, this course is designed to prepare students for data science oriented situations they may encounter in their first few years at a financial institution.

At the end of this course, the student should be knowledgeable enough about the field to be conversant and pursue individual topics of interest further. In addition, the topics will include implementation of the techniques in Python on financial data or other sample data when financial data not available.

Requirements: Some fluency in Python or relevant programming language makes this course more accessible to the student. The class will use Jupyter Notebooks and all students are expected to run code and do homeworks in that environment.

Textbooks are not required for purchase: Throughout the course, each lecture will draw on material from the textbooks below. These are excellent resources at different levels of difficulty. In addition, as Machine Learning and Data Science are a rapidly evolving subject, online resources are often excellent sources and will be distributed ahead of each lecture.

- Pattern Recognition and Machine Learning, Bishop
- The Elements of Statistical Learning by Hastie et al.
- Deep Learning by Goodfellow et al.
- Neural Networks and Deep Learning, Michael Nielsen
- [JVP] Python Data Science Handbook by VanderPlas
- [WM] Python for Data Analysis by Wes McKinney
- [AG] Hands-On Machine Learning with Scikit Learn and TensorFlow by A. Geron.
- [SB] Reinforcement Learning: An Introduction by Sutton and Barto

Grading (subject to change): 7 HWs (70%), final project (30%).

Course Outline: Material will not necessarily be taught in this order and some topics are subject to be added/removed depending on student interest.

Part I: *Machine Learning in Finance*

- Introduction to machine learning in finance and Python
- Unsupervised Learning: Agglomerative clustering for portfolio construction
- Entity Resolution
- Basic Natural Language Processing: Sentiment analysis and classification
- Ensembles with Decision Trees: Random Forests and trading strategy
- Feature Selection: Constrained regression and VaR hedging
- Classification with Imbalanced data sets

Part II: *Neural Networks and Deep Learning*

- Working with Tensor Flow and Keras
- Artificial Neural Networks
- Training Deep Neural Networks (Vanishing/exploding gradients, Regularization Techniques, fine tuning hyperparameters)
- Convolution Neural Networks
- Recurrent Networks (GRU, LSTM, Deep RNN, Natural Language Processing)
- Reinforcement Learning
- AutoEncoders and GANs