CFRM 521 Machine Learning for Finance, Spring 2021

Instructor: Kevin Lu (kwlu@uw.edu).

Teaching assistant: Yang Zhou (yzhou7@uw.edu).

Lecture time: Mondays & Wednesdays 1:00pm to 2:50pm. Zoom link:
https://washington.zoom.us/j/98911965338.

Office hours: Thursdays & Sundays 3:00pm to 4:00pm (starting April 1). Zoom link:
https://washington.zoom.us/j/92987945151.

Course description: This course is an introduction to machine learning for an audience with a background in quantitative finance. The course takes a hands-on approach and favors gaining working knowledge of several major machine learning techniques rather than focusing on a handful of methods. Students learn to use well-tested and widely used Python implementations of machine learning algorithms instead of coding them from scratch. The following topics will be covered: an overview of classification and regression techniques, support vector machines, decision trees, random forests, and dimensionality reduction. We also discuss selected topics in unsupervised learning and artificial neural networks.

Prerequisites: Financial Data Science (CFRM 502) is the prerequisite for the course. The course relies heavily on Python, and it is assumed that you are familiar with Python's scientific libraries NumPy, SciPy, Pandas, and Matplotlib. I will discuss many Python snippets during the lectures. However, if you don't have any experience with Python and decide to take the course, it is your responsibility to familiarize yourself with Python. There are many good online resources, such as http://learnpython.org/ or https://docs.python.org/3/tutorial/.

Textbooks: The instructor will post lecture notes. The main textbook is:

- *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*, Aurélien Géron, 2nd edition, O'Reilly, 2019. The electronic version can be obtained from the UW network: https://learning.oreilly.com/library/view/hands-on-machine-learning/9781492032632/

Other good references (for self-study) include:

- *Bayesian Reasoning and Machine Learning*, David Barber, Cambridge University Press, 2012. The electronic version can be downloaded at: http://www.cs.ucl.ac.uk/staff/d.barber/brml/
- *Statistics and Data Analysis for Financial Engineering with R Examples*, David Ruppert and David Matteson, 2nd edition, Springer, 2015. The electronic version can be downloaded from the UW network at: https://link.springer.com/book/10.1007/978-1-4939-2614-5
- *The Elements of Statistical Learning*, Trevor Hastie, Robert Tibshirani and Jerome Friedman, 2nd edition, Springer, 2009. The electronic version can be downloaded at: https://web.stanford.edu/~hastie/ElemStatLearn/

- A Primer on Scientific Programming with Python, by Hans Langtangen, 5th edition, Springer, 2016. The electronic version can be downloaded from the UW network at: https://link.springer.com/book/10.1007/978-3-662-49887-3

Course website: The course Canvas website is https://canvas.uw.edu/courses/1447619 (UW credentials needed). If you are registered in the course, you should see a link to the course website. Announcements, homework, lecture recordings, lecture notes, and other course materials will be posted on the course website on a regular basis.

Discussion forum: There is a discussion forum on the course website for you to ask questions, and view and respond to questions that other students have asked. The instructor will regularly monitor the forum and answer questions. Please be courteous and considerate when posting comments, and keep the forum friendly and collaborative such that all students feel welcome to use it.

Course schedule: The following table shows the course schedule. The instructor reserves the right to alter the schedule as the course progresses. Please refer to the current version of the syllabus to stay up-to-date with the course schedule.

Week	Date	Topic	Chapter	Homework
1	Mar 29	Preliminaries	1, 2	
	Mar 31	Classification	3	
2	Apr 5	Training models, pt 1	4	HW1 posted
	Apr 7	Training models, pt 2	4	
3	Apr 12	Support vector machines, pt 1	5	
	Apr 14	Support vector machines, pt 2	5	
4	Apr 19	Decision trees	6	HW1 due, HW2 posted
	Apr 21	Random forests	7	
5	Apr 26	PCA	8	
	Apr 28	Kernel PCA, LLE, k-NN	8	
6	May 3	K-means clustering	9	HW2 due, HW3 posted
	May 5	Artificial neural networks (NN)	10	
7	May 10	Deep NN, pt 1	11	
	May 12	Deep NN, pt 2	11	
8	May 17	Deep NN, pt 3	11	HW3 due, HW4 posted
	May 19	Convolutional NN	14	
9	May 24	Recurrent NN	15	
	May 26	Project presentations		
10	May 31	Holiday (no class)		HW4 due
	Jun 2	Project presentations		

Grading policy: The assessment structure for the course is as follows:

Assessment Item	Due date	% of course grade
Homework	See course schedule	60%
Project	Jun 7, 11:59pm	40%

- **Homework**: There will be 4 weekly homework sets, each of which you will have two weeks to finish. See the course schedule for due dates. The due time is 11:59pm on those dates. Each

homework has equal contribution to the total grade, regardless of the total points assigned to it. Homework sets are posted on Canvas, and they are to be submitted online through Canvas as well. While you are allowed to discuss the homework with other students, you must complete the homework individually, and in particular, sharing code between students is not allowed. Late submission is allowed, but, a 10% penalty per day will be applied regardless of the reason for a late submission. The lowest homework grade will not be dropped.

- **Project**: The project is conducted by groups of 1 to 4 members. Each group must submit a report and give a short presentation at the end of the quarter, during a prescheduled Zoom session. Please refer to the project announcement on the course website for details.

- **UW grade**: A linear grade scale will be used for converting percentage course grades into UW grades. That is, the posted course grade will be the percentage course grade divided by 25, and then rounded up to the nearest tenth.

- **Honor code**: All students are expected to comply with the usual standards for academic conduct as outlined in the CFRM Student Honor Code.

- **Access and accommodations**: Your experience in this class is important to me. If you have already established accommodations with Disability Resources for Students (DRS), please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course.

  If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact DRS at 206-543-8924 or uwdrs@uw.edu or http://disability.uw.edu. DRS offers resources and coordinates reasonable accommodations for students with disabilities and/or temporary health conditions. Reasonable accommodations are established through an interactive process between you, me, and DRS. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law.

  Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/. Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form available at https://registrar.washington.edu/students/religious-accommodations-request/.