



Northeastern University

College of Engineering

Multidisciplinary Graduate Engineering Course Syllabus

Course Information

Course Title: Data Science Engineering Methods and Tools (Machine Learning & Python in Finance)

Course Number: INFO6105

Credit Hour: 4.0

Instructor Information

Full Name: Yizhen Zhao

Email Address: yizhenzhao@northeastern.edu

Technical/Course Materials Requirements

- No textbook is required.
- Students are expected to bring their own laptops with Python installed to attend the class.

Course Description/Prerequisite

Machine learning has had fruitful applications in finance well before the advent of mobile banking apps, proficient chat bots, or search engines. This class is designed to teach introductory machine learning techniques as applied in finance. The course combines methodology with theoretical foundations and computational aspects. The focus of the course is on implementation rather than theory. It treats both the art of financial intuition and the science of realizing algorithms in Python. Students will learn implementing algorithms and solving real-world problems faced by quants, market makers and portfolio managers. The course will guide students through five case studies and applications like running a competition. Topics include: (i) supervised learning (parametric/non-parametric methods, LASSO, support vector machines, kernels, random forests, neural networks). (ii) unsupervised learning (clustering, dimensionality reduction, isolation forest). (iii) best practices in machine learning (pattern recognition, LSTM, NLP, etc.).

There is no prerequisite for the course, but students are expected to be comfortable with statistics, matrix analysis and at least one type of programming languages. Much of the course addresses machine learning algorithms, and students who are deficient in statistics may find it difficult to keep up. I will do my best to teach the course at a level appropriate for someone who has not had any instruction in finance. Some background material may be taught using differential equations and stochastic calculus; this material will only be used for the demonstration of concepts and you will not

be tested on it. I will make myself available before and after classes if you would like to meet to further discuss class material or related topics.

Student Learning/Course Outcomes (SLOs)

Specialized Knowledge	Broad and Integrative Knowledge	Applied and Collaborative Learning	Civic and Global Learning	Experiential Learning
<i>Machine Learning in Finance will study major machine learning algorithms in the context of finance using Python. The course will also introduce leading quantitative models used by finance professionals.</i>	<i>Master the mainstream machine learning algorithms.</i>	<i>Obtain a hands-on experience in working with quantitative finance modeling using Python via teamwork.</i>	<i>The focus of the course will be on implementation rather than on theories. The methods can be extensively applied in public health, education and other civic learning areas.</i>	<i>Understand the implications of algorithm building blocks spanning across matrix analysis, statistics, optimization, econometrics and stochastic calculus.</i>

Attendance Policy

Students are expected to complete course readings, participate in class discussions or other learning activities during the unit, and complete written assignments for each unit during the time of that unit. It is understood that there might be one week when active participation in ongoing class conversations and learning activities might be delayed.

Beyond one week time, if there is an absence or lateness in participation (1) faculty must be notified in advance; (2) grades will be adjusted accordingly.

Late Work Policy

Students must submit assignments by the deadline in the time zone noted in the syllabus.

Students must communicate with the faculty prior to the deadline if they anticipate work will be submitted late.

Work submitted late without prior communication with faculty will not be graded.

Grading/Evaluation Standards

Grade Scale

95-100%	A	87-89.9%	B+	77-79.9%	C+	69.9% or below	F
		84-86.9%	B	74-76.9%	C		
90-94.9%	A-	80-83.9%	B-	70-73.9%	C-		

Grade Breakdown:

Category # 1 - 10%

Category # 2 - 80%

Category # 3 – 10%

Course Schedule

Week/Lectures	Topic	Reading/Project
Lecture 1	Mathematics Foundation and Financial Data Structure	Each group selects an asset class that they would like to work with for the rest of the semester and presents summary statistics.
Lecture 2	Machine Learning in Market Making	Each group selects an algorithm learned in the lecture to realize it using pseudo real-time approach with the selected asset class. Present preliminary results and take challenges from the instructor, the teaching assistant and other group members.
Lecture 3	Machine Learning in Passive Investment	
Lecture 4	Machine Learning in Active Investment	
Lecture 5	Machine Learning in Risk Management	
Lecture 6	Advanced Topics in Machine Learning	Fine-tune our portfolios and strategies using advanced machine learning algorithms.
Lecture 7	Final Exam	
Lecture 8	Project Presentation	

Academic Integrity

A commitment to the principles of academic integrity is essential to the mission of Northeastern University. The promotion of independent and original scholarship ensures that students derive the most from their educational experience and their pursuit of knowledge. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University.

As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, examinations of whatever kind, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Students are responsible for learning the conventions of documentation and acknowledgment of sources in their fields. Northeastern University expects students to complete all examinations, tests, papers, creative projects, and assignments of any kind according to the highest ethical standards, as set forth either explicitly or implicitly in this Code or by the direction of instructors.

Go to <http://www.northeastern.edu/osccr/academic-integrity-policy/> to access the full academic integrity policy.

Student Accommodations

Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act (ADAAA) to participate fully in the activities of the university. To receive accommodations through the DRC, students must provide appropriate documentation that demonstrates a current substantially limiting disability.

For more information, visit <http://www.northeastern.edu/drc/getting-started-with-the-drc/>.

Library Services

The Northeastern University Library is at the hub of campus intellectual life. Resources include over 900,000 print volumes, 206,500 e-books, and 70,225 electronic journals.

For more information and for Education specific resources, visit <http://subjectguides.lib.neu.edu/edresearch>.

Diversity and Inclusion

Northeastern University is committed to equal opportunity, affirmative action, diversity and social justice while building a climate of inclusion on and beyond campus. In the classroom, member of the University community work to cultivate an inclusive environment that denounces discrimination through innovation, collaboration and an awareness of global perspectives on social justice.

Please visit <http://www.northeastern.edu/oidi/> for complete information on Diversity and Inclusion

TITLE IX

Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal financial assistance.

Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, faculty and staff.

In case of an emergency, please call 911.

Please visit www.northeastern.edu/titleix for a complete list of reporting options and resources both on- and off-campus.