THE UNIVERSITY OF CHICAGO
DATA SCIENCE INSTITUTE

DATA 23100 Machine Learning Fundamentals: Theory and Practice
Autumn 2026
University of Chicago

Class Time: Tuesdays and Thursdays 11:00 AM- 12:20 PM
Classroom: Pick Hall 022
Units/ Credits: 100 units

Instructor: Dr. Kriti Sehgal
Email: ksehgal@uchicago.edu
Office: Ryerson Phys Lab 260

Office Hours:
Time: 2 PM- 4 PM on Tuesdays,
and by appointment (Zoom or in-person)
Location: Ryerson Phys Lab 260 (may be changed later)

Course Description:
This course introduces topics in current applications of machine learning for Data Science major students. Topics include machine learning models, supervised and unsupervised learning, loss functions, risk, empirical risk and overfitting, regression and classification, clustering, gradient boosting, decision trees and random forests, and a brief introduction to Neural Networks and deep learning.

Prerequisites:
DATA 12000 (could be taken concurrently) or CMSC 14200; DATA 21100 (or equivalent); DATA 21300 (could be taken concurrently) and DATA 21200 (or equivalent) recommended.

Textbooks:
1. An Introduction to Statistical Learning.
2. Probabilistic Machine Learning: An Introduction.
3. The Hundred-Page Machine Learning Book.
4. Machine Learning for Absolute Beginners
5. Deep Learning Book

Topics Covered:

1. **Foundations of Machine Learning:** supervised and unsupervised learning, parameter estimation, loss functions, gradient descent, and model evaluation.
2. **Probabilistic and Linear Models:** Naive Bayes, logistic regression, regularization, and cross-validation.
3. **Tree-Based and Ensemble Methods:** decision trees, bagging, and boosting.
4. **Unsupervised Learning and Dimensionality Reduction:** k-means clustering and principal component analysis (PCA).
5. **Neural Networks and Deep Learning:** introduction to neural networks, PyTorch, autoencoders, convolutional neural networks (CNNs), word embeddings, and an overview of modern sequence models and transformers.

Later topics in deep learning may be adjusted depending on course pace.

Learning Goals:

1. Reinforce computational skills necessary to explore and model data: Students should acquire computational skills pertinent to implementing commonly used machine learning models and be familiar with a repertoire of abstractions for working with data in machine learning.
2. Reinforce statistical skills necessary to explore, model, and interpret data: Students should be familiar with statistical theory pertinent to model selection and hypothesis testing and with common data abstractions used in statistical modeling. Students should be able to apply the theory to address real-world problems and think critically about data collection and statistical models.
3. Reinforce skills necessary for effective data communication: Students should be able to report results obtained from machine learning models by crafting a narrative based on their analysis and using effective visualizations.
4. Reinforce the ability to consider data in context and apply critical thinking: Students should question assumptions, evaluate evidence, and recognize biases in both datasets and interpretations. They should approach data and interpretations with healthy skepticism and draw conclusions based on reliable, well-contextualized information rather than superficial patterns.

Course Communication:

1. We will use **Ed and Canvas** for all course-related communication. Students should post questions on Ed rather than emailing the instructional staff, as this allows everyone to benefit from shared answers and reduces duplicate questions. Students are also encouraged to respond to one another's questions on Ed.
2. **Before posting to Ed, please check whether your question has already been asked.** Duplicate questions may not receive a response. Please review the **Ed Discussion Guidelines**, which are available in a pinned post on Ed.
3. For individual matters, including personal concerns, accommodations, or grading questions, you are welcome to email me or attend office hours.
4. Course announcements will be made in lecture and posted on Ed and/or Canvas and will be considered known within one business day. Students are expected to check both platforms regularly.

Assessments and Grading Policy:

1. **Homework** (6 total; lowest 1 dropped, 5 counted): **30%**
   Homework assignments will be posted on Canvas. The assignments are intended to help with absorbing the material and preparing for class. You are encouraged to discuss your homework with others and to work in study groups. However, all submitted work must be completed independently.

2. **Midterm Exam**: **30%**
   The midterm will take place in class during Week 6. Students are expected to take the exam as scheduled. In cases of unavoidable conflicts, official documentation must be provided to request an alternative arrangement.

3. **Project** (includes proposal, project presentation, jupyter notebook, report): **40%**
   This is a group project with 2 students per group. Students will select a dataset of personal interest, analyze the data, and present their work during the finals week. Each group will submit a cleaned Jupyter notebook and a written report summarizing their findings.

This grading structure is designed to support consistent practice, collaboration, and multiple ways of demonstrating understanding.

Late Policy:
All assessments must be submitted on time. **Late submissions are not accepted, and extensions are not granted.** To accommodate unforeseen circumstances, the grading policy includes built-in flexibility through the **dropping of the lowest homework score**. This policy is intended to account for personal challenges, technical issues, or other unexpected situations, and students are encouraged to use it thoughtfully.

Grading Scale:

Letter Grade	Range
A	93-100%
A-	90-92.99%
B+	87-89.99%
B	83-86.99%
B-	80-82.99%
C+	77-79.99%
C	73-76.99%
C-	70-72.99%
D+	66-69.99%
D	60-65.99%
F	0-59.99%

Attendance Policy:
You are strongly encouraged to attend classes and participate in class discussions. Missing an occasional class is understandable. If you do miss a class, you are expected to review the posted slides and consult notes from a classmate. For a more thorough understanding, you may also refer to the relevant textbooks listed in the syllabus. Additional explanations and examples are widely available online, and you are always welcome to seek clarification through TA office hours, Ed discussions, or by meeting with the instructor.
In cases where a final grade falls very close to a grade boundary, attendance and participation may be considered as part of the overall evaluation.

Regrade Requests:
Students may submit regrade requests through Gradescope within one week of the grades being released. Requests submitted after this period will not be considered.

Pass/ Fail ("P/F") Grade:
A Pass/Fail grade may be given upon written request to the instructor before the reading period starts i.e. by Friday of Week 9. The grade of P will be awarded only for work of C- or better quality. Please consult here for more details.

Withdrawn ("W") Grade:
A "W" (Withdrawn) grade indicates that a student has chosen, after Week 3 of the quarter, not to complete the course. Students who wish to withdraw must submit a written request to their adviser by 5 p.m. on the Monday of Week 9 of instruction, or by the day before the final project or exam is due, whichever comes first. Please consult here for more details.

Incomplete ("I") Grade:
The mark "I" (Incomplete) is intended for a student who has not completed all course requirements by the end of the quarter but has participated actively in the course, completed the majority of the work at a passing level, and made satisfactory arrangements with the instructor to complete the remaining work. Students must submit a written request for an Incomplete to the course instructor via UChicago email and discuss their plans with their Academic Adviser before the end of the quarter. Please consult here for more details.

Use of Generative AI policy:
Students are allowed to use AI tools, such as Claude or ChatGPT, responsibly to support their learning. AI can be helpful for clarifying concepts, understanding technical material, exploring software engineering ideas, or proofreading work you have already written. However, it is strictly forbidden to submit any work that has been generated by AI or to copy AI outputs as your own. All submitted assignments, projects, and exams must reflect your own understanding.

For homework, AI may be used as a "study buddy" to explain concepts or provide guidance, but not to produce answers. For projects, AI use should be minimal and limited to very small technical issues. The use of AI on exams is not permitted. Think of AI as a tool to enhance your thinking process rather than replace it. Any violation of this policy will result in a zero for the affected assignment.

Using AI is optional, but if you choose to use these tools, you must properly cite their contributions. This is an opportunity to learn how to engage with AI tools critically and ethically. Failure to cite AI-generated content will be treated as a violation of the University of Chicago's Academic Honesty and Plagiarism policy.

Academic Integrity:
Acting with academic integrity means, in brief, not submitting the statements, work, or ideas of others as one's own. Students are expected to comply with University regulations regarding honest work. If you are in doubt about what constitutes academic dishonesty, speak with me before the assignment is due. Failure to maintain academic integrity on an assignment will result in a penalty befitting the violation, up to and including failing the course and further University sanctions. For more information, consult the student manual:
https://studentmanual.uchicago.edu/academic-policies/academic-honesty-plagiarism/

Accessibility:
The University of Chicago is committed to ensuring equitable access to our academic programs and services. Students with disabilities who have been approved for the use of academic accommodations by Student Disability Services (SDS) and need a reasonable accommodation(s) to participate fully in this course should follow the procedures established by SDS for using accommodations. Timely notifications are required to ensure that your accommodations can be implemented. Please meet with me to discuss your access needs in this class after you have completed the SDS procedures for requesting accommodations. For more information, please visit: https://disabilities.uchicago.edu/

Mental Health:
Student Wellness' Mental Health professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety and depression. See:
https://wellness.uchicago.edu/mental-health/

Diversity and Inclusion:
I value diversity and inclusion. I am committed to a climate of mutual respect and full participation. My goal is to create learning environments that are usable, equitable, inclusive, and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion, achievement, or the accurate assessment of your learning, please notify me as soon as possible. Students with disabilities are also welcome to contact Student Disability Services to discuss a range of options to removing barriers in the course, including official accommodations.

Bias Reporting:
The University has a process through which students, faculty, staff and community members who have experienced or witnessed incidents of bias, prejudice or discrimination against a student can

report their experiences to the University's Bias Education and Support (BEST) team.
See: https://diversityandinclusion.uchicago.edu/resources/reporting-incidents/

Accommodations based upon sexual assault:
The University is committed to offering reason- able academic accommodations to students who are victims of relationship or sexual violence, regardless of whether they seek criminal or disciplinary action. If a student comes to us to discuss or disclose an instance of sexual assault, sex discrimination, sexual harassment, dating violence, domestic violence or stalking, or if we otherwise observe or become aware of such an allegation, we will keep the information as private as we can, but as faculty members of University of Chicago, we are required to immediately report it to a Department Chair or Dean or directly to the University's Title IX Coordinator. If you would like to speak with the Title IX Coordinator directly, Bridget Collier can be reached at bcollier@uchicago.edu. Additionally, you can report incidents or complaints by contacting UCPD at (773)702-8181 or your local law enforcement agency. For more information:
https://studentmanual.uchicago.edu/university-policies/the-university-of-chicago-policy-on-title-ix-sexual-harassment/