

Statistics 415 – Introduction to Machine Learning

March 30, 2025

Suggested reference textbooks:

- Elements of Statistical Learning, Hastie et al
- Deep Learning, Goodfellow et al
- Interpretable Machine Learning, Christoph Molnar
- More specific readings will be posted to the course's Github page, including papers.

Grading:

- 45% Homework assignments
- 30% Oral presentation
- 25% Coding final exam

Github page: The course's Github page has more extensive information regarding the topics that are covered, as well as the homework instructions and the homework due dates. Please see here https://github.com/bstadie/Stat_415_Spring_2025/

Assignments: There will be 5 assignments. For the assignments, you will be given data and asked to carry out an analysis. You must provide plots and visualizations to explain your analysis, and also include text descriptions of why you carried out this analysis. Each assignment will be given out roughly two weeks before the due date, and you will have the subsequent two weeks to finish. These assignments can involve extensive coding, and you will need the full time to complete them. It is essential you begin early. Given the long time horizon to complete the assignments, late work is generally not accepted.

Oral Presentation: Students are required to give one oral presentation throughout the quarter. The oral presentation must be about analysis they carried out on one homework assignment of their choice. The presentation should be six to nine minutes long, and detail what analysis the student finds interesting on the assignment and why. Students will be questioned on this analysis. There

will be a sign-up sheet that students are expected to use to register for a time to give a presentation. Presentations will be carried out via Zoom.

Final Exam: There will be a final coding exam, which is about three hours long. It will be released on Canvas, but since it involves coding, students are expected to take it at home using their workstations. Essentially, the exam will test if you can spin up and evaluate a small machine learning model in 3 hours.

Office Hours:

- **Bradly** - TBD
- **Ryan (TA)** - TBD

Course Description:

- **Overview:** Modern advances in machine learning have lead to rapid progress in a variety of fields including economics, medicine, causal inference, self-driving, and robotics. The most remarkable thing about these advances is that the underlying machine learning models are largely problem agnostic and transferable across domains. In this course, we will cover modern machine learning from an applied perspective. We will start with the question: “How can we predict future events given past observations?” From there, we will delve into a variety of modern methods for handling noisy high-dimensional input data, including random forests and neural networks. An emphasis will be placed on how these methods are actually implemented in practice, and real world problems we face in industry and in research when wrangling real data.
- **Prerequisites:** Linear Algebra (MATH 240), Multi-variable Calculus (MATH 230), Statistical Theory and Methods (STAT 320-1, STAT 320-2)

Turning in homework:

- For your homework assignments, you will turn in a .pdf file containing your data analysis and discussion.
- These files must present the results of your analysis in graphical and visual form. They must also have text descriptions of the analysis you carried out and why.
- You must also submit your raw code in a .zip file. This code will be put through code similarity detection, and if there is a match to a classmates code, you will be questioned. Academic integrity violations are grounds for receiving a 0 on an assignment.
- You may collaborate on the homework, but you must clearly state who you collaborated with.
- Homework will be submitted and graded via **gradescope.com**
- An account on Gradescope will be created for you automatically, if you don't already have one.
- This makes it much easier for me to grade assignments consistently and fairly. And also means you get feedback as soon as it is available.
- Please reach out to me with any concerns or questions, or if you require alternative accommodations.

Homework and Grading Policies:

- The course instructor and TA will only grade the work that is actually submitted, before the deadline, for each assigned homework problem. You are responsible for checking to ensure your submission is correct. Any submissions of incorrect, incomplete, or corrupted files is your responsibility and must be rectified before the deadline, so please double check after submitting your work. No extensions will be given for this reason. And nothing submitted after the deadline will be graded, regardless of the reason.

This course follows the Northwestern University Syllabus Standards: <https://www.registrar.northwestern.edu/registration-graduation/northwestern-university-syllabus-standards.html>.

Students are responsible for familiarizing themselves with this information. Students in this course are required to comply with the policies found in the booklet, "Academic Integrity at Northwestern University: A Basic Guide". All papers submitted for credit in this course must be submitted electronically unless otherwise instructed by the professor. Your written work may be tested for plagiarized content. For details regarding academic integrity at Northwestern or to download the guide, visit: <https://www.northwestern.edu/provost/policies-procedures/academic-integrity/index.html>

Cheating on exams:

Cheating on exams takes many forms, including but not limited to: using your phone during an exam, using your phone to take a picture of an exam, using LLMs to help with exams, having someone else take the exam for you. If an incident of cheating is confirmed, students will receive a score of 0.0 on the exam.

Northwestern University is committed to providing the most accessible learning environment as possible for students with disabilities. Should you anticipate or experience disability-related barriers in the academic setting, please contact AccessibleNU to move forward with the university's established accommodation process (e: accessiblenu@northwestern.edu; p: 847-467-5530). If you already have established accommodations with AccessibleNU, please let me know as soon as possible, preferably within the first two weeks of the term, so we can work together to implement your disability accommodations. Disability information, including academic accommodations, is confidential under the Family Educational Rights and Privacy Act.

Students, faculty and staff must comply with University expectations regarding appropriate classroom behavior, including those outlined below and in the COVID-19 Expectations for Students. With respect to classroom procedures, this includes: Policies regarding masking, social distancing and other public health measures evolve as the situation changes. Students are responsible for understanding and complying with current University, state and city requirements. In some classes, masking and/or social distancing may be required as a result of an Americans with Disabilities Act (ADA) accommodation for the instructor or a student in the class even when not generally required on campus. In such cases, the instructor will notify the class. If a student fails to comply with the COVID-19 Expectations for Students or other University expectations related to COVID-19, the instructor may ask the student to leave the class. The instructor is asked to report the incident to the Office of Community Standards for additional follow-up.

Class sessions for this course will occur in person. Individual students will not be granted permission to attend remotely except as the result of an Americans with Disabilities Act (ADA) accommodation as determined by AccessibleNU.

Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of University policy and state law. Students requesting the use of assistive technology as an accommodation should contact AccessibleNU. Unauthorized use of classroom recordings – including distributing or posting them – is also prohibited. Under the University's Copyright Policy, faculty own the copyright to instructional materials – including those resources created specifically for the purposes of instruction, such as syllabi, lectures and lecture notes, and presentations. Students cannot copy, reproduce, display, or distribute these materials. Students who engage in unauthorized recording, unauthorized use of a recording, or unauthorized distribution of instructional materials will be referred to the appropriate University office for follow-up.

Northwestern University is committed to supporting the wellness of our students. Student Affairs has multiple resources to support student wellness and mental health. If you are feeling distressed or overwhelmed, please reach out for help. Students can access confidential resources through the Counseling and Psychological Services (CAPS), Religious and Spiritual Life (RSL) and the Center for Awareness, Response and Education (CARE). Additional information on all of the resources mentioned above can be found here:

<https://www.northwestern.edu/counseling/>
<https://www.northwestern.edu/religious-life/>
<https://www.northwestern.edu/care/>