DATASCI 315: Statistics and Artificial Intelligence

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Overview

Description. Statistical concepts are increasingly integrated into artificial intelligence applications, which often draw on a large amount of data received, transmitted, and generated by computers or networks of computers. This course introduces students to statistics and machine learning techniques such as deep neural networks, with applications to text and image data.

At the end of this course, students will be familiar with the deep learning paradigm, and will be able to analyze data using different classes of deep learning models. The course gives an introduction to the basics of deep neural networks, and their applications to various AI tasks.

Prerequisites. The prerequisites are: (STATS 250 or STATS 206 or STATS 280 or STATS 412 or IOE 265) and (STATS 306 or EECS 183 or ENG 101) and (MATH 116 or MATH 121 or MATH 156 or MATH 176 or MATH 186)

Textbooks. Class readings will mainly come from the following books.

- *Deep Learning with Python (2nd edition)* by Chollet.
- *Dive Into Deep Learning* by Zhang, Lipton, Li, and Smola. Link.
- *Deep Learning Step by Step with Python: A Very Gentle Introduction to Deep Neural Networks for Practical Data Science* by N. D. Lewis.
- *Neural Networks and Deep Learning* by Michael Nielsen. Link.
- *Deep Learning* by Goodfellow, Bengio, and Courville. Link.
- *Introduction to Deep Learning* by Charniak.

Piazza and participation bonus. All communications with the teaching team should be conducted on piazza; please do not email. If you wish to ask a question privately to the teaching team, please post a private note on Piazza; see instructions here; you can expect an answer within 24 hours during weekdays (except holidays). The GSIs and the instructor will be monitoring piazza, endorsing correct student answers, and answering questions that remain after a discussion.

As a bonus, **up to 3 percentage points will be added to your final course grade based on piazza participation.** You will get $x \cdot 3\%$ bonus points if the number of your total Piazza contributions is $(x \cdot 100)\%$ of the maximum number of contributions among all students. The number of Piazza contributions will be determined by Piazza class statistics.

Requirements and Grades

1. **In-class quizzes (15%).** There will be roughly biweekly in-class quizzes. Each quiz is a closed-book, individual pen-and-paper quiz. The quiz questions will be randomly selected from recent homeworks or lab work. No notes, books, internet, software, or AI tools may be used.

   The bottom one quiz scores will be dropped; this policy is expected to accommodate circumstances where students could not complete course work due to the add/drop period, registration matters, and/or personal reasons.

   Regrade Policy. You may submit a regrade request if you believe that the course staff made an error in grading. Any regrade requests should be submitted through Gradescope *within **seven** days* of receiving your grade. Please try to be as specific as possible with your regrade request.

2. **Lab work submitted in lab (5%).** Each lab includes some lab work. Students may discuss ideas and debugging during the lab, but each student submits their own lab work before leaving the lab. The lab work is graded based on effort.

   The bottom three lab scores will be dropped; this policy is expected to accommodate circumstances where students could not complete lab work due to the add/drop period, registration matters, and/or personal reasons.

3. **Midterm Exam (35%).** There will be a midterm exam.

4. **Final Exam (45%).** There will be a final exam.

5. **Final letter grade.** The final grade will be set so that the distribution of final grades approximately matches that of previous offerings of the course.

Schedule

The schedule is subject to change.

1. Introduction
2. Vectorization and linear algebra
3. Regression and classification as neural networks
4. TensorFlow and Keras
5. Generalization and regularization
6. Convolutional neural networks
7. Deep learning for sequence data
8. Deep generative modeling
9. Guest lectures

Support Resources

Course recordings. Course lectures may be audio/video recorded and made available to other students in this course. As part of your participation in this course, you may be recorded. If you do not wish to be recorded, please contact the instructor during the first week of class (or as soon as you enroll in the course, whichever is latest) to discuss alternative arrangements.

Academic integrity. The University of Michigan community functions best when its members treat one another with honesty, fairness, respect, and trust. The college promotes the assumption of personal responsibility and integrity and prohibits all forms of academic dishonesty and misconduct. All cases of academic misconduct will be referred to the LSA Office of the Assistant Dean for Undergraduate Education. Being found responsible for academic misconduct will usually result in a grade sanction, in addition to any sanction from the college. See the LSA academic integrity policy for examples and potential sanctions.

You are welcome to discuss lab ideas with your classmates, but the lab work that you submit must be your own. List the people with whom you worked. This disclosure applies whether a student has helped someone else or has received help. It is not necessary to disclose a discussion with the course instructor or course GSIs.

Restricted U-M GPT rule. U-M GPT may be used only to answer conceptual questions, give hints, explain error messages, or suggest the next diagnostic step. It may not generate full or paste-ready code, complete a TODO, exercise, or notebook section, or supply a final answer, explanation, or transfer response. Students must disclose permitted use. Each lab's labeled, content-specific U-M GPT investigation is a course-authorized exception. Students may use its supplied prompt or prompts, then submit their own predictions, assigned verification evidence, and conclusions, not a pasted model response. Other generative-AI and code-completion tools are prohibited.

Accommodations for students with disabilities. The University of Michigan recognizes disability as an integral part of diversity and is committed to creating an inclusive and equitable educational environment for students with disabilities. Students who are experiencing a disability-related barrier should contact Services for Students with Disabilities https://ssd.umich.edu/; 734-763-3000 or ssdoffice@umich.edu). For students who are connected with SSD, accommodation requests can be made in Accommodate. If you have any questions or concerns please contact your SSD Coordinator or visit SSD's Current Student webpage. SSD considers aspects of the course design, course learning objects and the individual academic and course barriers experienced by the student. Further conversation with SSD, instructors, and the student may be warranted to ensure an accessible course experience.

Mental Health and Well-Being. University Students may experience stressors that can impact both their academic experience and their personal well-being. These may include academic pressures and challenges associated with relationships, mental health, alcohol or other drugs, identities, finances, etc. If you are experiencing concerns, seeking help is a courageous thing to do for yourself and those who care about you. If the source of your stressors is academic, please contact me so that we can find solutions together. For personal concerns, U-M offers a variety of resources, many of which are listed on the Resources for Student Well-being webpage. You can

also search for additional well-being resources here.

Acknowledgments.

The course materials are adapted from the related courses offered by Alexander Amini, Alfredo Canziani, Justin Johnson, Andrew Ng, Bhiksha Raj, Grant Sanderson, Rita Singh, Ava Soleimany, and Ambuj Tewari.