

# EECS 445: Introduction to Machine Learning

## Fall 2023

### Course Staff

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## Course Description

EECS 445 provides an introduction to machine learning, including algorithms and applications. Increasingly, extracting value from data is an important contributor to the global economy across a range of industries. The field of machine learning provides the theoretical underpinnings for data analysis, as well as more broadly for artificial intelligence; it has had a major impact on many real-world applications. We will introduce theory and implementation of state-of-the-art machine learning algorithms for large-scale real-world applications. Topics include supervised learning (regression, classification, kernel methods, neural networks, and regularization) and unsupervised learning (clustering, density estimation, and dimensionality reduction).

In this course, we will emphasize understanding of foundational algorithms and “tricks of the trade” through implementation and theoretical analysis. On the implementation side, the emphasis will be on practical applications of machine learning to computer vision, data mining, speech recognition, text processing, bioinformatics, and robot perception and control. Real-world datasets will be used whenever feasible to encourage understanding of practical issues. On the theoretical side, the course will give an undergraduate-level introduction to the foundations of machine learning topics including regression, classification, kernel methods, regularization, neural networks, graphical models, and unsupervised learning.

### Prerequisites:

- (Enforced) EECS 281 and (MATH 214 or 217 or 296 or 417 or 419 or ROB 101)
- (Advisory) STATS 250 or equivalent

# Course Components

While we will monitor university and department policies in this evolving situation, the modality for this course is in-person. For pedagogical reasons, it is **highly recommended** that you attend lectures and discussions in person as far as possible. See subsections for further details.

## Lectures

### **Mondays and Wednesdays:**

- **9am-10:30am (ET) In person (BEYST 1670).**
- **10:30am-noon (ET) In person (CHRY 220).**

Additionally, lectures will be recorded and posted on Canvas within 24 hours. All questions (along with the names and potentially audio and video of those asking questions) will be recorded and may be shared with course participants from all sections.

Lectures will include slides and note taking. If you miss a lecture or discussion, you are expected to watch all recordings and keep up to date with the material. Quizzes, homework, and exams will be based in part on lecture material.

As they have throughout the past more than two years, policies around academic and public health are subject to change as this pandemic evolves. This course will follow all policies issued by the University, which are documented here: <https://healthresponse.umich.edu/policies-guidance/>. These policies may change over the course of the term, so please review the policies for the most up to date information.

You may find support and additional resources here: <https://healthresponse.umich.edu/faqs/>

## Discussion

Discussions will be held in person. One section will be recorded. In addition to attending lectures, you are strongly encouraged to attend these discussions weekly. Students may attend any section regardless of official registration (subject to space constraints). During the discussion, the course staff will go over additional examples related to concepts introduced in lecture. You will also have the opportunity to ask additional questions and get clarification regarding concepts covered in the lecture.

## Canvas

Information about the course including notes, assignments, schedule and course logistics will be posted on Canvas (<https://canvas.umich.edu/>). You are expected to check the site frequently.

## Piazza

You can access the course Piazza site from Canvas or at <https://piazza.com/umich/fall2023/eecs445fa2023/home>.

**In this course, we use Piazza strictly for technical course content.** You are encouraged to use Piazza to answer each other's questions and ask for clarifications on concepts, lecture topics, discussion notes, and assignment problems. You can even ask questions privately to the staff. Please note that the staff might ask you to make your question public on Piazza if we feel it will be beneficial to other students. Course staff will monitor Piazza at regular intervals, but will not provide immediate responses. For more immediate feedback, students are encouraged to attend office

hours. Please do not share answers to assignments on Piazza. For any other types of questions, including about course logistics and policies please see the section below. If you contact course staff with policy/logistics questions on Piazza we will mark your question private and ask you to redirect your question via email (see below).

### **Contacting the Course Staff**

We also want to hear from you should you have any questions that are not related to the technical aspects of the course (e.g. logistics, grading, quizzes, extensions, scheduling). For all such questions, you can reach the course staff at: [eeecs445-staff@umich.edu](mailto:eeecs445-staff@umich.edu). This will allow us to better triage your questions and answer your queries in a timely manner. Depending on your question, you might be asked to come to office hours or set up an individual meeting. If you do not get a reply within 48 hours, please resend your email. We expect professional courtesy in your emails and communications with us. **Please do not contact the staff individually.** You may reach the professors at their email addresses listed on page 1 for matters that you wish to communicate directly with them. **In communicating directly with your professors, please use the following as the subject line for prioritized responses: [EECS 445 F23]**

## **Course Materials, Textbook and Programming Language**

Course slides and additional reference materials (including discussion notes and solutions to assignments) will be posted online via Canvas or on the course schedule.

### **Recommended Textbooks (optional)**

The course does not have a required textbook; the following books are good references (all available online and/or through the UM library):

1. A Course in Machine Learning by Hal Daumé III (available [online](#))
2. Pattern Recognition and Machine Learning by Christopher Bishop (available [online](#))
3. Probabilistic Machine Learning: An Introduction by Kevin Murphy (available [online](#))
4. Hands-on Machine Learning with Scikit-Learn and TensorFlow by Aurélien Géron (available through the library)
5. Mining of Massive Datasets by Leskovec, Rajaraman and Ullman (available [online](#))
6. Fairness And Machine Learning by Barocas, Hardt and Narayanan (available [online](#))

We will use Python extensively for the coding assignments and projects in this course. We will host tutorials to acquaint you with relevant portions of Python. We will also provide notes. An important learning objective achieved in successfully completing an upper level course in Machine Learning is gaining confidence in your ability to problem solve in this space. The course projects will also give you an opportunity to learn to read specs and documentation. Additionally, there are various Python references available online. We may link to these in the tutorial notes.

## Course Grading:

Homework (evenly weighted)	25%
Projects (evenly weighted)	20%
Midterm	20%
Final	25%
Quizzes*	9.5%
Course Evaluation	0.5%

Below are the *guaranteed* grade thresholds: if your final raw score exceeds the threshold for grade X, your final letter grade will be X **or better**. The actual thresholds will be determined after the final exam (but will be no higher than what appears below). Performing very poorly on the final exam (more than 3 standard deviations below mean) is grounds for failing the course.

A:	94% and above
A-:	90%
B+:	87%
B:	83%
B-:	80%
C+:	77%
C:	70%

## Grading Philosophy:

In technical writing, you must write clearly and concisely to get your point across. It is not sufficient that a correct argument appears *somewhere* in your writing, if it is also accompanied by incorrect or faulty reasoning. The same applies for this course: your responses must be *clear*, *concise*, and *correct* to receive full credit.

## Grade Components:

### Homework Assignments (25%) + Projects (20%)

Homework assignments play an important role in the learning process. There will be 6 roughly biweekly assignments: homeworks HW1 - HW4, and two projects. Due dates will be specified in Ann Arbor local time on each assignment.

*Late submission policy for homework and projects:*

It is imperative that you complete your course assignments in a timely manner. Since the concepts in this course are interdependent, engaging with the course material through the assignments will solidify your understanding of them. However, since there may be exceptional circumstances that occur, we will make 3 *late days* available to you to use over the course of the semester for *all homework* and 3 *separate late days for projects*. Note: The late days used are determined by the timestamp of your latest submission. Late days used for projects (which typically have two associated submissions) will be determined by the timestamp on the component you submitted the latest.

These will be strictly enforced and are meant to cover unexpected life events. **Use these wisely!** We will count late days in increments of days starting immediately. For example, suppose that you submit 15 minutes late. This counts as a late day and will decrease your remaining late days for that assignment type by 1. **No late submissions will be accepted after the 3 days have been used up.** Should you encounter more extreme life events, the matter will be considered serious and we will refer you to student support services. In that case, please be ready to provide **official documentation that explicitly specifies both a timeline and states that you are unable to engage in your coursework**, if applicable.

### **Midterm (20%) and Final Exam (25%)**

One midterm and a *cumulative* final exam will be given. A large fraction of the questions on these exams will be similar to lecture, discussion and homework problems or variations/extensions. Thus a good way to study is to make sure you know how to solve these problems.

Everyone is expected to take all exams at the scheduled times (**Monday, October 23 7pm-9pm for the midterm and Wednesday, December 13 7pm-9pm for the final**). The times of the exams can also be found on the course schedule. Any exam conflicts are to be communicated to the professors by email *as soon as possible* and **no later than September 22 by 10pm ET**. It is departmental, college, and university policy that discretionary travel and vacation plans **never** take precedence over exam schedules. In case of a conflict due to a university sponsored event (such as participation in a sponsored sports event or a competition) a university official in charge of the event should contact the professors by email as soon as possible and **no later than September 22 by 10pm ET** to determine how the missing grade will be made up.

### **Quizzes (9.5%)**

Throughout the course, you will be assigned quizzes due approximately weekly. The main purpose of these quizzes is to ensure that you keep up with the course material. In this course, this is especially important because of the interconnectedness of the various topics. Full credit for the quiz component of the grade will be earned by students who get **at least 66% overall** on the quizzes; thus allowing for some missed quizzes as well as incorrect responses. Please make a sincere attempt to solve all the quizzes to allow for some flexibility for missed quizzes due to illness or other commitments. If you do not meet this cutoff for any reason (including any of the above), this portion of the grade will be assigned to your final exam score. **In that case, your final exam will be worth 34.5% of your final grade.**

### **Course Evaluation (0.5%)**

The course evaluation is important to us and proof of completing the final course evaluation counts 0.5% towards your final grade. Students will receive full credit only if they submit the *final course evaluations* **and** upload a screenshot indicating completion (a corresponding assignment will be made available for this). While submitting the midterm evaluations is not required it is **strongly encouraged**.

### **Regrading Policy:**

If a student feels that credit has been inappropriately allocated, then they may ask for a regrade. The student should submit these via gradescope. Regrade requests must be made within **the deadline specified** after grades for that assignment are released. Any exceptional policy for regrades will be specified separately. We are unable to accept regrade requests once the deadline has passed.

**\*\*\*No oral and/or e-mail regrade requests will be accepted\*\*\***

Students are cautioned that they have the possibility of both gaining and losing points (i.e., if the regrade determines that the answer was more incorrect than marked). Students are reminded that accuracy alone is not sufficient; the answer should also be clear.

## **Honor Code and Collaboration:**

Unless otherwise specified in an assignment, all submitted work must be your own, original work. If you are referencing others' work, put it in quotes. If you are directly quoting, or building on others' writing, provide a citation. See the [Rackham Graduate policy on Academic and Professional Integrity](#) for the definition of plagiarism, and associated consequences. Violations of the Honor Code will be taken seriously; Please see details: <https://elc.engin.umich.edu/honor-council/>. Students are **encouraged to collaborate** on conceptual understanding (except when taking exams). Please use Piazza to this effect and for other technical discussions. However, students are expected to **write their solutions on their own** and **should not look at any other student's write-up.**

### **Note on use of Generative AI (GenAI) tools**

GenAI is changing rapidly, and new tools are becoming increasingly prevalent. Any and all use of tools that emulate human capabilities (including but not restricted to ChatGPT, Stable Diffusion, DALL-E, etc.) to perform assignments or other works in the course should be disclosed (this includes all graded deliverables as well as other course works and activities).

In addition, an explanatory appendix is required for each and every unique usage to describe in clear steps how such a tool was used, including (1) what was your original prompt to the chatbot; (2) what are some examples of incorrect outputs that the chatbot provided to you; and, (3) how did you rework and revise to reach your final submission.

In effect, using a Generative AI tool is akin to discussing the class material with another person; if it will aid your understanding and you are able to critically assess the input, you may use it (with attribution). Please note that unattributed use of these tools constitutes a clear honor code violation.

## **Sexual Misconduct Policy**

Policy Title IX prohibits discrimination on the basis of sex, which includes sexual misconduct — including harassment, domestic and dating violence, sexual assault, and stalking. We understand that sexual violence can undermine students' academic success and we encourage anyone dealing with sexual misconduct to talk to someone about their experience, so they can get the support they need. Confidential support and academic advocacy can be found with the Sexual Assault Prevention and Awareness Center (SAPAC) on their 24-hour crisis line, (734) 936-3333 and at <https://sapac.umich.edu>.

Alleged violations can be non-confidentially reported to the Office for Institutional Equity (OIE) at [institutional.equity@umich.edu](mailto:institutional.equity@umich.edu)

## **Inclusive Learning Environment**

It is our intention that students from all backgrounds and perspectives will be well served by this course, and that the diversity that students bring to this class will be viewed as an asset. We welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, socioeconomic background, family education level, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. Your suggestions are encouraged and appreciated. Further, we will gladly honor your request to address you by an alternate name or gender pronoun.

## **Student Mental Health and Wellbeing**

We want you to be successful in and outside of this class. Students may experience stressors that can impact both their academic experience and their personal well-being. These may include academic pressure 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 the professors so that we can find solutions together. For personal concerns, U-M offers many resources, some of which are listed at [Resources for Student Well-being](#) on the Well-being for U-M Students website. You can also search for additional resources on that website.

## **Handling Data with Integrity & Unfair Advantage**

You may not falsify or misrepresent methods, data, results, or conclusions, regardless of their source. You may not possess, look at, use, or in any way derive advantage from the solutions of homework, exams or papers prepared in prior years (or from other courses), whether these solutions were former students' work products or solutions that have been made available by University of Michigan faculty or on the Internet.

## **Accommodations for Students with Disabilities**

If you think you need an accommodation for a disability, please contact the Services for Students with Disabilities (SSD) office with your request. More information can be found here: <https://ssd.umich.edu/students>. Some aspects of this course may be modified to facilitate your participation and progress. The course staff will treat any information you provide in this regard as private and confidential.

**Have Fun and Be Well!**