

COMPSCI 589: MACHINE LEARNING SYLLABUS

Summer 2026

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Course format: Flipped-classroom

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(i) **Instructional videos**

- Prerecorded videos available on Canvas

(ii) **Weekly synchronous meetings**

- Fridays, 1:00 to 2:15 pm (Optional)
 - In person: LGRT 431
 - Online: Live via Zoom
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1 About the course

This course will introduce core machine learning (ML) models and algorithms for classification, regression, clustering, and sequential decision-making. On the theory side, the course will cover the mathematical foundations underlying the most commonly used ML algorithms, focusing on understanding models and their relationships. On the applied side, the course will focus on effectively using ML methods to solve real-world problems, with an emphasis on model selection, regularization, experiment design, and presentation and interpretation of results. Assignments will consist of mathematical problems and implementation tasks.

Broad topics covered in this course will include classification algorithms in general, decision trees, random forests, probabilistic models, Naive Bayes methods, ensemble algorithms, gradient-based techniques, linear regression, logistic regression, neural networks, convolutional neural networks and deep learning, reinforcement learning, and philosophy of AI.

The course will use a **flipped-classroom format** and will include:

(i) **Short prerecorded videos providing the main instructional content.**

- Students are expected to watch these videos before the corresponding weekly synchronous session.

(ii) **Optional weekly synchronous sessions** for discussion, questions, further exploration of the material, and office hours with the primary instructor.

- For students on campus, these sessions will be held in person (LGRT 431). For remote students, the sessions will also be broadcast live via Zoom.

The course includes several hands-on projects, done both in groups and individually, as well as online support for questions.

In this course, each voice in the classroom has something of value to contribute. Please take care to respect the different experiences, beliefs, and values expressed by students and staff. My colleagues and I support UMass' commitment to diversity, and welcome individuals regardless of age, background, citizenship, disability, sex, gender, gender identity, sexual orientation, education, ethnicity, family status, geographical origin, language, military experience, political views, race, religion, socioeconomic status, and work experience.

2 Learning Objectives

1. Distinguish between the main classes of machine learning algorithms and identify the most appropriate one for solving a particular problem.
2. Explain how key algorithms in the field work and under what conditions.
3. Learn to implement and apply key machine-learning algorithms to solve real-world problems.
4. Learn to solve issues that may arise when deploying particular algorithms to tackle real-world problems.
5. Identify the changes that may be required for an algorithm to be applicable in novel settings and conditions.

3 Course Platform

This course's syllabus will be hosted [here](#) and on [Canvas](#). Since the course uses a flipped-classroom format, short prerecorded videos providing the main instructional content will be posted periodically on Canvas. Students are expected to watch these videos before the corresponding weekly synchronous meeting (see [Section 4](#)). Homework assignments, PDF slides, and other course materials will also be available there.

4 Synchronous Meetings (*Optional*)

As part of the course's flipped-classroom format, prerecorded instructional videos will be complemented by (optional) weekly synchronous meetings for discussion, questions, further exploration of the material, and office hours with the primary instructor. Students are expected to watch the corresponding instructional videos before each meeting. Synchronous meetings will take place on Fridays from 1:00 to 2:15 pm. Students on campus may attend in person in LGRT 431, while remote students may participate live via Zoom. The relevant Zoom links will be available on Canvas.

5 Discussion Board

We will use [CampusWire](#) (*access code: 0453*) as our interactive discussion board. This will be a dynamic platform for ongoing conversations throughout the course. On Campuswire, you can reach out to instructors with questions, participate in discussions, and engage with your peers. This will be the main platform through which students can collaborate, share insights, and debate different strategies for solving real-world problems with machine learning. It is important that you actively participate in the discussions, as such continuous interaction is key to enhancing your learning experience, allowing you to explore various approaches and deepen your understanding of course concepts as you work on assignments together.

6 Textbooks

The course has no mandatory textbook. However, you may find the following (freely available) books helpful:

- [Machine Learning: a Probabilistic Perspective](#), by Kevin Patrick Murphy.
- [The Elements of Statistical Learning](#), by Hastie, Tibshirani and Friedman.
- [An Introduction to Statistical Learning](#), by James, Witten, Hastie and Tibshirani.

7 Required background

While this course has an applied focus, it still requires an appropriate mathematical background in probability and statistics, multivariate calculus, linear algebra, and programming. The official prerequisites for undergraduate students can be found [here](#). Graduate students can check the descriptions for these courses to verify that they have a sufficient mathematical background for COMPSCI 589. The following references can provide a useful review:

- [Probability Theory](#).
- [Linear Algebra and Matrix Calculus](#).
- [Matrix Cookbook](#).
- Optimization: Any calculus textbook.

8 Course Schedule

- **Week 1.**
 - Introduction to machine learning and supervised learning.
 - k-nearest neighbors.
 - Decision Trees.
 - Introduction to probabilistic classifiers.
- **Week 2.**
 - Naive Bayes.
 - Document classification. Bernoulli and Multinomial Naive Bayes.
 - Evaluation metrics.
- **Week 3.**
 - Ensemble methods. Random forests.
 - ROC analysis. Bias-variance trade-off. Bagging and boosting.
 - Gradient descent methods. Linear regression.
 - Logistic regression.
- **Week 4.**
 - Introduction to neural networks.
 - Backpropagation algorithm.
 - Neural networks with multiple outputs.
 - Regularization techniques.
- **Week 5.**
 - Vectorized training.
 - Mini-batch training. Heuristics to accelerate gradient descent.
 - Convolutional neural networks.
 - Reinforcement learning and Markov decision processes.
- **Week 6.**
 - Q-Learning and deep reinforcement learning.
 - Philosophy of AI.
 - Future and challenges.

9 Attendance policy

As part of the course's flipped-classroom format, prerecorded instructional videos will be complemented by weekly synchronous meetings for discussion, questions, further exploration of the material, and office hours. All students are expected to watch the corresponding instructional videos before each meeting. Synchronous meetings will take place on Fridays from 1:00 to 2:15 pm. Students on campus may attend in person, while remote students may participate live via Zoom. **Attending synchronous meetings is optional.**

10 Office Hours

→ **TBD. Office hours details will be posted closer to the start of the course.**

11 Grading

Your grade will have three components:

1. **Homework Assignments (70%)**: There will be frequent homework assignments, both written and programming. All assignments will have equal weight.
2. **Project (30%)**: Given the wide range of real-world applications of machine learning, it is important to learn how to implement, fine-tune, and deploy these algorithms in practice. More details will be shared when the project is assigned, after we have covered the most relevant course material.

Letter grades will be assigned using the following scale:

- [90%, 100%] : **A- or A**
- [75%, 90%) : **B-, B, or B+**
- [65%, 75%) : **C-, C, or C+**
- [55%, 65%) : **D or D+**

Course grades will be curved only in students' favor (that is, the thresholds above may be lowered, but a cumulative grade of 90% will still receive at least an A-). Some extra-credit opportunities may be offered. Your grade may be reduced at the instructor's discretion in cases of inappropriate behavior, including academic dishonesty.

12 Re-grading policy

Errors in grading assignments and exams can occur despite the best efforts of the course staff. If you believe you have found a grading error, complete an online regrade request form via Gradescope. Regrade requests must be submitted no later than one week after the assignment is returned. Note that regrading may result in your original grade being *increased* or *decreased* as appropriate.

13 Late Policy

- Deadlines in this course are **strict**. A submission one minute after the deadline will receive zero credit. You are strongly encouraged to submit hours before any deadline.
- That said, to allow some flexibility to complete assignments (*homeworks only*) given other constraints, you have a total of *six* free late days that you can choose to use when submitting a homework. You will be charged one late day for handing in an assignment within 24 hours after it is due, two late days for handing in an assignment within 48 hours after it is due, etc. Your assignment is considered late if either the written or code portions are submitted late. The late homework clock stops when both the written and code portions are submitted. After you have used up your late days, late homework will not count for credit except in special circumstances (e.g., illness documented by a doctor's note).
- Extensions may be granted, for example, if you have a medical emergency and bring proof of such to the instructor before final grades for the given assignments are computed. In any other case (unless those covered by the [University's Academic Regulations](#)), missing a deadline will result in a zero for the assignment.

14 Cheating

- Cheating will not be tolerated. Assignments may include instructions about what forms of collaboration are allowed, if/when relevant.
- Copying answers or code from external sources (books, web pages, etc.), from other students, or from solutions to assignments from previous years is *always* considered cheating. Note that, according to the new UMass Academic Honesty Policy, the use of AI text generators (such as **ChatGPT**) is **prohibited**. To emphasize: no detectable copying is acceptable, even, e.g., copying a single sentence from an outside source. Sharing your code or solutions with other students is also considered cheating.
- The College of Information and Computer Sciences explicitly forbids any redistribution of CICS course materials, including posting them publicly online and sharing student solutions to homework assignments, projects, or exams, without the express written consent of the instructor. Violations of this policy will be deemed instances of "facilitating dishonesty" (since a student making use of such materials would be guilty of plagiarism) and therefore may result in charges under the [Academic Honesty Policy](#).
- Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent.
- **All instances of cheating will be reported to the university's Academic Honesty Board.** Any detected cheating will result either *(i)* in a grade of -100% on the assignment for all students involved (negative credit); or *(ii)* a grade of "F" in the course. The instructor will decide at their discretion which of these possible resolutions is more appropriate.

15 Pass/Fail & SAT/Fail

- If you are an undergraduate student, Pass/Fail is requested through the university.
- If you are a graduate student, at some time near the end of the semester (likely around the last day of class), you will be given the option to take the class SAT/Fail rather than for a letter grade. If you plan to take the course SAT/Fail, keep an eye out for an email (or a message on Canvas) from me around the end of the semester with instructions for requesting SAT/Fail. If you elect SAT/Fail, you will earn a SAT grade if your letter grade would have been a C or higher, and you will receive an F if your letter grade would have been lower.
- The above conditions *do not* hold for students with an academic honesty violation. In these cases, the requests described in this section are disallowed and/or un-approved.

16 Disability Services

The University of Massachusetts is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with [Disability Services](#), you may be eligible for academic accommodations to help you succeed in this course. If you would like to register with Disability Services, please visit their [website](#) or their office (161 Whitmore Administration Building; phone (413) 545-0892). Finally, if you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we can make appropriate arrangements.

17 Title IX

In accordance with Title IX of the Education Amendments of 1972, which prohibits gender-based discrimination in educational settings that receive federal funds, the University of Massachusetts Amherst is committed to providing a safe learning environment for all students, free from all forms of discrimination, including sexual assault, sexual harassment, domestic violence, dating violence, stalking, and retaliation.

- This includes interactions in person or online through digital platforms and social media. Title IX also protects against discrimination on the basis of pregnancy, childbirth, false pregnancy, miscarriage, abortion, or related conditions, including recovery.
- There are resources on campus to support you. For a summary of confidential and non-confidential options, please see the [UMass Title IX resources page](#).
- You can seek support regardless of whether you decide to make a formal report. If you need immediate support, you are not alone. Free and confidential support is available 24 hours a day, 7 days a week, 365 days a year at the SASA Hotline: (413) 545-0800.