CMU MLD Logo

10-301/601: Introduction to Machine Learning

Summer 2024

Narwhal Net

Key Information and Links

Instructor:	Henry Chai
Education Associate:	Nichelle Phillips
Announcements/Q&A:	We will be using Piazza for making announcements and answering questions.
Lectures:	Monday, Tuesdays and Wednesdays from 9:30 AM to 10:50 AM (EDT) in SH 105. Lectures will be recorded for students to review after the fact; the recordings will be hosted by Panopto.
In-class Polls:	Some portion of your grade will be determined based on participation in polls during lecture. The latest poll can always be found at pollev.com/301601polls; in order to respond, you must be logged in with your CMU email.
Recitations:	Thursdays from 9:30 AM to 10:50 AM (EDT) in SH 105. Attendance at recitations is optional and therefore, outside of extraordinary circumstances, these will not be recorded. Recitation handouts can be found under the Recitations tab.
Assignments:	Homework handouts will be posted to the course website under the Assignments tab. All code and written responses to empirical questions should be submitted via Gradescope.
Office Hours:	The time and location of office hours can be found on the course calendar.

Syllabus

1. Course Description

Machine Learning is concerned with computer programs that automatically improve their performance through experience, e.g., programs that learn to recognize human faces, recommend music and movies, and drive autonomous robots. This course covers the theory and practical algorithms for machine learning from a variety of perspectives. Specific topics include Bayesian networks, decision tree learning, support vector machines, statistical learning methods, unsupervised learning and reinforcement learning as well as theoretical concepts such as inductive bias, the PAC learning framework, Bayesian learning methods, margin-based learning, and Occam's Razor. Programming assignments include hands-on experiments with various learning algorithms. This course is designed to give a graduate-

level student a thorough grounding in the methodologies, technologies, mathematics and algorithms currently needed by people who do research in machine learning.

10-301 and 10-601 are identical. Undergraduates must register for 10-301 and graduate students must register for 10-601.

Learning Outcomes: By the end of the course, students should be able to:

- Implement and analyze existing learning algorithms, including well-studied methods for classification, regression, structured prediction, clustering, and representation learning.
- Integrate multiple facets of practical machine learning in a single system: data preprocessing, learning, regularization and model selection.
- Describe the formal properties of models and algorithms for learning and explain the practical implications of those results.
- Compare and contrast different paradigms for learning (supervised, unsupervised, etc...).
- Design experiments to evaluate and compare different machine learning techniques on real-world problems.
- Employ probability, statistics, calculus, linear algebra, and optimization in order to develop new predictive models or learning methods.
- Given a description of a ML technique, analyze it to identify (1) the expressive power of the formalism; (2) the inductive bias implicit in the algorithm; (3) the size and complexity of the search space; (4) the computational properties of the algorithm: (5) any guarantees (or lack thereof) regarding termination, convergence, correctness, accuracy or generalization power.

2. Prerequisites

Students entering the class are expected to have a pre-existing working knowledge of probability, linear algebra, statistics and algorithms; some recitation sessions will be held to review basic concepts.

1. You need to have, before starting this course, significant experience **programming** in a general programming language. Specifically, you need to have written from scratch programs consisting of several hundred lines of code. For undergraduate students, this will be satisfied for example by having passed 15-122 (Principles of Imperative Computation) with a grade of 'C' or higher, or comparable courses or experience elsewhere.

   Note: For each programming assignment, you will be required to use **Python**. You will be expected to know, or be able to quickly pick up, that programming language.

2. You need to have, before starting this course, basic familiarity with **probability and statistics**, as can be achieved at CMU by having passed 36-217 (Probability Theory and Random Processes) or 36-225 (Introduction to Probability and Statistics I), or 15-259, or 21-325, or comparable courses elsewhere, with a grade of 'C' or higher.
3. You need to have, before starting this course, college-level maturity in **discrete mathematics**, as can be achieved at CMU by having passed 21-127 (Concepts of Mathematics) or 15-151 (Mathematical Foundations of Computer Science), or comparable courses elsewhere, with a grade of 'C' or higher.

You must strictly adhere to these pre-requisites! Even if CMU's registration system does not prevent you from registering for this course, it is still your responsibility to make sure you have all of these prerequisites before you register.

3. Recommended Textbooks

This course does not exactly follow any one textbook. However, most lectures will have some optional reading to help you better understand the material or see a different presentation/perspective. We recommend you read these after the corresponding lecture. These readings will typically be drawn from the following texts, many of which are freely available online:

- A Course in Machine Learning, Hal Daumé III.
- Machine Learning, Tom Mitchell.
- Machine Learning: a Probabilistic Perspective, Kevin P. Murphy.
- Pattern Recognition and Machine Learning, Christopher M. Bishop.

The textbook below is a great resource for those hoping to brush up on the prerequisite mathematics background for this course:

- Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong.

4. Course Components

The graded components of this course consist of participation in lectures, midterm and final exams, programming assignments and in-class quizzes. The breakdown is as follows:

- 9 Homework Assignments = 45%
- Midterm = 25%
- Final = 25%
- Participation = 5%

We will convert numerical course grades to letter grades based on grade boundaries that are determined at the end of the semester. The following is a list of **upper bounds** on the grade cutoffs we will use; in all likelihood, these will be

adjusted down at the end of the semester:

- A+: ≥ 97%
- A: ≥ 93%
- A-: ≥ 90%
- B+: ≥ 87%
- B: ≥ 83%
- B-: ≥ 80%
- C+: ≥ 77%
- C: ≥ 73%
- C-: ≥ 70%
- D+: ≥ 67%
- D: ≥ 63%
- R: < 63%

Homework

There are two types of homework assignments in this course: programming and written. The programming assignments will ask you to implement machine learning algorithms from scratch; they emphasize understanding of real-world applications, building end-to-end systems, and experimental design. The written assignments will focus on core concepts, "on-paper" implementations of classic learning algorithms, derivations, and understanding of theory.

LaTeX is a valuable tool for communicating machine learning concepts to others. As such, we are requiring that your homework submissions be completed in LaTex. To facilitate this, we will always release a LaTeX starter template that you can simply fill in with your answers.

Your code for programming assignments will be autograded by our grading scripts. However, a major issue with autograders is that some submissions can receive close to zero points despite being mostly correct due to some small bug. For all of our programming assignments, we will give partial credit (through manual grading of code) to those submissions which receive fewer than 75% of the points on the autograder. The total number of points that such a submission can receive will be 75% of the original point total so those assignments that we do not manually grade will remain unaffected by this policy.

Midterm and Final Exams

You are required to attend all the exams. Unless otherwise noted, all exams will be closed-book. You may bring one sheet of A4 or letter-sized paper as a cheatsheet (both back and front may be used). You are encouraged to handwrite this cheatsheet as a form of preparing for the exam but you may typeset it if you so choose.

Both exams will be scheduled by the registrar sometime during the official university exam periods; note that we will be using the mini-5 final exam date as the date of our midterm exam. The dates of both exams can be found on the lecture schedule; please plan your travel accordingly as we will not be able accommodate individual travel needs.

If you have an unavoidable conflict with an exam (e.g., an exam in another course), notify us as soon as possible by making a private post on Piazza.

Participation

We will be using PollEverywhere for in-class polls. In order to access these polls, you must create an account using your CMU email address. You can always access the latest poll at pollev.com/301601polls.

You will always be allowed to submit multiple times so if there are multiple questions during a lecture, you should submit multiple times. Your participation grade will be based on the percentage of in-class polls answered:

- 5% for 80% or greater poll participation.
- 3% for 65%-80% poll participation.
- 1% for 50%-65% poll participation.

The correctness of your responses will not be taken into account when computing participation grades, all that matters is that you submit something. **All in-class polls will only be live until the start of the next lecture or recitation** (roughly a 24-hour period); you will receive 50% credit for any poll you respond to after the corresponding lecture ends, i.e., if you were to respond to every poll after the end of the corresponding lecture, then your overall participation grade would be 1%.

5. Office Hours

The schedule of office hours will always appear on the course calendar. All office hours will be held in-person. Instructor office hours will (usually) be held immediately after class in either the classroom or a nearby space. We encourage you to stick around and ask any questions you have about lecture material, homework problems, exam preparation, course logistics, etc...

In office hours, when it is your turn, you should pose your question to the TA(s) and they will determine whether or not your question would be best addressed privately or publicly, i.e., to anyone in the room who wants to listen in.

We will make use of the following (informal) rules:

- **10 Minute Rule:** Each student's question will be addressed by the TA for at most 10 minutes. The only exception to this will be if a TA is answering a question publicly that has broad interest to many other students.
- **The Pseudo Code Rule:** This is not a programming course; you are expected to know how to debug code. As such, if your question is of the form "Could you help me to debug my code?", you must bring with you detailed pseudocode that describes your implementation design. If you do not have pseudocode, the TA will not look at your code, but instead ask you to sketch out pseudocode at the chalkboard and discuss there instead. After discussing at a high-level, if your 10 minutes have not expired, the TA may have time to look at your code.

While you're awaiting your turn, we encourage you to listen in to the answers to any publicly answered questions. Please be courteous and allow the student who posed the question to primarily direct the discussion with the TA. We also encourage you to collaborate with others (following our collaboration policies below) while waiting.

6. General Policies

Late homework policy

Late homework submissions are only eligible for 75% of the points the first day (24-hour period) after the deadline and only eligible for 50% the second day after the deadline.

You have a total of 10 grace days for use on any homework assignment. We will automatically keep a tally of these grace days for you; they will be applied greedily. No assignment will be accepted more than 2 days after the deadline. This has two important implications: (1) you may not use more than 2 grace days on any single assignment (2) **you may not combine grace days with the late policy above to submit more than 2 days late.**

All homeworks will be submitted electronically via Gradescope. As such, lateness will be determined by the latest timestamp of any part of your submission. For example, suppose the homework requires two submission uploads – if you submit the first upload on time but the second upload 1 minute late, your entire homework will be penalized for the full 24-hour period.

Extensions

In general, we do not grant extensions on assignments. There are several exceptions:

- **Medical Emergencies:** If you are sick and unable to complete an assignment or attend class, please go to University Health Services. For minor illnesses, we expect grace days or our late penalties to provide sufficient accommodation. For medical emergencies (e.g., prolonged hospitalization), students may request an extension afterwards.
- **Family/Personal Emergencies:** If you have a family emergency (e.g., death in the family) or a personal emergency (e.g., mental health crisis), please contact your academic adviser and/or Counseling and Psychological Services (CaPS).
- **University-Approved Travel:** If you are traveling out-of-town to a university approved event or an academic conference, you may request an extension for any time lost due to traveling. For university approved absences, you must provide confirmation of attendance, usually from a faculty or staff organizer of the event or via travel/conference receipts.

For any of the above situations, you may request an extension by emailing Nichelle at nichellp@andrew.cmu.edu – **do not email the instructor or TAs.** Please be specific about which assessment(s) you are requesting an extension for and the number of hours requested. The email should be sent as soon as you are aware of the conflict and at least 5 days prior to the deadline. In the case of an emergency, no notice is needed.

If this is a medical emergency or mental health crisis, you must also CC your CMU college liaison and/or your academic advisor. Do not submit any medical documentation to the course staff. If necessary, your college liaison and The Division of Student Affairs (DoSA) will request such documentation and they will view the health documentation and conclude whether a retroactive extension is appropriate. If you haven't interacted with your college liaison before, they are experienced student affairs staff who work in partnership with students, housefellows, advisors, faculty, and associate deans in each college to assure support for students regarding their overall Carnegie Mellon experience.

Audit Policy

Formal auditing of this course is permitted. You must follow the official procedures for a course audit as outlined by the HUB/registrar. Please do not email the instructor requesting permission to audit. Instead, you should first register for the appropriate section. Next fill out the Course Audit Approval form, obtain your academic advisor's signature and then approach the instructor in-person immediately after class to obtain their signature.

Auditors are required to:

- Attend or watch all of the lectures.
- Receive a 65% participation grade or higher.
- Submit at least 4 of the 9 homework assignments.
- Auditors are encouraged to sit for the exams, but should only do so if they plan to put forth actual effort in solving them.

Pass/Fail Policy

You are allowed to take this course as Pass/Fail; instructor permission is not required. What letter grade is the cutoff for a Pass will depend on your specific program; we do not specify whether or not you Pass but rather we compute your letter grade the same as everyone else in the class and your program converts that letter grade to a Pass or Fail depending on their cutoff. Be sure to check with your program/department as to whether you can count a Pass/Fail course towards your degree requirements.

Accommodations for Students with Disabilities

If you have a disability and have an accommodations letter from the Disability Resources office, please email Nichelle at nichellp@andrew.cmu.edu to set up a meeting for the purposes of discussing your accommodations and needs as early in the semester as possible. He will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.

7. Technologies

We will use a variety of technologies throughout the summer:

- Piazza: we will use Piazza for all course discussion. Questions about homeworks, course content, logistics, etc... should all be directed to Piazza. If you have a question, chances are several others had the same question. By posting your question publicly, the course staff can answer once and everyone benefits. If you have a private question, you should also use Piazza as it will likely receive a faster response.

- Gradescope: we will use Gradescope to collect PDF submissions of open-ended questions on the homework e.g., mathematical derivations, plots, short answers. The course staff will manually grade your submission, and you'll receive personalized feedback explaining your final marks.

  You will also submit your code for programming questions on the homework to Gradescope. After uploading your code, our grading scripts will autograde your assignment by running your program on a virtual machine. This provides you with immediate feedback on the performance of your submission.

  If you believe an error was made during manual grading, you'll be able to submit a regrade request on Gradescope. For each quiz, regrade requests will be open for only 1 week after the grades have been published. This is to encourage you to check the feedback you've received early.

- Panopto: lecture recordings will be hosted by Panopto; note that recordings may not be immediately available after lecture due to editing/processing time.
- PollEverywhere: in-class polls will be conducted through Polleverywhere. You can access the most recent poll at pollev.com/301601polls but you must be logged into an account associated with your CMU email in order to do so.

8. Collaboration and Academic Integrity

Read this carefully!

Collaboration among Students

The purpose of student collaboration is to facilitate learning, not to circumvent it. Studying the material in groups is strongly encouraged. You are also allowed to seek help from other students in understanding the material needed to solve a particular homework problem, provided any written notes (including code) are taken on an impermanent surface (e.g., whiteboard, chalkboard), and provided learning is facilitated, not circumvented. The actual solution must be written by each student alone.

A good method to follow when collaborating is to meet with your peers, discuss ideas at a high level, but do not copy down any notes from each other or from a white board. Any scratch work done at this time should be your own only. Before writing the assignment solutions, you should make sure that you are doing this without anyone else present, putting all notes away, closing all tabs on your computer, and writing it completely by yourself with no other resources.

You are absolutely not allowed to share/compare answers or screen share your work with one another.

The presence or absence of any form of help or collaboration, whether given or received, must be explicitly stated and disclosed in full by all involved. Specifically, each assignment solution must include answers to the following questions:

1. Did you receive any help whatsoever from anyone in solving this assignment? Yes / No.
   - If you answered 'yes', give full details: _____
   - (e.g., "Jane Doe explained to me what is asked in Question 3.4")
2. Did you give any help whatsoever to anyone in solving this assignment? Yes / No.
   - If you answered 'yes', give full details: _____
   - (e.g., "I pointed Joe Smith to section 2.3 since he didn't know how to proceed with Question 2")
3. Did you find or come across code that implements any part of this assignment? Yes / No. (See below policy on "found code")
   - If you answered 'yes', give full details: _____
   - (book & page, URL & location within the page, etc.).

If you gave help after turning in your own assignment and/or after answering the questions above, you must update your answers before the assignment's deadline, if necessary by emailing the course staff.

Collaboration without full disclosure will be handled severely, in compliance with CMU's Policy on Academic Integrity.

Note that the policies outlined above only apply to the programming assignments. Students are allowed to collaborate to any extent when working on the study guides, including directly working together to arrive at solutions and sharing solutions with other members of the class. The only aspect of this collaboration policy that extends to the study guide material is the Duty to Protect One's Work: while sharing work with other students enrolled in the course is permitted, you should never post solutions publicly (see below for more details).

Previously Used Assignments

Some of the programming assignments used in this class may have been used in prior offerings, in classes at other institutions, or elsewhere. Solutions to them may be, or may have been, available online, or from other people or sources. It is explicitly forbidden to use any such sources, or to consult people who have solved these problems before. It is explicitly forbidden to search for these problems or their solutions on the internet. You must complete the programming assignments completely on your own. We will be actively monitoring your compliance. Collaboration with other students who are currently taking the class is allowed, but only under the conditions stated above.

AI Assistance

To best support your own learning, you should complete all graded assignments in this course yourself, without any use of generative artificial intelligence (AI), such as ChatGPT. Please refrain from using AI tools to generate any content (text, video, audio, images, code, etc.) for an assessment. Passing off any AI generated content as your own (e.g., cutting and pasting content into written assignments, or paraphrasing AI content) constitutes a violation of CMU's academic integrity policy.

Policy Regarding "Found Code"

You are encouraged to read books and other instructional materials, both online and offline, to help you understand the concepts and algorithms taught in class. These materials may contain example code or pseudocode, which may help you better understand an algorithm or an implementation detail. However, when you implement your own solution to an assignment, you must put all materials aside, and write your code completely on your own, starting "from scratch". Specifically, you may not use any code you found or came across. If you find or come across code that implements any part of your assignment, you must disclose this fact in your collaboration statement.

Duty to Protect One's Work

Students are responsible for proactively protecting their work from copying and misuse by other students. If a student's work is copied by another student, the original author is also considered to be in violation of the course policies. It does not matter whether the author allowed the work to be copied or was merely negligent in preventing it from being copied. When overlapping work is submitted by different students, both students will be punished.

To protect future students, do not post your solutions publicly, neither during the course nor afterwards.

Penalties for Violations of Course Policies

All violations of course policies (even the first one) will always be reported to the university authorities (your department head, associate dean, the dean of Student Affairs, etc.) as an official Academic Integrity Violation and will carry severe penalties.

1. The penalty for the first violation is a negative 100% on the assignment i.e., it would have been better to submit nothing and receive a 0%.
2. The penalty for the second violation is failure in the course, and can even lead to dismissal from the university.

9. Support

Take care of yourself. Do your best to maintain a healthy lifestyle by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at http://www.cmu.edu/counseling/.

If you or someone you know is feeling suicidal or in danger of self-harm, call someone immediately, day or night:

- CaPS: 412-268-2922
- Re:solve Crisis Network: 888-796-8226
- If the situation is life threatening, call the police:
  - On campus: CMU Police: 412-268-2323
  - Off campus: 911

10. Diversity

We must treat every individual with respect. We are diverse in many ways, and this diversity is fundamental to building and maintaining an equitable and inclusive campus community. Diversity can refer to multiple ways that we identify ourselves, including but not limited to race, color, national origin, language, sex, disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Each of these diverse identities, along with many others not mentioned here, shape the perspectives our students, faculty, and staff bring to our campus. We, at CMU, will work to promote diversity, equity and inclusion not only because diversity fuels excellence and innovation, but because we want to pursue justice. We acknowledge our imperfections while we also fully commit to the work, inside and outside of our classrooms, of building and sustaining a campus community that increasingly embraces these core values.

Each of us is responsible for creating a safer, more inclusive environment.

Unfortunately, incidents of bias or discrimination do occur, whether intentional or unintentional. They contribute to creating an unwelcoming environment for individuals and groups at the university. Therefore, the university encourages anyone who experiences or observes unfair or hostile treatment on the basis of identity to speak out for justice and support, within the moment of the incident or after the incident has passed. Anyone can share these experiences using the following resources:

- Center for Student Diversity and Inclusion: csdi@andrew.cmu.edu, 412-268-2150
- Report-It online anonymous reporting platform: reportit.net
  - username: tartans
  - password: plaid

All reports will be documented and deliberated to determine if there should be any following actions. Regardless of incident type, the university will use all shared experiences to transform our campus climate to be more equitable and just.

Staff

Instructor

Henry Chai

Henry

Education Associate

Nichelle Phillips

Nichelle

Teaching Assistants

Alex Xie

Doris Gao

Alex

Doris

Zhifei Li

Zoe Xu

Class Mascot

Zhifei

Zoe

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Schedule

Date	Topic	Slides	Readings/Resources
Mon, 5/13	Introduction: Notation & Problem Formulation	Lecture 1	

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		(Inked)	
Tue, 5/14	Decision Trees - Model Definition & Making Predictions	Lecture 2 (Inked)	Daumé III, Chapter 1: Decision Trees Olah, Visual Information Theory (blog post)
Wed, 5/15	Decision Trees - Learning	Lecture 3 (Inked)	Daumé III, Chapter 1: Decision Trees Olah, Visual Information Theory (blog post)
Mon, 5/20	Nearest Neighbors	Lecture 4 (Inked)	Daumé III, Chapter 3: Geometry and Nearest Neighbors
Tue, 5/21	Model Selection (Mini-lecture)	Lecture 5 (Inked)	Daumé III, Chapter 2: Limits of Learning
Wed, 5/22	Perceptron	Lecture 6 (Inked)	Mitchell, Chapter 4.4
Mon, 5/27	No Class (Memorial Day)		
Tue, 5/28	Linear Regression (Mini-lecture)	Lecture 7 (Inked)	Murphy, Chapters 7.1-7.3
Wed, 5/29	Optimization for Machine Learning	Lecture 8 (Inked)	
Mon, 6/3	MLE & MAP	Lecture 9 (Inked)	Mitchell, Estimating Probabilities
Tue, 6/4	Logistic Regression (Mini-lecture)	Lecture 10 (Inked)	Murphy, Chapters 8.1-8.3
Wed, 6/5	Feature Engineering & Regularization	Lecture 11 (Inked)	Murphy, Chapter 7.5
Mon, 6/10	Neural Networks - Model Definition & Making Predictions	Lecture 12 (Inked)	Mitchell, Chapter 4.1-4.6
Tue, 6/11	Differentiation & Computation Graphs (Mini-lecture)	Lecture 13 (Inked)	
Wed, 6/12	Neural Networks - Learning & Advanced Optimization	Lecture 14 (Inked)	
Mon, 6/17	Societal Impacts of ML	Lecture 15 (Inked)	
Tue, 6/18	Recitation in lieu of Lecture		
Wed, 6/19	No Class (Juneteenth)		
Fri, 6/21	Midterm Exam (Time and Location TBD)		
Mon, 6/24	Unsupervised Learning: Dimensionality Reduction	Lecture 16 (Inked)	Daumé III, Chapter 15: Unsupervised Learning Murphy, Chapters 12.2.1-12.2.3
Tue, 6/25	Unsupervised Learning: Clustering (Mini-lecture)	Lecture 17 (Inked)	Daumé III, Chapter 15: Unsupervised Learning Murphy, Chapters 25.5.1-25.5.2
Wed, 6/26	Deep Learning - CNNs	Lecture 18 (Inked)	
Mon, 7/1	Deep Learning - RNNs	Lecture 19 (Inked)	
Tue, 7/2	Deep Learning - Attention & Transformers	Lecture 20	

		(Inked)	
Wed, 7/3	Recitation in lieu of Lecture		
Thu, 7/4	No Class (Independence Day)		
Mon, 7/8	Reinforcement Learning: MDPs & Value Functions	Lecture 21 (Inked)	Mitchell, Chapter 13
Tue, 7/9	Reinforcement Learning: Value & Policy Iteration (Mini-lecture)	Lecture 22 (Inked)	Mitchell, Chapter 13
Wed, 7/10	Reinforcement Learning: Q-learning & Deep RL	Lecture 23 (Inked)	Mitchell, Chapter 13
Mon, 7/15	Learning Theory	Lecture 24 (Inked)	Mitchell, Chapters 7.1-7.3
Tue, 7/16	Learning Theory (Mini-lecture)	Lecture 25 (Inked)	Mitchell, Chapter 7.4
Wed, 7/17	Boosting	Lecture 26 (Inked)	Schapire, The Boosting Approach to Machine Learning: An Overview (2001)
Mon, 7/22	Random Forests (Mini-lecture)	Lecture 27 (Inked)	
Tue, 7/23	No Class		
Wed, 7/24	Special Topics: Pretraining, Fine-tuning & In-context Learning	Lecture 28 (Inked)	
Mon, 7/29	Special Topics: Generative Models for Vision	Lecture 29 (Inked)	
Tue, 7/30	Instructor OH in lieu of Lecture		
Wed, 7/31	No Class (Reading Day)		
Fri, 8/2	Final Exam (Time and Location TBD)		

Recitations

Attendance at recitations is not required, but strongly encouraged. Recitations will be interactive and focus on problem solving; we strongly encourage you to actively participate. A problem sheet will usually be released prior to the recitation. If you are unable to attend one or you missed an important detail, feel free to stop by office hours to ask the TAs about the content that was covered. Of course, we also encourage you to exchange notes with your peers.

Date	Topic	Handout
Thu, 5/16	HW2 Recitation	Recitation 1 (Solutions)
Thu, 5/23	HW3 Recitation	Recitation 2 (Solutions)
Thu, 5/30	No Recitation	
Thu, 6/6	HW4 Recitation	Recitation 3 (Solutions)
Thu, 6/13	HW5 Recitation	Recitation 4 (Solutions)
Tue, 6/18	Midterm Review	Midterm Practice Problems (Solutions)
Thu, 6/20	No Recitation (Reading Day)	
Thu, 6/27	HW6 Recitation	Recitation 5 (Solutions)
Wed, 7/3	HW7 Recitation	Recitation 6 (Solutions)
Thu, 7/11	HW8 Recitation	Recitation 7 (Solutions)
Thu, 7/18	HW9 Recitation	Recitation 8 (Solutions)
Thu, 7/25	Final Review	Final Practice Problems (Solutions)
Thu, 8/1	No Recitation (Reading Day)	

Homework Assignments

Release Date	Topic	Files	Due Date
Mon, 5/13	HW1: Background Material	HW1, Overleaf	Thu, 5/16 at 11:59 PM
Thu, 5/16	HW2: Decision Trees	HW2, Overleaf	Thu, 5/23 at 11:59 PM
Thu, 5/23	HW3: KNN, Perceptron & Linear Regression	HW3, Overleaf	Tue, 6/4 at 11:59 PM
Tue, 6/4	HW4: Logistic Regression	HW4, Overleaf	Tue, 6/11 at 11:59 PM
Tue, 6/11	HW5: Neural Networks	HW5, Overleaf	Tue, 6/18 at 11:59 PM
Tue, 6/25	HW6: Unsupervised Learning & Algorithmic Bias	HW6, Overleaf	Tue, 7/2 at 11:59 PM
Tue, 7/2	HW7: Deep Learning in PyTorch	HW7, Overleaf	Thu, 7/11 at 11:59 PM
Thu, 7/11	HW8: Reinforcement Learning	HW8, Overleaf	Thu, 7/18 at 11:59 PM
Thu, 7/18	HW9: Learning Theory & Ensemble Methods	HW9, Overleaf	Thu, 7/25 at 11:59 PM

Course Calendar

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