CSCI 467: Introduction to Machine Learning
Units: 4.0
Spring 2025, Tuesday/Thursday, 3:30-4:50pm
Section: Friday 3:00-3:50pm

Location:
Lecture: DMC 100
Section: SOS B4
Course website: https://usc-csci467.github.io/

Instructor: Robin Jia
Office Hours: Wednesday 11am-12pm, Friday 10-11am, location TBD (see course website)
Contact Info: robinjia@usc.edu. I will reply within 48 hours. Please include "CSCI 467" in your email subject.

Teaching Assistant: Deqing Fu
Office Hours: TBD (see course website)
Contact Info: deqingfu@usc.edu

Course Description
This course provides a broad introduction to *machine learning*, a family of methods through which programs can infer desired behavior from data. We will start with *supervised learning*, where our goal is to learn an input-to-output mapping given a set of correct input-output pairs. Next, we will study *unsupervised learning*, which seeks to identify hidden structure in data. Finally, we will cover *reinforcement learning*, in which an agent learns from observations it makes as it explores the world. The course will focus both on applying machine learning techniques and on theoretically understanding these methods and their algorithmic properties.

Learning Objectives
By the end of this course, students will be able to apply machine learning techniques—including supervised learning, unsupervised learning, and reinforcement learning—to a wide variety of problem domains. This includes being able to choose appropriate methods, implement them, evaluate them, and diagnose factors contributing to poor performance. They will also be able to prove properties of machine learning algorithms and derive new machine learning algorithms to suit new problems.

Prerequisite(s): CSCI 270, MATH 225, EE 364 or MATH 407 or BUAD 310

Course Notes
Grading type: Letter or Credit/No Credit

Technological Proficiency and Hardware/Software Required
Assignments will require a computer with python and the ability to install python packages. Students must complete programming assignments in python 3.

Optional Readings and Supplementary Materials
There are no required readings for this class. You may find the following references useful:

- *Probabilistic Machine Learning: An Introduction* (PML) and Probabilistic Machine Learning: Advanced Topics (PML2) by Kevin Murphy
- *The Elements of Statistical Learning* by Trevor Hastie, Robert Tibshirani, and Jerome Friedman
- *Patterns, Predictions, and Actions: A Story about Machine Learning* by Moritz Hardt and Benjamin Recht
- *Fairness and Machine Learning: Limitations and Opportunities* (FAML) by Solon Barocas, Moritz Hardt, and Arvind Narayanan.

Description and Assessment of Assignments

Grades will be based on homework assignments (40%), a class project (20%), and two exams (40%).

The final project can be done individually or in groups of up to 3. This is your chance to freely explore machine learning methods and how they can be applied to a task of our choice. You will also learn about best practices for developing machine learning methods—inspecting your data, establishing baselines, and analyzing your errors.

Grading Breakdown

Assessment Tool (assignments)	% of Grade
Homework 0	4%
Homework 1-4	9% each = 36%
Project proposal	2%
Project midterm report	3%
Project final report	15%
Midterm exam	15%
Final exam	25%
TOTAL	100%

Grading Scale
The course will use the following grading scale as a default:

Letter grade	Corresponding numerical point range
A	[93, ∞)
A-	[90, 93)
B+	[87, 90)
B	[83, 87)
B-	[80, 83)
C+	[77, 80)
C	[73, 77)
C-	[70, 73)
D+	[67, 70)
D	[63, 67)
D-	[60, 63)
F	[0, 60)

We may alter this grading scale but only to lower these thresholds, i.e., only to make the final letter grades higher.

Assignment Submission Policy
Assignments should be submitted on Gradescope. All assignments will be due by 11:59pm on the due date. For additional information, see the course website.

Grading Timeline
Assignments will be graded within ten days of submission.

Course Specific Policies
You have **6 late days** you may use on any assignment **excluding the Project Final Report**. Each late day allows you to submit the assignment 24 hours later than the original deadline. You may use a maximum of **3 late days per assignment**. If you are working in a group for the project, submitting the project proposal or midterm report one day late means that **each member** of the group spends a late day. We do not allow use of late days for the final project report because we must grade the projects in time to submit final course grades.

If you have used up all your late days and submit an assignment late, you will lose 10% of your grade on that assignment for each day late. We will **not accept any assignments more than 3 days late**.

Academic Integrity
The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the USC Student Handbook. All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

You may discuss the homework problems at a high level with other students, but you should not look at another student's solutions. Trying to find solutions online or from any other sources for any homework or project is prohibited. Using AI tools to automatically generate solutions to written or programming problems is also prohibited. To prevent any future plagiarism, uploading any material from the course (your solutions, quizzes etc.) on the internet is prohibited. Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage. Plagiarism includes the submission of code written by, or otherwise obtained from someone or somewhere else.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

If found responsible for an academic violation, students may be assigned university outcomes, such as suspension or expulsion from the university, and grade penalties, such as an "F" grade on the assignment, exam, and/or in the course.

Course Content Distribution and Synchronous Session Recordings Policies
USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. (Living our Unifying Values: The USC Student Handbook, page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. (Living our Unifying Values: The USC Student Handbook, page 13).

Course Schedule

	Topics/Daily Activities	Readings/Preparation	Deliverables
Week 1	Introduction; Linear Regression	PML 1, 7.8, 8.2	
Week 2	Featurization, Convexity, Maximum Likelihood Estimation; Logistic Regression, Softmax Regression	PML 2.6.3, 4.2, 8.1, 10.1-10.3	Homework 0 due
Week 3	Overfitting, Regularization, Bias and Variance; Normal Equations	PML 4.5, 4.7, 11.2-11.4	
Week 4	Generative Classifiers, Naive Bayes; Non-parametric methods, Nearest Neighbors	PML 9.3-9.4, 16.1, 16.3	
Week 5	Kernel methods, Support Vector Machines; Introduction to Neural Networks	PML 4.3, 17.1, 17.3, 13.1-13.2	Homework 1 due
Week 6	Backpropagation; Neural network optimizers, Regularization for neural networks	PML 13.3-13.5	Project Proposal due
Week 7	Convolutional Neural Networks; Word vectors	PML 14.1-14.2, 20.5	
Week 8	Recurrent Neural Networks, sequence-to-sequence models, attention	PML 15.1-15.2, 15.4	Homework 2 due
Week 9	Decision Trees, Ensembling; **In-class midterm exam**	PML 18.1-18.5	
Week 10	Transformers, Pretraining	PML 15.5-15.7	
Week 11	k-Means Clustering; Gaussian Mixture Models, Expectation Maximization	PML 21.3-21.4, PML2 8.1-8.2	Project Midterm Report due
Week 12	Dimensionality Reduction, Principal Component Analysis; Multi-armed bandits	PML 20.1-10.4; PML2 34.1-34.4	
Week 13	Reinforcement learning, Q-learning Q-learning with function approximation,	PML2 34.5-34.6, 35.1, 35.4	Homework 3 due
Week 14	Policy Gradient; Adversarial Examples; Spurious correlations, fairness in ML	PML2 35.2-35.3, 19.1-19.8, FAML 1-4	
Week 15	Large language models, ChatGPT, RLHF; Conclusion		Homework 4 due
FINAL	**Final Exam May 13, 2-4pm**		Project Final Report due May 8

Statement on Academic Conduct and Support Systems

Academic Integrity:
The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - *(213) 740-9355 – 24/7 on call*
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - *988 for both calls and text messages – 24/7 on call*
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services

(though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - *(213) 740-9355(WELL) – 24/7 on call*
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - *(213) 740-5086*
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - *(213) 740-5086 or (213) 821-8298*
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - *(213) 740-0776*
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - *(213) 740-0411*
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - *(213) 740-2101*
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - *UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - *UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call*
Non-emergency assistance or information.

Office of the Ombuds - *(213) 821-9556 (UPC) / (323-442-0382 (HSC)*
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - *(323) 442-2850 or* otfp@med.usc.edu
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.