

CIS 515 Math For Machine Learning

Fall 2020

Instructors

Jean Gallier, Professor, Department of Computer and Information Science

Jocelyn Quaintance, Lecturer, Department of Computer and Information Science

Course Description

There are hardly any machine learning problems whose solutions do not make use of linear algebra. This course presents tools from linear algebra and basic optimization that are used to solve various machine learning and computer science problems. It places emphasis on linear regression, data compression, support vector machines and more, all of which will provide a basis for further study in machine learning, computer vision and data science. Both theoretical and algorithmic aspects will be discussed, and students will apply theory to real-world situations through MATLAB projects.

Course Learning Objectives

- Understand the important mathematical concepts of linear algebra and how they underpin real-world problems.
- Apply MATLAB to address curve drawing, data compression and optimization problems.
- Explain the mathematical foundations which guarantee the existence of a singular value decomposition (SVD) for a linear map, and be able to use several applications of the SVD.
- Develop a conceptual understanding of the Lagrangian framework and apply it to quadratic optimization problems found in machine learning.

Course Prerequisites

- prerequisite: Calculus.
- Suggested prerequisite: Undergraduate course in linear algebra (helpful but not required)
- Suggested preparation: Chapters 1 through 4 of Schaums Outline of Linear Algebra, fourth version.

Course Textbook

Recommended

- *Linear Algebra and Optimization with Applications to Machine Learning Vols. I & II*, Gallier & Quaintance (Link to PDF will be provided)

Grading & Assessment

You must attempt all graded assignments to pass the course. If you have any questions or concerns about grading or progress in the course, please reach out to the instructor.

This course will use a variety of assessments to determine whether learners understand and can apply the key concepts and skills that the course teaches. This includes:

Type	%	Description
Projects	50%	Projects #1 and #2 have A and B sections. Projects #3, #4, and #5 do not. Students will work in teams of size 2 or 3, and each team will submit a joint project. All members of the team will receive the same grade for a completed project.
Homeworks	35%	There are 14 homeworks. All homeworks are optionally group assignments (groups of size up to 3). We won't be using the group Coursera tool (students can work together but are graded individually). Students will submit the same assignment separately and TAs will grade them the same. If you change team members, you must let the TA's know about the change no later than the day of submission.
Final Exam	15%	The final exam will be cumulative and in week 15 of the course.

Each graded assessment will use Coursera/Gradescope for submission.

Please read the instructions for each assignment very carefully to make sure you know what to submit to receive credit!

Late Policy/Extensions

The instruction staff is committed to your success and understands how challenging it can be to learn online while balancing other commitments. Despite students' best intentions, sometimes life gets in the way and a little extra time to complete an assignment may be necessary.

If you need extra time on an assignment, please email mcitonline@seas.upenn.edu, and the instructors will work with you to find a way to complete the assignment and keep up with the pace of the course. However, please request extensions 48 hours before the assignment due date; requests for extensions made after the due date are unlikely to be approved.

If an extension is not approved, an assignment that is turned in late will receive a 15% grade reduction per day up to 3 days. After the 3rd day, the highest grade you can earn will be 0%.

Regrade Requests

Regrade requests are handled on a case-by-case basis and are allowed up to 1 week after the grades are released. Regrade requests must be made through gradescope. Regrade requests may take up to a week to process. When submitting a regrade request, please explain (in detail) why you feel the grading is incorrect.

Extra Credit

There is no opportunity for extra credit in this course.

Other Course Activities

The following activities are not mandatory, but will greatly support your success on the graded assignments.

Recitation

Recitations are weekly live sessions with your TAs designed around some kind of problem/activity that is supposed to take about an hour to solve. TAs will answer questions as you work through the problem or answer questions that you have submitted in advance of the session. If you are not able to attend either of the scheduled recitation times, you can review a recording of the session, posted the day after.

Additional Segments

The professor may add additional optional segments to support the class as needed.

Creating an Inclusive Environment

All members of the course community – the instructor, TAs, and students – are expected to work together to create a supportive, inclusive environment that welcomes all students, regardless of their race, ethnicity, gender identity, sexuality, religious beliefs, physical or mental health status, or socioeconomic status. Diversity, inclusion, and belonging are all core values of the MCIT Online program, the instruction staff, and this course. **All participants in this course deserve to and should expect to be treated with respect by other members of the community.**

Discussion boards, messaging channels, recitations, office hours, and group working time should be spaces where everyone feels welcome and safe. In order to facilitate a welcoming environment, students of this course are expected to:

- Exercise consideration and respect in their speech and actions
- Attempt collaboration and consideration, including listening to opposing perspectives and authentically and respectfully raising concerns, before conflict
- Refrain from demeaning, discriminatory, or harassing behavior and speech

All members of the course community are expected to be familiar with and abide by the University's guidelines on general conduct and sexual harassment:

- University Code of Conduct:
<https://catalog.upenn.edu/pennbook/code-of-student-conduct/>
- University Sexual Harassment Policy:
<http://www.upenn.edu/affirm-action/introsh.html>

Students should also be familiar with other University guidelines regarding personal conduct:

- Conduct & Personal Responsibility guidelines in Pennbook:
<https://catalog.upenn.edu/pennbook/#policiesbytopictext>
- University Principles of Responsible Conduct:
http://www.upenn.edu/audit/oacp_principles.htm

If you are a victim of, witness, or are otherwise affected by unacceptable behavior:

- In cases of sexual harassment or assault, please consult DPS Special Services (<https://www.publicsafety.upenn.edu/about/special-services/sensitive-crimes/> at 215-573-3333; this is a confidential resource.
- To report other bias incidents, contact the Penn Office of Diversity:
<https://diversity.upenn.edu/diversity-at-penn/bias-motivated-incident-report>

- For other violations of the code of student conduct, the Office of Student Conduct has an incident reporting form at <https://www.osc.upenn.edu/referral-form>

If you are unsure which office to contact, please contact the instructor or any Penn Engineering Online Learning staff member.

Getting and Giving Help

TA and Faculty Support

TAs will hold office hours weekly, when they will offer 15/20-minute time slots on a sign-up basis.

Your professor will be available for a limited number of private meetings per week, depending on the needs of the class.

Collaboration Guidelines

Discussion forums (Piazza) and recitations *are* collaborative—please take advantage of those times to work with your colleagues. For general communication with your colleagues, use your Slack channels or Slack direct messages.

Forming study groups to understand the material is also a good idea.

Note: When in doubt always ask the instructor or TA first, to avoid any potential collaboration that can lead to academic dishonesty.

Do not cheat. **Please note that searching for solutions online is the same as cheating.**

You can further read Penn's [Code of Academic Integrity](#) page on this subject matter, as well as the SEAS Graduate Student guidelines on the code of ethics.

Fall 2020 Course Schedule and Important Dates

Dates are subject to change. Please check Piazza for announcements regarding schedule changes.

CIS 515 - Math for Machine Learning Fall 2020						
Note: Weeks run Monday through Sunday						
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
30	WEEK 1 > 31 First Day of Term	September 1	2	3	4	5
6	WEEK 2 > 7 Homework 1 Due	8	9	10	11	12
13	WEEK 3 > 14 Homework 2 Due	15	16	17	18	19
20	WEEK 4 > 21 Project 1A Due Homework 3 Due	22	23	24	25	26
27	WEEK 5 > 28 Homework 4 Due	29	30	October 1	2	3
4	WEEK 6 > 5 Project 1B Due Homework 5 Due	6	7	8	9	10
11	WEEK 7 > 12 Homework 6 Due	13	14	15	16	17
18	WEEK 8 > 19 Project 2A Due Homework 7 Due	20	21	22	23	24
25	WEEK 9 > 26 Project 2B Due Homework 8 Due	27	28	29	30	31
November 1	WEEK 10 > 2 Homework 9 Due	3	4	5	6	7
8	WEEK 11 > 9 Homework 10 Due	10	11	12	13	14
15	WEEK 12 > 16 Project 3 Due Homework 11 Due	17	18	19	20	21
22	23	24	25	26	27	28
	Thanksgiving Break - No Classes this week					
29	WEEK 13 > 30 Homework 12 Due	December 1	2	3	4	5
6	WEEK 14 > 7 Project 4 Due Homework 13 Due	8	9	10	11	12
13	WEEK 15 > 14 Homework 14 Due	15	16	17	18	19
				Final Exam----->		
20	21	22	23	24	25	26
----->				Penn Closed		