

Course Information

Course Number: MATH 677
Course Title: Mathematical foundations for data science
Section: 700
Location: *This is an asynchronous online class.*
Time: *All references to times in this course are in Central Time.*
Credit Hours: 3

Instructor Details

Instructor: Peter Kuchment
E-Mail: kuchment@tamu.edu
Zoom Office Hours: TBA

Graders

TBA

Course Description

Linear systems; least squares problems; linear regression; eigenvalue decomposition; singular value decomposition; dimension reduction; vector calculus; convex optimization; gradient descent; elements of machine learning. **Time permitting:** dynamical programming; linear programming; semidefinite programming; compressive sensing.

This is a course that is designed to provide students with basic mathematics knowledge used in current data science.

Prerequisites

1. Linear algebra, such as MATH 304, MATH 309, MATH 311, MATH 323, Math 640, or equivalent.
2. Being enrolled in MS in Data Science, MS in Quantitative Finance, or MS in Mathematics.

Course Learning Outcomes

Upon successful conclusion of this course, students should be able to:

- Identify main problems arising in data science.
- Determine which mathematical techniques are appropriate in each case.
- Apply the basic techniques as listed in the course description.

- Have an idea about how the deep learning techniques work.

Textbook and/or Resource Materials

1. Lecture notes and videos
2. Mathematics for Machine Learning, by M. Deisenroth, A. Faisal, and C. S. Ong
Available freely at mml-book.com
3. Some parts of the following book could be useful: Henry Ricardo, *A Modern Introduction to Linear Algebra*, New York: Chapman and Hall/CRC, 2009, [eBook ISBN 9780429184413]
(available online through TAMU library).
4. The following book might be useful: *Linear Algebra for Data Science*, by Gilbert Strang.

Course Format, Technical Requirements, and Support

This course is a 15-week asynchronous online course. Throughout the course, [Canvas](#) will be used as the primary venue for lectures, discussions, assignments, and collaboration with classmates. You will need to participate in discussions and submit all assignments and projects via [Canvas](#) (the learning management system supported by TAMU). Thus, you must be familiar with it. In addition to accessing [Canvas](#) through <https://canvas.tamu.edu/>, you can find a link to it in the [Howdy](#) portal. To access the system, you will use your TAMU NETID and password. Please contact me immediately if you are unable to access the course website. If you require more technical assistance, try Help Desk Central (<http://hdc.tamu.edu/> or 979-845-8300). Help Desk Central is open 24 hours each day, 7 days a week, 365 days a year.

Time Frame

For this class, the “online week” will reset on Wednesdays. This means that one week of assignments will end on Wednesday at noon and a new week of assignments will begin. Your final grades will be posted in [Howdy](#) at the end of the course, but your individual grades on assignments will be viewable in [Canvas](#) regularly. Students are expected to follow the course outline and engage and participate in the activities outlined in each weekly lesson. Students are required to keep pace with the class, follow the course outline, and complete necessary reading, video lectures, and assignments by the posted due dates. **All dates and times are expressed in CT (Central Time).** Students are responsible for adjusting them to their time zone.

Communication

Here are several ways you can communicate with your classmates and the instructor:

- **Class Announcements:** Class announcements will be posted in [Canvas](#) and sent to your university e-mail account (make sure to check your notification preferences to control how the course updates are sent). You are responsible for monitoring Canvas notifications and checking your account for announcements.
- **Email:** Email is the best way to contact me on an individual basis. Please use the Inbox tool in Canvas to write to me about Math 689. Other correspondence can be directed to kuchment@tamu.edu. I will do my best to respond to you within 24 hours of your email. I hope that I can respond quicker than 24 hours, but I can't guarantee this, especially on the weekends.
- **Zoom Appointment:** I will set up a permanent ZOOM appointment time, but I am also available for individual video conferences by an appointment.
- **Discussion Forum:** A discussion forum will be available on [Canvas](#). Use it to ask your classmates, as well as the instructor, questions about work in the class or to clear up any confusion regarding class instructions, procedures, materials, or assignments. Sharing solutions is not allowed.

Grading Policy

At the end of the semester, you will be given your grade based on the scale provided. I am unable to discuss grades via email or phone due to FERPA privacy concerns. Please schedule a Zoom meeting with me if you have a question about your grade.

Grade Breakdown

ACTIVITY	%	POLICIES, DUE DATES, AND REMARKS
Homework	60	Typically, it will be assigned weekly on Wednesday at noon (approximately twelve assignments in total) and it will be due next Wednesday at noon. It must be turned in on time.
Midterm Exam	20	Take home. The instructor may ask a student for a Zoom meeting for student's explanations of the submitted work.
Final Exam	20	Take home, under the same provision as for the midterm.
Participation		Participation in discussions and other activities may also count for up to three extra points added to the final tally.

Grading Scale

Range	Grade
$90 \leq \text{Average}$	A
$80 \leq \text{Average} < 90$	B
$70 \leq \text{Average} < 80$	C
$60 \leq \text{Average} < 70$	D
Average < 60	F

- **Homework:** Individual assignments will be given most weeks throughout the course, with each student submitting their individual solutions. You must show all your work to receive full credit. You may email the instructor, discuss with classmates via the discussion board, or look things up on the web or in a book while working on individual assignments, but you may not copy solutions/answers. Copying a solution from a source and referencing the source is still considered a violation of academic integrity because you are submitting work for a grade that is not your own work. You must cite the source if you use resources to complete your assignments. For more information on plagiarism and the Aggie Code of Honor, see the section on Academic Integrity below.
- **Exams:**
 - *Your exam solutions must be your own work, using only resources explicitly allowed by the instructor, consistent with the university rules on academic integrity.*
 - The duration of each exam might be restricted to 2.5-3 hours. Additional instructions will be announced before each exam.
- **Participation in Discussions:** Regular interaction online is strongly encouraged, and a portion of it is figured into your overall grade. Learning what other classmates know about mathematics and how they think about mathematics is a very valuable aspect of the learning process. It is good practice to log onto [Canvas](#) 4 to 5 times a week to check in and participate in discussions. A discussion board will be available for each weekly assignment and these discussion boards should be used as a platform for collaboration on assignments. There is also an option to subscribe to discussions, so you receive notifications of new posts and replies.
- **Whenever you have questions, meeting the instructor on zoom during office hours or additional appointments is highly encouraged. You can also e-mail to the instructors.**

Late Work Policy

Late work will NOT be accepted unless you have a university-approved reason (as defined by TAMU [Student Rule 7](#)) and contact me (not graders) within two business days of the missed assignment.

Makeup Policy

- **Makeup work will only be allowed in cases of a university excused absence in accordance with TAMU [Student Rule 7](#)**
- If you **cannot submit a homework or** must miss an exam due to illness or other university excused absence, notify me (before, if feasible, otherwise within two working days after you return). Contact me as soon as possible to schedule a make-up exam.
- An Incomplete Grade will be given only in the event you have completed most of the course but circumstances beyond your control cause prolonged absence from class and the work cannot be made up.

Appeal Policy

Students have 3 business days to notify the instructor of any inaccuracies in their graded work upon the return of individual grades. Students should bring all grade disputes to their instructor in an individual Zoom meeting. Due to FERPA privacy issues, grade disputes will not be discussed over email.

Tentative Course Schedule

Week	Topic
1	General discussion of data science
2	Review of linear algebra
3	Solving linear systems
4	Least square problems
5	Eigenvalues and eigenvectors
6	Singular values. SVD
7	Dimension reduction
8	Vector calculus Midterm Exam.
9	Convex optimization. Gradient descent
10-11	Neural networks
12-14	Various other optimization techniques Final exam

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to [Student Rule 7](#) in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to [Student Rule 7](#) in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" ([Student Rule 7, Section 7.4.1](#)).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" ([Student Rule 7, Section 7.4.2](#)).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See [Student Rule 24](#).)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must always keep appropriate records. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" ([Section 20.1.2.3, Student Rule 20](#)).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below). Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu.

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see [University Rule 08.01.01.M1](#)):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, a person who is subjected to the alleged conduct will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with [Counseling and Psychological Services \(CAPS\)](#).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's [Title IX webpage](#).

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in healthy selfcare by utilizing available resources and services on your campus

Students who need someone to talk to can contact Counseling & Psychological Services (CAPS) or call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.