MATH 218D: FALL 2020 SYLLABUS

Note: *the syllabus and course schedule are subject to change. Any changes to the syllabus and/or course schedule after the semester begins will be relayed to the students through Sakai and email.*

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Office Hours:	See the course webpage	
Course website:	https://services.math.duke.edu/~jdr/2021f-218/	

Description

This is an introductory course on linear algebra that will focus on concepts, methods and applications. Gaussian elimination is presented as the fundamental process for solving systems of linear equations. Deeper understanding is developed by examination of matrix factorizations, orthogonality, and associated vector subspaces. Least squares problems, eigenvalue problems, the singular value decomposition and principal component analysis will also be studied as fundamental tools for solving data-driven applications.

This course will be more applied and computational than *Math 221* (for students heading to a math major), which goes into much more depth on theory and develops skills in writing rigorous mathematical proofs. Math 218 is also significantly different from *Math 216*—less differential equations will be covered; instead, we will treat more advanced topics from linear algebra.

Textbook

The official text for the course is *Introduction to Linear Algebra* (5th Ed) by Gilbert Strang, Wellesley–Cambridge Press/SIAM (2016). However, we will follow Strang only loosely. Another good reference is the online text *Interactive Linear Algebra*, by Dan Margalit and Joe Rabinoff; it can be found here: https://services.math.duke.edu/~jdr/ila/.

Organization

This course consists primarily of **two 50-minute lectures** and **one 50-minute problem session** each week.

Lectures focus on new theory, concepts, and techniques, with very few examples. They are held in large groups of around 50 students. They are conducted online and synchronously. Your **attendance** in the lectures is strongly encouraged, and we will make them as interactive as possible. During lecture, please **keep your camera on** when at all feasible! Class is much more interactive this way, even if you are not saying anything. Lectures will also be recorded for offline viewing. (You should feel free to watch the other instructor's presentation afterward if you found yourself confused.)

Problem sessions are devoted to working examples related to the previous two lectures. They are held in small groups of at most 20 students. They are also conducted online and synchronously. Problem sessions are meant to be entirely interactive, with students working through examples in small groups in breakout rooms. Hence **attendance** in your problem session is required.

Homework will be assigned weekly and posted on the web page above. The homework is where you will get your hands dirty with the concepts, and can be seen as practice for the exams. All homework will be submitted and graded on **Gradescope**. You will need to take photos of your homework or scan

it in. Raw photos are very hard to read and are **not accepted**: you will need to use a scanner or an app. I recommend *Scannable* on iOS or *Genius Scan* on Android.

Brief **quizzes** will be given every week during the problem session. These are group quizzes, meaning that you will solve the problems in a breakout room with 2–3 randomly assigned classmates. They will consist of one or two problems designed to check basic understanding of what happened in the previous two lectures.

There will be three **midterm exams**. Each exam will focus on the material covered after the previous exam, but due to the cumulative nature of the material, you will be responsible for knowing all of the material covered up to that point. You will have a 24-hour window in which to start your midterm; after downloading it, you will have 3 hours to complete it. Calculators may be used for arithmetic purposes only unless otherwise noted on an exam problem.

The **final exam** will cover all course materials, except those specifically excluded in class. Calculators may be used for arithmetic purposes only unless otherwise noted on an exam problem.

Most **course materials** will appear on the course website. I will use **Sakai** for the gradebook, announcements, and Zoom lectures.

Grades for class work will be weighted as follows:

20%	Homework
5%	Quizzes
15%	Midterm 1
15%	Midterm 2
15%	Midterm 3
30%	Final exam

Cutoffs for letter grades will be determined at the end of the semester, subject to the following guarantee: a final score of 90% or above will merit at least an A-; 80% or above is at least a B-, etc.

Lab

Math 218 has an optional 0.5 credit lab component, Math 218L. In this lab, we will cover programming techniques and implement a wide variety of linear algebra algorithms. Later, we will apply them to varied concepts such as machine learning, handwriting recognition, image compression, and others. We will end the semester by implementing a facial recognition algorithm. Code will be developed in Python using the NumPy package. We will explore algorithms, numerical implementations and their difficulties, and develop a substantial code base to use in applications. The workload won't be too large, especially as most work will be carried out in pairs. If you are planning to work in the field of data-based research or data science, the labs will give you a very strong introduction to ideas commonly used in those fields, as well as providing a gateway to more advanced courses.

I highly recommend attending the lab component for a real hands-on learning experience.

Course Schedule

A calendar outlining the materials covered each day, the relevant sections of Strang, the midterm and final exam dates, and more can be found on the course webpage.

Policies

Late homework will generally not be accepted, as I will post solutions shortly after the homework is due. Students may be excused from a missed homework assignment on a case-by-case basis.

I will not hold **make-up midterms.** If you must miss a midterm, then you will be excused from that exam and the others will be weighted more heavily.

Collaboration on homework assignments is encouraged: please work in groups! However, all students must write up their own work, in their own words. Collaboration of any kind on exams is strictly prohibited; suspected instances will result in a referral to the Office of Student Conduct. Please refer to the Duke Community Standard.

How to Get Help

Your first stop for help should be **office hours!** Joe and Jesse will be holding plenty, and you should not hesitate to show up with questions and chat with the other students there. If you can't make the scheduled office hours, send us an email and we'll set up a meeting.

The Math Department operates several **Help Rooms** to provide assistance to students in lower-level courses. Students are invited to drop by the Help Rooms whenever they are open. No appointment is necessary. Link:

https://math.duke.edu/undergraduate/help-tutoring/help-rooms

The **Academic Resource Center** (ARC) offers free services to all students during their undergraduate careers at Duke. Services include Learning Consultations, Peer Tutoring, Learning Communities, ADHD/LD Coaching, Outreach Workshops, GRE/MCAT Prep, Study Connect, and more. Because learning is a process unique to every individual, we work with each student to discover and develop their own academic strategy for success at Duke. Contact the ARC to schedule an appointment. Undergraduates in any year, studying any discipline can benefit! https://arc.duke.edu • `theARC@duke.edu` • 919-684-5917 • 211 Academic Advising Center Building, East Campus – behind Marketplace.