Math 4210 Syllabus

Mathematical Foundations of Data Science, All Sections, 3 credits
Fall 2026

Instructor Information

Instructor: Martin Short

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General Course Information

Description

This course will introduce modern data science techniques and the foundational mathematical concepts in linear algebra, probability, and basic optimization related to these techniques. The course will also provide students with valuable first-hand experience in handling real and complex data via the various assignments.

Course Learning Outcomes

Upon successful completion of this course, students should be able to

1. Understand the mathematical basis for several data science techniques and algorithms
2. Apply several data science algorithms to data sets in order to accomplish a variety of data science related goals
3. Analyze which of many data science techniques might be most appropriate for a given data set

Required Course Materials

There are two textbooks for the course, both of which are free to download online (legally). They are

1. An Introduction to Statistical Learning, Second edition, by Gareth James, Daniela Witten, Trevor Hastie, and Rober Tibshirani. This is available at https://www.statlearning.com/
2. The Elements of Statistical Learning, Second edition, by Trevor Hastie, Robert Tibshirani, and Jerome Friedman. This is available at https://hastie.su.domains/ElemStatLearn/

Grading Policy:

Homework: 30% in total, with the homework with lowest percentage score being weighted at 2.5% and the remaining homework at 5.5% each; Exams: 40% in total, with the exam with the lowest percentage score being weighted at 15% and the highest at 25%; Final project and presentation: 30%.

To summarize:

- Single lowest percentage score homework: 2.5% of overall grade
- Remaining 5 homeworks are 5.5% each: 27.5% of overall grade
- Single lowest percentage score exam: 15% of overall grade
- Remaining exam: 25% of overall grade
- Final project and presentation: 30% of overall grade

Final letter grades: A>90%, B>80%, C>70%, D>60%.

Description of Graded Components

Homework: There will be 6 homework assignments; due dates will be listed on Canvas, and will fall roughly 2-3 weeks apart. Note that the final homework due date may fall on the final instructional day of the semester. Homework assignments will involve both long-answer mathematical problems as well as computer programming problems. Homework will be submitted on Gradescope, which can be reached via the course Canvas site. Homework will be graded based on two factors: the first factor is completeness and the second factor is correctness. For completeness, we look at how many problems are completed. For correctness, we pick some problems to grade in depth. It is acceptable for students to discuss homeworks with each other to brainstorm, etc. But, all students must provide an individual homework submission that is their own. Each non-code submission should be a single .pdf file, and must be clearly legible (typed homeworks are especially encouraged). Code will be submitted in a separate (set of) document(s) for each relevant assignment. Your code should be well organized and commented, with some explanation on how it should be run.

Exams: There will be two in-class exams; exam dates will be listed on Canvas. Exams may include multiple choice, short answer, and free response problems.

Final Project: Rather than a final exam, this course will have a final project, for which students will form groups of 3-4 to work on a project with real data set(s) over the course of the semester, giving a final presentation on their work in the final days of the course. Due to constraints on time, there is a maximum number of groups, so the instructor reserves the right to modify group memberships and sizes early in the semester to fit this constraint.

The instructor will provide a list of possible projects/data sets early in the semester, and groups should be formed soon thereafter. Each group will pick a topic and send a proposal of group members and project to the instructor for approval. Upon approval, the groups will continue to work on the project throughout the remainder of the semester. Each group will make a final presentation in the last week(s) of the semester during lecture time, and submit their slide deck to the instructor. Grading "rubrics"/guidelines for the final presentations/projects will be provided on Canvas. Note: few things will draw the ire of the instructor more than an individual not contributing to the group project. Note that it is acceptable for individuals within the group to largely work on their own, so long as their work is contributing to the overall project of the group. Those who are found/reported to not be contributing will face disastrous grade repercussions.

Course Policies

Attendance and/or Participation

General attendance during lectures will not be taken and will have no direct impact on student grades, but is highly advised, as notes may not be posted online. However, all students are expected to participate in all group project presentation days at the end of the semester by attending and paying attention/asking questions of the presenting groups. Those students who must miss any of these days for a documented reason should contact the instructor as soon as possible.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Pre- &/or Co-Requisites

Calculus I and II (Math 1551 and Math 1552), Linear algebra (such as 1553, 1554, or 1564), and Probability (such as Math 3215, 3225, 3235, 3236, or 3670) are required to succeed in this class. Students should also be comfortable writing computer code in at least one advanced language/software package, such as Python, R, or Matlab (of these three, the instructor can only offer assistance in Matlab). Note that this course will explain to some extent how some algorithms might be coded on a computer, but generally only at the level of pseudo-code. No specific computer language will be taught in this course, though examples in Matlab will be shown.

Collaboration, Group Work, and Use of Generative AI

As mentioned above, students may brainstorm together on homework assignments, but all assignments, including computer code, must be uniquely written by the individual submitting the assignment. Do not copy computer code directly from another student. Sections of computer code obtained from online sources should be credited within the student's submission as a comment, stating precisely where it was obtained and when. Use of Generative AI is not permitted in this course, unless the assignment explicitly states otherwise or the instructor provides express written permission.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Extensions on homework and rescheduling of exams will be made in cases of an institute-approved absence, student accommodations (as discussed with the instructor early in the semester), religious holidays, illnesses, or other emergency situations. All such cases require advanced notice by e-mail to the instructor (to the greatest extent possible) and documentation. Outside of these cases, no late assignments will be accepted.

Inclement Weather and Digital Learning Days

In case of a weather-related event that affects campus operations, students should consult Canvas for an announcement on how to proceed. In cases of an impacted lecture, an online lecture will generally take place.

Regrade Requests

All regrade requests must be made via Gradescope within 1 calendar week of the graded assignment being released on Gradescope. Any requests in any other format (e-mail, in-person, etc) will be denied. Any requests made outside the 1 week window will be denied.

Campus Resources for Students

Undergraduate Student Academic Success Resources:

A list of resources for undergraduate students' academic success and information about advising can be found at Success at Tech

- Academic Support: Academic Success and Advising (a unit in the Office of Undergraduate Education & Student Success) provides free support for your courses. Students can attend scheduled supplemental review (PLUS) sessions, stop by Drop-In Tutoring, or schedule a one-on-one appointment through Knack. To explore what options work best for you, please visit us online at success.gatech.edu/tutoring, email us at tutoring@gatech.edu, or come see us at Clough Undergraduate Learning Commons, Suite 283.

Graduate Student Academic and Professional Success Resources:

A list of resources for graduate students is given on the Office of Graduate and Postdoctoral Education website. Specific information for current graduate students includes

- Academic Resources such as the Communications Center, Language Institute, Library, Catalog, Registrar, resources for conducting research, Advocacy and Conflict Resolution resources, and how to manage unexpected situations that may impact your academic performance;
- Student Resources such as Campus Services, Child Care/Family programs, Health & Wellness, Career Services, and the Student Resource Guide; and
- *Professional Development such as the programming from the Career Center and other professional development resources and events"*

Student Well-Being:

At Georgia Tech, we are concerned about your overall physical, social, and mental well-being. A comprehensive list of wellness related resources has been compiled and maintained by the Office of the Vice President for Student Engagement and Well-being.