

Georgia Institute of Technology

Course Syllabus: Topics on High-Dimensional Data Analytics

Instructor Information

Instructor:	<i>Kamran Paynabar;</i> kamran.paynabar@isye@gatech.edu	
Teaching Assistants	Clayton Gerstner cgerstner@gatech.edu Hairong Wang hairongwhr@gatech.edu Mani Bayani mbayani@gatech.edu Mohammad Salut mms30@gatech.edu Shu Hui Melissa Ng ngshms@gatech.edu Jonathan Soto Ortega jonathansoto93@gatech.edu Wei Yang yang.wei@gatech.edu	
Weekly Office Hours via Blue Jeans	Clayton Gerstner Hairong Wang Mani Bayani Mohammad Salut Shu Hui Melissa Ng Jonathan Soto Ortega Wei Yang	Tuesday 6-7pm Friday 1-2pm Wednesday 8-9pm Saturday 11-12pm Monday 3-4pm Sunday 2-3pm Thursday 11-12pm

General Course Information

Description

This course focuses on analysis of high-dimensional structured data including profiles, images, and other types of functional data using statistical machine learning. A variety of topics such as functional data analysis, image processing, multilinear algebra and tensor analysis, and regularization in high-dimensional regression and its applications including low rank and sparse learning is covered. Optimization methods commonly used in statistical modeling and machine learning and their computational aspects are also discussed.

Pre- &/or Co-Requisites

NONE

Course Learning Outcomes

By the end of the course, you will:

1. Learn machine learning and statistical methods for image processing and analysis of functional data;
2. Learn a variety of regularization techniques and their applications;
3. Be able to use multilinear algebra and tensor analysis techniques for performing dimension-reduction on a broad range of high-dimensional data.
4. Understand how to use well-known optimization methods to create efficient learning algorithms;

Course Materials

Course Text

This is no textbook for this course. Lecture notes and supplementary reading material will be provided via the course website.

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Course Requirements, Assignments & Grading

Assignment Distribution and Grading Scale

Assignment	Release Date	Due Date*	Weight
Homework #1: Functional data analysis	May 11	May 24	6%
Homework #2: Image analysis	May 25	June 3	6%
Homework #3: Tensor data analysis	June 4	June 17	6%
Exam I	June 18	June 24	35%
Homework #4: Regularization	June 25	July 5	6%
Homework #5: Regularization Applications	July 6	July 19	6%
Exam II	July 20	July 26	35%

*All homework assignments and exams are due at 11:59 on the due dates.
Exams are open-book and take-home

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Assignment Due Dates

All assignments a will be due at the times listed above. These times are subject to change so please check back often. Please convert from UTC to your local time zone using a [Time Zone Converter](#).

Timing Policy

- The Modules follow a logical sequence that includes knowledge-building and experience-building.
- You will have access to the course content for the scheduled duration of the course.

Grading and Feedback

- Your Homework will be graded within one week of the due date.
- Requests for re-grading HW or exams should be made within a week of returning HW/exams.

Technology Requirements and Skills

Computer Hardware and Software

High-speed Internet connection

Laptop or desktop computer with a **minimum** of a 2 GHz processor and 2 GB of RAM

Windows for PC computers OR Mac iOS for Apple computers.

Complete Microsoft Office Suite or comparable and ability to use Adobe PDF software (install, download, open and convert)

Mozilla Firefox, Chrome and/or Safari browsers

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Matlab and R

Technology Skills

Basic programming knowledge in R and Matlab

Canvas & edX

This class will use Canvas and edX to deliver course materials to online students. ALL course materials and activities will take place on these two platforms.

Course Policies, Expectations & Guidelines

Communication Policy

- Email course questions and personal concerns, including grading questions, to me and TA's privately. Do NOT submit posts of a personal nature to the discussion board unless it is a private post on Piazza.
- Email will be checked at least once per day Monday through Friday. During the week, I will respond to all emails within 24 hours; on weekends and holidays, allow up to 48 hours. If there are special circumstances that will delay my response, I will make an announcement to the class.
- Student Forum/Q&A discussion boards will be checked once per day.
- Virtual office hours will be held using the Bluejeans. I will hold Virtual Office Hours every [day, time].

Online Student Conduct and (N)etiquette

Communicating appropriately in the online classroom can be challenging. In order to minimize this challenge, it is important to remember several points of “**internet etiquette**” that will smooth communication for both students and instructors:

1. Read first, Write later. Read the ENTIRE set of posts/comments on a discussion board before posting your reply, in order to prevent repeating commentary or asking questions that have already been answered.
2. Avoid language that may come across as strong or offensive. Language can be easily misinterpreted in written electronic communication. Review email and discussion board posts BEFORE submitting. Humor and sarcasm may be easily misinterpreted by your reader(s). Try to be as matter-of-fact and professional as possible.
3. Follow the language rules of the Internet. Do not write using all capital letters, because it will appear as shouting. Also, the use of emoticons can be helpful when used to convey nonverbal feelings. ☺
4. Consider the privacy of others. Ask permission prior to giving out a classmate's email address or other information.
5. Keep attachments small. If it is necessary to send pictures, change the size to an acceptable 250kb or less (one free, web-based tool to try is picesize.com).
6. No inappropriate material. Do not forward virus warnings, chain letters, jokes, etc. to classmates or instructors. The sharing of pornographic material is forbidden.

NOTE: The instructor reserves the right to remove posts that are not collegial in nature and/or do not meet the Online Student Conduct and Etiquette guidelines listed above.

University Use of Electronic Email

A university-assigned student e-mail account is the official university means of communication with all students at Georgia Institute of Technology. Students are responsible for all information sent to them via their university-assigned e-mail account. If a student chooses to forward information in their university e-mail account, he or she is responsible for all information, including attachments, sent to any other e-mail account. To stay current with university information, students are expected to check their official university e-mail account and other electronic communications on a frequent and

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consistent basis. Recognizing that some communications may be time-critical, the university recommends that electronic communications be checked minimally twice a week.

Plagiarism & 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. All students enrolled at Georgia Tech, and all its campuses, are to perform their academic work according to standards set by faculty members, departments, schools and colleges of the university; and cheating and plagiarism constitute fraudulent misrepresentation for which no credit can be given and for which appropriate sanctions are warranted and will be applied. For information on Georgia Tech's Academic Honor Code, please visit <http://www.catalog.gatech.edu/policies/honor-code/> or <http://www.catalog.gatech.edu/rules/18/>.

Any student suspected of cheating or plagiarizing 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 at (404)894-2563 or <http://disabilityservices.gatech.edu/>, 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.

Collaboration & Group Work

- You are encouraged to discuss homework problems with your fellow students. But your final answers should be based on your own understanding. Copying others' work is NOT acceptable and violates the honor code.
- You are not allowed to discuss exam problems with anybody under any circumstances.

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

- NO late submission is acceptable for homework and Exams.
- Exceptions might be made for special cases (e.g., illness, accidents, family emergency). In such cases student must present valid documents.

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. See <http://www.catalog.gatech.edu/rules/22/> for an articulation of some basic expectation 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.

Subject to Change Statement

The syllabus and course schedule may be subject to change. Changes will be communicated via the Canvas announcement tool. It is the responsibility of students to check email messages and course announcements to stay current in their online courses.

Course Schedule

Week	Date	Topic	Events, Assignments, & Assessments
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		All topics, events, assignments, and assessments can be found in:  All assignments due by 11:59 pm EST on the date listed in this column.	
1	May 11	Functional Data Analysis	
2	May 18	Functional Data Analysis	Sunday, May 24: Homework 1
3	May 25	Image Analysis	
4	June 1	Image Analysis	Wednesday, June 3: Homework 2
5	June 4	Tensor Data Analysis	
6	June 15	Tensor Data Analysis and Exam I	Wednesday, June 17: Homework 3
7	June 25	Regularization and Exam I	Wednesday, June 24: Exam I
8	June 29	Regularization	Sunday, July 5: Homework 4

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9	July 6	Applications of Regularization	
10	July 13	Applications of Regularization	Sunday, July 21: Homework 5
11	July 20	Exam II	Sunday, July 26: Exam II