

## **MATH 4803 Syllabus**

**Course Name:** Topics Course: Advanced Statistical Theory for Machine Learning

**Section:** 421

**Credit hours:** 3

**Term:** Fall 2026

### **Instructor Information**

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**Instructor:** Cheng Mao

**Email:** cheng.mao@math.gatech.edu

### **General Course Information**

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#### **Description**

The course focuses on the theory of statistical inference and machine learning, providing a rigorous treatment of a range of estimation and prediction problems. The topics include, for example, linear regression, classification, matrix estimation, nonparametric statistics, and neural networks. The course emphasizes theoretical topics and is intended for students who are interested in the mathematical foundations of statistics and machine learning.

#### **Course Learning Outcomes**

Upon successful completion of this course, you should be able to:

- Explain core concepts in estimation, prediction, and generalization that form the mathematical foundations of statistical inference and machine learning.
- Formulate statistical and machine learning problems in precise mathematical terms and identify appropriate assumptions, models, and performance criteria.
- Analyze and derive theoretical results for fundamental methods such as linear regression, classification, and nonparametric procedures.
- Apply rigorous probabilistic and statistical reasoning to justify methodological choices and evaluate results in estimation and prediction problems.

## **Pre-Requisites**

(MATH 3235 or MATH 3215 or MATH 3670 or MATH 3740 or ISYE 3770 or CEE 3770 or ISYE 3030 or ECE 3077). More specifically, prerequisites include a solid background in probability theory, multivariable calculus, and linear algebra. It is important to be comfortable with mathematical proofs. Some prior exposure to machine learning and/or data science is helpful but not required.

## **Required Course Materials**

Textbook: “Learning Theory from First Principles” by Francis Bach, MIT Press, 2024 (an electronic version is available at [https://www.di.ens.fr/~fbach/ltfp\\_book.pdf](https://www.di.ens.fr/~fbach/ltfp_book.pdf))

## **Grading Policy:**

The overall numerical grade will be calculated based on the weighting: 35% Assignments + 25% Midterm + 40% Project.

The final letter grade will be assigned according to the scale: A = [90%,100%]; B = [80%,90%]; C = [70%,80%]; D = [60%,70%]; F = [0%,60%).

## **Description of Graded Components**

Assignments (35%): Assessment will include traditional grading and oral evaluations.

Midterm (25%): There will be one in-class midterm.

Project (40%): The project consists of the following components:

- Written proposal (5%)
- Oral proposal (5%)
- Final presentation (10%)
- Final report (20%)

## **Course Policies**

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### **Attendance and/or Participation**

Class attendance and participation in discussions are strongly encouraged. The midterm, oral proposal, and final presentation must be completed in class or under supervision.

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

No late assignment or exam will be accepted unless an exception is communicated to the instructor in accordance with institute policy. If an institute-approved circumstance prevents you from finishing your work, please notify the instructor as early as possible to discuss possible alternatives.

## **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.

## **Core IMPACTS**

[Core IMPACTS](#) is the University System of Georgia's General Education curriculum. If you are teaching a course that counts towards Core IMPACTS, you should include a syllabus statement about the Core area and associated [career competencies](#). [This resource](#) developed by the Center for Excellence in Teaching and Learning and Online Education at Georgia State University includes template syllabus statements for each of the Core IMPACTS areas that you may adapt for your course.

## **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.

## **Campus Resources for Students**

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### **Undergraduate Student Academic Success Resources:**

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](https://success.gatech.edu/tutoring), email us at [tutoring@gatech.edu](mailto: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](#).