MATH 8803 Syllabus

Special Topics (Optimal Transport: Theory and Applications), Section RIE, 3 credit hours

Fall 2026

Instructor Information

Instructor: Dr. Tobias Ried

Email: tobias.ried@gatech.edu

General Course Information

Description

This is a graduate level special topics course in the theory and selected applications of optimal transport. The goal of this course is to give students a solid introduction to the theoretical foundations of optimal transport and its diverse applications in the sciences. The course will cover the following topics:

- Multimarginal optimal transport: existence and examples
- Convex analysis and Kantorovich duality
- Brenier's theorem and Monge solutions of the optimal transport problem
- Wasserstein barycenters and interpolation of measures
- Dynamical formulation: Benamou-Brenier formula
- Selected applications, e.g. Wasserstein gradient flows and JKO scheme; HWI inequality; Wasserstein GANs

Course Learning Outcomes

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

- understand the basic concepts and fundamental principles of (multi-marginal) optimal transport
- Independently prove and thoroughly explain central theorems (existence and (non-)uniqueness of optimal transport; Kantorovich duality and its relation to important concepts in convex analysis; sparsity results for optimal transport plans, in particular Brenier's theorem)
- describe the geometry induced by the Wasserstein-2 distance and its applications to PDEs (Wasserstein gradient flows, JKO scheme)
- explain selected applications of optimal transport
- demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from optimal transport.

Required Course Materials

No textbooks or materials are required. Lecture notes will be posted online; they are mainly based on the following textbook:

- G. Friesecke: Optimal Transport: A Comprehensive Introduction to Modeling, Analysis, Simulation, Applications. SIAM, Philadelphia, PA, 2024. doi:10.1137/1.9781611978094.

Other useful textbooks are:

- F. Santambrogio: Optimal Transport for Applied Mathematicians. Calculus of Variations, PDEs, and Modeling. Springer International Publishing, Switzerland, 2015. doi:10.1007/978-3-319-20828-2.
- C. Villani: Topics in Optimal Transportation. Graduate Studies in Mathematics (GSM) 58, AMS, Providence, RI, 2003. https://bookstore.ams.org/gsm-58/.

- C. Villani: Optimal Transport. Old and New. Springer, Berlin Heidelberg, 2009. doi:10.1007/978-3-540-71050-9.

Grading Policy

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

A [90% ,100%] B [80% ,90%) C [70% ,80%) D [60% ,70%) F [0% ,60%)

The final grade will be based on the following graded homework assignments:

Assignment	Weight
Homework 1	25%
Homework 2	25%
Homework 3	25%
Homework 4	25%

Description of Graded Components

There will be 4 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 will be submitted on Gradescope, which can be reached via the course Canvas site. Your submissions (in a single .pdf file) must be written in clear, complete sentences. You will not receive credit if I do not understand your writing.

Homework assignments will involve both computations and proofs, and will be graded based both on mathematical precision and on clarity of exposition.

You are allowed (and encouraged) to work together with other students on the homework, as long as each of you writes up their own solution *independently*.

Homework assignment extensions will be considered for

1. approved institutional activities;
2. documented medical absence;
3. participation in a particular religious observance;
4. elections;
5. civic duties such as jury duty.

Students should contact the instructor by email or in person *prior* to the late assignment submission.

Course Policies

Attendance and Participation

Attendance is expected but will not be graded. It may happen that you miss a lecture for various reasons. It is your responsibility to catch up on the material you missed in class.

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.