Syllabus
MATH 607. Introduction to Optimal Transport Theory and Applications
Fall 2023

Instructor: Dr. Micah Warren, Fenton 318, 541-346-5618.

**Syllabus subject to change

Time and Location: TR. 10:00-11:20, 44 Columbia .

Geometric Analysis Seminar ...: On certain Tuesdays at 11:00 in STB 253 there will be a geometric analysis seminar, which is sort of my jam. The conflict is a scheduling oversight (I forgot to fill out my CAS IT form with teaching time preferences last year) Students in the class may or should be interested.

It's a 3 minutes and 25 second walk from the classroom in Colombia around the east side of the EMU and up the stairs to STB 253. So I will be dismissing at 10:55 and those who are interested can walk over. For example, the first talk is September 27, by John Lott.

Office Hours: Monday 2:30 - 3:30
Thursday 1:30 - 2:30
or by appointment.

Final: This is a topics course
Course description from the advertisement : Optimal transport is a branch of mathematics that studies the problem of efficiently moving one mass distribution (e.g., a pile of dirt) to another (e.g., a hole) while minimizing the cost of transport (e.g., the amount of effort required to move the dirt). This course will provide a comprehensive introduction to the theory and applications of optimal transport.

Topics to be covered include:

-The Monge-Kantorovich problem, which is the classical formulation of the optimal transport problem

-The duality theory of optimal transport, which relates the primal optimal transport problem to a dual problem involving convex optimization

-The theory of optimal transport maps, including the existence and regularity of such maps

-Applications of optimal transport in machine learning, including the use of optimal transport to define distances between probability distributions, giving us the Wasserstein metric

-Examine the use of optimal transport in the study of partial differential equations and geometry, including the concept of Ricci curvature

Prerequisites for this course include a foundation in real analysis and basic probability theory.
Textbook: Santambrogio: *Optimal Transport for Applied Mathematicians*

Prerequisites: Basic understanding of topics from real analysis in particular, integration theory.
Learning Outcomes: The aim of this course is to give the students who attend a solid background and flavor of optimal transportation that be useful in their further studies. The description above offers a few topics, but this could vary depending on the composition of the course. The textbook is good, and despite the name, it's mostly pure math.

One easy option is just to go directly through the textbook. It's all good stuff.

However, there are some topics that are not covered, that might be of interesting to the students in the class.

- Geometry of Ricci Curvature lower bounds. Geometric analysts should find this interesting
- Regularity of the optimal transport PDE: Those who study non-linear PDEs may find this interesting
- Entropic regularization. This is more applied, with close proximity to computational methods and applications to fun things like GANs.
- Applications of Wasserstein space in Deep Learning
- Economics of matching problems.

Grading: There will be periodic assignments. It's a topics course. If you turn in a reasonable number of the assignments, and demonstrate some engagement, you can expect an A.
Homework: Homework will be assigned on Canvas.
Attendance and Classroom environment: Please come and be engaged, otherwise you won't get anything out of it.

Academic dishonesty: Any type of academic dishonesty will not be tolerated. In the event of academic dishonesty, the offense will be reported to the Office of Student Conduct and Community Standards and the student will be sanctioned up to receiving a failing grade in the course.

Students with Disabilities: If you are a student with a documented disability, please meet with me during the first week of class to discuss your needs. If you have not already requested a notification letter from Disability Services outlining recommended accomodations, please do so soon.

Other general university policies: Please see general universal policies (some of which are covered above, some which aren't) : https://canvas.uoregon.edu/courses/196884/pages/general-university-classroom-policies