2025-PIMS-OT

Introduction to Optimal Transport

A PIMS Kantorovich Initiative Online Graduate Course,

taught by Young-Heon Kim (UBC) and Soumik Pal (UW)

Classes start on **Sep 24** and continue through **Dec 5**.

Classes will be taught remotely on MWF and there will be in-person office hours at UBC and UW for further discussion.

Class times:

This course will be taught in a hybrid manner. This course is taught by two instructors YK and SP. The class time will depend on who teaches the individual class. Nevertheless, there will be three 90 mins lectures per week. Videos of the lectures will be put on YouTube and notes will be distributed to students over Slack.

- **Lecture times** MWF 11:00 am – 12:30 pm
- When YK teaches it will be hybrid (in-person at GEOG 109 in UBC + online). YH's in-person office hours will be announced later.
- When SP teaches it will be online. Additionally SP will provide in-person office hours on Tuesdays from 1-3 pm at Padelford C-547.

Online zoom link: TBA

Slack: TBA. This is for communications between students and instructors.

Grading will be based on class participation. Optional exercises will be provided.

The following is the list of holidays: Oct 10, 13 (Canadian Thanksgiving), Nov 26, 28 (US Thanksgiving)

Course calendar and syllabus (subject to changes):

- **Week 1:** YH teaches.
    1. Wed, Sep 24 - Statement of the OT problem. Existence of solutions.
    2. Fri, Sep 26 - Linear programming. Duality.
- **Week 2:** YH teaches.
    3. Mon, Sep 29 - Kantorovich Duality I: Role of convexity.
    4. Wed, Oct 1 - Kantorovich Duality II: Dual attainment.
    5. Fri, Oct 3 - Brenier's Theorem
- **Week 3:** YH teaches.
    6. Mon, Oct 6 - Gangbo-McCann theorem.
    7. Wed, Oct 8 - Monge-Ampère equation.
- **Week 4:** SP teaches
    8. Wed, Oct 15 - 2-Wasserstein space as a metric space
    9. Fri, Oct 17 - geodesics, generalized geodesics, and displacement interpolations
- **Week 5: TBD**

10. Mon, Oct 20 - geodesic convexity
11. Wed, Oct 22 - Absolutely continuous curves and continuity equations
12. Fri, Oct 24 - Benamou-Brenier formulation of OT

- **Week 6:** YH teaches

13. Mon, Oct 27 - Otto calculus. Tangent spaces.
14. Wed, Oct 29 - Wasserstein gradients
15. Fri, Oct 31 - Gradient flows and diffusions

- **Week 7:** SP teaches.

16. Mon, Nov 3 - JKO scheme and gradient flows
17. Wed, Nov 5 (Special lectures)
18. Fri, Nov 7 (Special lectures)

- **Week 8:** SP teaches.

19. Mon, Nov 10 - Langevin diffusions as gradient flows
20. Wed, Nov 12 - Log-Sobolev and other functional inequalities
21. Fri, Nov 14 - Entropic regularization of OT

- **Week 9.** SP teaches.

22. Mon, Nov 17 - Schrödinger bridges
23. Wed, Nov 19 - Mirror gradient flows and mirror Langevin diffusions
24. Fri, Nov 21 **-** Mirror gradient flows and parabolic PDEs

- **Week 10.** YH teaches

25. Mon, Nov 24 - Wasserstein barycenters

- **Week 11.** YH teaches

26. Mon, Dec 1 - Unbalanced OT
27. Wed, Dec 3 - TBD
28. Friday. Dec. 5. TBD