STATISTICAL LEARNING THEORY

SYLLABUS: CSC2532 WINTER 2024

University of Toronto

1. Instructors.

Murat A. Erdogdu
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Office: Pratt 286b
Office Hours: W 11:00-12:00

2. Lectures. Th 16:00-18:00, UC 163

3. Teaching Assistants.

Mert Vural
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4. Course webpages. Course webpage contains all course information, additional readings, assignments, announcements, office hours, etc. Please check regularly!

- https://erdogdu.github.io/csc2532/
- q.utoronto.ca/
- https://piazza.com/utoronto.ca/winter2024/csc2532

5. Course Evaluation.

- 3 assignments: 30% (equally weighted)
- Midterm exam: 40%
- Project: 30%

6. Submitting Course Work.

- Through crowdmark.com. You will receive an invitation about this via email.

7. Course Outline. This course covers several topics in classical machine learning theory. Topics are:

1/11: Uniform convergence & Generalization
1/18: Epsilon-nets and covering
1/25: Rademacher complexity I
2/01: Rademacher complexity II
2/08: Combinatorial Measures of Complexity
2/15: Chaining
2/22: Reading week (no class)
2/29: Kernel Methods I

3/07: Kernel Methods II
3/14: Exam (in class)
3/21: Non-monotonic risk curve
3/28: Neural Networks: Linearization
4/04: Neural Networks: Feature learning

8. Prerequisites. CSC2515 is a prerequisite. This class requires a good informal knowledge of probability theory, linear algebra, real analysis. Homework 0 is a good way to check your background.

9. Textbooks. There is no required course textbook. Ask instructor for optional readings.

10. Assignments. There will be 3 assignments in this course.

10.1. *Collaboration policy.* After attempting the problems on an individual basis, you may discuss and work together on the homework assignments with up to two classmates. However, you must write your own code and write up your own solutions individually. Each student must explicitly state the name of any collaborators at the top of their homework submission.

11. Exam. There will be an in-class midterm exam on Mar 14. Details will be announced on the course webpage. The exam is closed book. You can use an optional A4 cheat sheet - double-sided.

12. Project. Final project should give you experience on carrying out theoretical research.

12.1. *Objectives.*

- **Option 1:** Your project goal is to read and write a comprehensive review of a theoretical machine learning paper, and understand the main building blocks, and propose future directions.
- **Option 2:** You will conduct theoretical research that is relevant to this course. Several research directions will be posted on the course webpage, but the list is by no means comprehensive, and your project topic need not be drawn from it. You will review relevant literature, find interesting research directions, and either develop novel methodology, or explain an observed behavior related to a learning algorithm.

12.2. *Collaboration policy.* You may work on the project alone or in a group of 2 (groups of 2 need to review 2 papers and the standards for a group project will be higher). We strongly encourage you to come to office hours to discuss your project ideas, progress, and difficulties with the course staff.

12.3. *Evaluation.* Evaluation will be based on two reports:

1. Proposal 2%: 1/2 page, to be submitted on 3/03: the papers to be reviewed, and a brief summary of what paper is about, why it is interesting.
2. Final report 28%: 3 pages, to be submitted on 4/07: comprehensive review of the papers, key ideas/tools used in proofs, potential future directions, open problems. More details about the expectations will be posted on course website.

13. Late policy. Ten percent of the value will be deducted for each late day (up to 3 days, then submission is blocked). No credit will be given for assignments submitted after 3 days.

14. Absence declaration. Students who are absent from academic participation for any reason (e.g., COVID, cold, flu and other illness or injury, family situation) and who require consideration for missed academic work have been asked to record their absence through the ACORN online absence declaration. The absence declaration is considered sufficient documentation to indicate an absence and no additional information or documentation should be required when seeking consideration from an instructor. Students should also advise their instructor of their absence. Instructors will not be automatically alerted when a student declares an absence. **It is student's responsibility to let instructors know that they have used the Absence Declaration** so that you can discuss any needed consideration, where appropriate.

15. Grading concerns. Any requests to have graded work re-evaluated must be made within one week of the date the grade is released. Re-evaluation may result in a decrease in the grade.

16. Computing. In the assignments and project, you may need to write your own programs, debug them, and use them to conduct various experiments, plot curves, etc. You may use any programming language, but `Python` is preferable. For some of the assignments, we will provide you a starter code in `Python` only.

17. Missed Tests.

- If a test is missed for a valid reason, you must submit documentation to the course instructor.
- If a test is missed for a valid medical reason, you must submit the absence declaration form and let your instructor know immediately.
- The form will only be accepted as valid if the form is filled out according to the instructions on the form.
- If the midterm test is missed for a valid reason then the final test will be worth 60% of your final grade. Other reasons for missing a test will require prior approval by your instructor. If prior approval is not received for non-medical reasons then you will receive a term test grade of zero.

18. Accommodation for Disability Policy. Please send your documented accessibility requests directly to the instructor, at least a week before the due date of each evaluation item. Extensions may be granted, and the duration will be determined based on the letter from the Accessibility Services at the University of Toronto.