TOPICS IN STATISTICAL LEARNING THEORY

Syllabus: Csc2547/Sta4273 Winter 2019

University of Toronto

1. **Instructors.**

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    Email: erdogdu@cs.toronto.edu
    Office: Sidney Smith Building, Room 5016b
    Office Hours: Mondays 12pm-1pm (tentative)

2. **Lectures.** Thursday 2pm-4pm at AB Room 107 (50 St. George St.)

3. **Teaching Assistants.** TBD

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

    - www.cs.toronto.edu/~erdogdu/teaching/Csc2547
    - q.utoronto.ca

5. **Course Evaluation.** For undergraduate and graduate students

    - 3 assignments: 60%
    - Project: 40%

6. **Course Outline.** This course covers several topics in machine learning theory and optimization. In this course, we will try to answer questions like

    - How fast will your algorithm converge?
    - How much data do you need to get good prediction results?
    - What is the performance of your algorithm on test data?

    Topics may include (depending on time and interest):

    1. Gaussian mean estimation
    2. Asymptotic statistics
    3. Uniform Convergence

        (a) Covering, bracketing numbers

        (b) Radamacher complexity

        (c) VC dimension

    4. Kernel Methods
    5. Online Learning
    6. Sampling and optimization

7. Prerequisites. This class requires a good informal knowledge of probability theory, linear algebra, real analysis (at least Masters level). Homework 0 is a good way to check your background.

8. Textbooks. There is no required course textbook. The following materials can be helpful.

- High Dimentional Probability by Roman Vershynin
- Information Theory, Inference, and Learning Algorithms by David MacKay
- Elements of Statistical Learning by Jerome Friedman, Trevor Hastie, and Robert Tibshirani

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

9.1. *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 and explicitly name any collaborators at the top of the homework.

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

10.1. *Objectives.* Your project goal is to make a significant contribution to understanding a machine learning related observation. An ideal project will begin with an interesting observation, later explained through theory, and end with a thorough empirical analysis.

Several research directions can be found 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.

10.2. *Collaboration policy.* You may work on the project alone or in a group of three; 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.

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

1. Progress report 15%: 1 page, to be submitted on Feb 21 (tentative)
2. Final report 25%: 2 pages, to be submitted on Mar 28 (tentative)

11. Late policy. If you are traveling, you may email your submission to one of the course staff in advance of the deadline. Ten percent of the value will be deducted for each late day. No credit will be given for assignments submitted after solutions have been posted. Exceptions will be made for documented emergencies.

12. 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.

13. 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`, and `R` might be preferable.