MATH 680–FALL 2020
Computation Intensive Statistics (4 credits)

Instructor: Yi Yang
Email: yi.yang6@mcgill.ca
Website: www.math.mcgill.ca/yyang/
Lecture meeting time: Tuesday, Thursday 3:35 pm – 4:55 pm
Office Hour: Thursday 5:00 pm – 6:00 pm
Prerequisites: MATH 556, MATH 557 or permission of instructor

Course Website: the course website will be hosted on

http://www.math.mcgill.ca/yyang/comp.html

You will be able to access all online course material through this website. If you encounter any problems, please ask the course instructor.

References: optional, no required textbook:

1. The Elements of Statistical Learning (2nd Ed) by T. Hastie, R. Tibshirani and J. Friedman
2. Convex Optimization by Boyd and Vandenberghe
3. Numerical Analysis for Statisticians (2nd Ed) by K. Lange
4. Proximal Algorithms by Neal Parikh | Stephen Boyd
5. Distributed Optimization and Statistical Learning via the Alternating Direction Method of Multipliers by Stephen Boyd | Neal Parikh | Eric Chu | Borja Peleato | Jonathan Eckstein

Links to other learning resources will be provided in the notes.

Audience The course will be aimed at first- and second-year students in the statistics/biostatistics master and Ph.D. program. Students from other departments or programs are welcome, space permitting; instructor permission required.

Grading

- **Homeworks (50%):** There will be four homeworks (plus a warmup which does not count towards your grade). Each homework must be submitted through Mycourses. You must submit a typed written assignment (e.g. LaTeX or Microsoft Word, here's a template). We will not accept scanned handwritten assignments. **Students can complete assignments in groups, each consists of maximum 2 persons**. You **need to change your teammates** for each assignment and make sure that you only work with the same person once.
- **Paper review (20%):** you will write a 2-4 page review of papers. The goal is to learn to read technically demanding papers critically, and hopefully in the process, generate novel research ideas. Your review should not only summarize the main result of the paper, but critique it, instantiate it on examples, discuss its overall significance, and suggest possible future directions. **The papers are**

selected by the students and require approval from the instructor. See this **Google Doc** for detailed guidelines and a list of papers. The paper reviews can be done in pairs. Paper reviews that are done in pairs will be evaluated with a slightly higher bar, and they ideally should contain reviews for two closely-related papers and are allowed two additional pages. Appendix or references beyond the page limit are allowed, but you will not be graded based on them.

- **Course project (25%)**: there will be a course project, with two milestones, a final report, and a class conference. Students are required to complete a course project. 2-3 students can form a team, the report must specify their individual contribution in their team project. **The projects are selected by the students and require approval from the instructor.** The team will present their project in class and a written technical report must be submitted. The page limit for project report is 10 pages, not including reference or appendix. (here's a template) More information will be given during the first lecture.
- **Scribe notes (5%):** you will be asked to scribe notes twice during the semester for our lectures in LaTeX. Each is worth 2.5% grades. See this **Google Doc** for the detailed guidelines. The scribe notes are due 2 days after the lecture. Please sign up here before Sept 29th and plan the time ahead.
- **Exam:** none

Policy on collaboration: Collaboration on homework assignments with fellow students is encouraged. However, such collaboration should be clearly acknowledged, by listing the names of the students with whom you have had discussions concerning your solution.

Programming languages: No restriction.

Tentative Topics:

- Least Squares and Matrix Decompositions: QR decomposition, Matrix inverse, LU decomposition, Cholesky decomposition, SVD, and eigen-decompositions, Ridge penalized least squares.
- Gradient descent, gradient boosting
- Subgradient method
- Statistical learning with sparsity
- Proximal gradient
- MM and EM algorithm
- Duality and KKT conditions
- ADMM algorithm

Feedback: I welcome comments and suggestions (and complaints) and will solicit feedback via a survey partway through the class. Comments at any other time are welcome, and if you prefer anonymity, you can leave a note in my mailbox or under my door.

When to see me about an assignment: I'm here to help, including providing guidance on assignments. But before coming to see me about a difficulty, you should try something a few different ways and

try to define/summarize what is going wrong or where you are getting stuck.

+ In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change. If you need special assessment arrangements or accommodations, please contact the Office for Students with Disabilities at 514–398–6009.

Assessments and Plagiarism: Any material (assignment solution scripts, R scripts etc.) that you hand in for assessment should be your work alone, unless the assignment concerned is a designated group project. This does not mean that you cannot consult or collaborate with others, merely that the material submitted for assessment must have been produced by you.

MCGILL UNIVERSITY POLICY STATEMENTS

The following three statements are included in this course outline, in keeping with Senate resolutions:

1. *McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the* ***Code of Student Conduct and Disciplinary Procedures****. For more information, see*

   `www.mcgill.ca/students/srr/honest/`

   [*Approved by Senate on 29 January 2003*]

2. *In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.*

   [*Approved by Senate on 21 January 2009*]

3. *Instructors who may adopt the use of text-matching software to verify the originality of students' written course work must register for use of the software with Educational Technologies and must inform their students before the drop/add deadline, in writing, of the use of text-matching software in a course.*

   [*Approved by Senate on 1 December 2004*]

If you have a disability and need special arrangements, please contact the **Office for Students with Disabilities** at 514–398–6009.