

Syllabus of CS 576 Fall 2016: Advanced Machine Learning and Optimization

September 15, 2016

1 Course Objective

This course aims at providing students modeling skills, optimization algorithms, and theories commonly in machine learning and data analytics, with a special emphasis on deep understanding on various mathematical models and algorithms. Mathematics is heavily involved in this course. How to use any software or tools is not covered in this course.

Comparing to the CSC 576 Fall 2015, more topics about machine learning will be covered. Students are also encouraged to present new topics in machine learning and optimization in class.

2 Basic Information

- Instructor: Professor Ji Liu
- Time: TR 3:25 - 4:40
- Classroom: CSB 601
- Office Hour: TR 4:40-5:40 or by appointment
- Email: ji.liu.uwisc@gmail.com
- Course website: <http://www.cs.rochester.edu/u/jliu/teaching.html>
- TA: Haichuan Yang
- TA office hour: Mon. 10:00-12:00pm at CSB 725
- TA Email: hyang1990.cs@gmail.com

3 Topics

- Preliminary (Fundamentals in linear algebra, matrix analysis)
- Preliminary (Fundamentals in probability theory, statistics)
- Preliminary (Fundamentals in optimization)

- Matrix factorization / completion (e.g., image in-painting, recommendation system)
- Tensor factorization / completion (e.g., video in-painting, foreground-background segmentation)
- Unconstrained Optimization Methods
- Constrained Optimization Methods
- Sparse learning (compressed sensing)
- Feature selection
- Asynchronous parallel algorithms
- Submodular optimization
- Reinforcement learning / dynamic decision
- Other recent topics in machine learning

4 Point Distribution and Grading Scheme (Total points: 110 - 120)

Point Distribution:

- 6 homework: 60 points
- 1 project: 30 points
- 1-2 presentation: 10 points
- participation and attendance: 10 points
- probably 1 midterm (by voting): 0-10 points

Grading Scheme:

- A: ≥ 100 or above top 20%
- A-: ≥ 90 or above top 30%
- B+: ≥ 85 or above top 40%
- B: ≥ 80 or above top 50%
- C: ≥ 70 or above top 70%
- D: ≥ 60
- E: < 60

5 Pre-requisite

- Machine learning, linear algebra, calculus, probability theory, and statistics.

6 Project

The project for this course cannot be shared with any other course. But you are allowed to work on the same project with your classmates in this class. The number of team members for each project is up to two. The main purpose of this project is to use the tools and theories you learn from this class to solve a data analysis problem, reformulate an existing problem, design a new optimization algorithm, or conduct new theories. You can start your project as early as possible. You have multiple options in this project:

- (New application) You can bring a practical (data analysis) problem from your research area. You are expected to use methods you learned from this class to solve it;
- (New formulation) You can re-define some existing problems by proposing a new formulation and apply the new technique you learn from this class to solve it;
- (New algorithm) You can propose a new algorithm to solve a specific data analysis problem. Your new algorithm should be able to handle big data problems. At least, it should be more efficient than benchmark algorithms;
- (New theory) You can derive new theoretical analysis for any existing data analysis algorithm;
- Any combination of above.

If you have no idea what to do in your project, please feel free to talk to me. I can help you to find a suitable project topic. A final report and 1-2 presentations are required for your project. In the ideal case, this report is eligible for submission to a conference. Team work is allowed to finish this project, but the number of team members is up to 2. More details about the project would be available very soon.

7 Academic Honesty Policy (steal from ECE 450)

The University of Rochester academic honesty policy applies to all assignments and exams for this class. The full-text of the academic honesty policy can be found at: <http://www.rochester.edu/College/CCAS/AdviserHandbook/AcadHonesty.html> In addition to the general guidelines mentioned in the above policy, for this course I require that: In examinations, you must work individually with no communication with others and use only materials/tools that have been explicitly allowed. For homework, you may discuss problems with your colleagues but final solutions need to be worked out, written and submitted individually. Any external material used should be clearly cited. In your own writings (example term papers, homework solutions, proposals etc), no more than one or two sentences may be used verbatim from any source.

READ THESE INSTRUCTIONS CAREFULLY! If any aspect of the academic honesty policy and guidelines for this course are unclear, please ask me for clarifications. Lack of awareness or understanding of this policy will not be an acceptable excuse or defense against disciplinary action.