Math 499
Special Topics - Mathematics of Machine Learning
Spring 2017

Instructor: Guillermo Reyes

Office: KAP 444B

Lecture days/hours: MWF, 2:00 - 2:50 pm, VKC 105.

Office Hours: MWF 3:00 pm - 5:00 pm.

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Description of the course: The proposed course is an introduction to Machine Learning. In the first part of the course, we will deal with the fundamental concepts and results of PAC learning: empirical and true risk, VC-dimension,the fundamental theorem of PAC learning, overfitting, etc. The second part is focused on the main classes of algorithms used for both supervised and unsupervised learning, stressing their connection with the general learning framework. We provide rigorous justification for the algorithms presented and their statistical complexity. We make extensive use of tools from Linear Algebra, Optimization, Probability Theory (in both its frequentist and Bayesian versions) and Statistical Inference. Real implementations in Python of some of the algorithms on small sets of data will be presented.

Prerequisites: Math 226 or 229, Math 208 (preferably Math 407), Math 225. A D-clearance will be required for this course.

Books/Material: The main textbook we will follow is

"Understanding Machine Learning: from Theory to Algorithms" by Shai Shalev-Shwartz and Shai Ben-David. The authors keep it available online at

http://www.cs.huji.ac.il/ shais/UnderstandingMachineLearning/

For some of the topics, I will use the notes by Prof. Andrew Ng at Stanford,

http://cs229.stanford.edu/materials.html

Grading:

- Class participation: 10% of the grade
- Perioidic assignments given every other week: 40%
- Final exam (on the last week of the course): 50%.

Tentative schedule of the course:

1. Introduction. Brief review of Probability Theory. Chapter 2 (Week 1)
2. Chapters 3-4 (Week 2)
3. Chapters 5-6 (without proofs) (Week 3)
4. Chapter 9 (without the VC calculation) (Week 4)
5. Chapter 10 (Week 5)
6. Chapter 11 (without proofs) (Week 6)
7. Chapters 12-13 (with some proofs) (Week 7)
8. Chapter 14 (with some proofs) (Week 8)
9. Chapter 15 (Week 9)
10. Chapter 16 (Week 10)
11. Chapter 18 (Week 11)
12. Chapter 22 (Week 12)
13. Chapter 23 (with some proofs) (Week 13)
14. Chapter 24 (Week 14)
15. Review (Week 15)

Statement on Academic Conduct and Support Systems

- Academic Conduct.

Plagiarism - presenting someone else's ideas as your own, either verbatim or recast in your own words - is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Section 11, Behavior Violating University Standardshttps://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct/.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu/ or to the Department of Public Safety http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety whole USC community. Another member of the university community â such as a friend, classmate, advisor, or faculty member â

can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

- Support Systems.

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs

http://sait.usc.edu/academicsupport/centerprograms/dsp/

provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information http://emergency.usc.edu/ will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.