Syllabus Fall 2023

MCS 549 – Mathematical Foundations of Data Science

Instructor: Lev Reyzin, SEO 417, (312)-413-3745, lreyzin@uic.edu

Time and location: M-W-F, 12:00-12:50pm, Burnham Hall (BH) 304

Credit hours: 4 credits (43424)

Prerequisite background: Familiarity with the design and analysis of algorithms, basic computational complexity, and mathematical maturity.

Office hours: Tu 11:00-11:50 am (online), Fr 11:00-11:50 am in-office

Website: http://homepages.math.uic.edu/~lreyzin/f23_mcs549/

Online textbook: Avrim Blum, John Hopcroft, and Ravindran Kannan. *Foundations of Data Science*

Topics: This course covers the mathematical foundations of modern data science from a theoretical computer science perspective. Topics will include random graphs, small world phenomena, random walks, Markov chains, streaming algorithms, clustering, graphical models, singular value decomposition, and random projections.

Weekly schedule: Week 1: geometry in high dimensions, Week 2: random projections, Week 3: singular value decomposition, Week 4: first and second moment methods, Week 5: random graphs, Week 6: random walks, Week 7: Markov Chain Monte Carlo, Week 8: graphs as electrical networks, Week 9: web algorithms, Week 10: machine learning theory, Week 11: streaming algorithms, Week 12: sketching methods, Week 13: clustering, Week 14: student presentations, Week 15: student presentations.

Grading:

- 60% take-home problem sets
- 30% in-class presentation – each student will present a research paper approved by the class instructor
- 10% class participation

Problem set collaboration policy: Unless otherwise specified on an assignment, students may discuss problem sets with one another, but they should afterward write the solutions on their own. Collaborators (people you speak to about an assignment) must be named at the top of the assignment. No collaboration will be allowed on exams.

Late work policy: In general, late work will not be accepted. Problem sets are to be turned in by 12pm on Gradescope on the day they are due. Exceptions must be asked for in advance of the due date and will be made rarely, on a case-by-case basis.

Classroom environment: University classes play an important role educating students and imparting a deep understanding of the course materials and topics. With this goal in mind, students are urged to speak their minds, explore ideas and arguments, play devil's advocate, and engage in civil but robust discussions. Students ought to do business in the proper currency of respectful intellectual discourse—a currency consisting of reasons, evidence, and arguments.

Disability policy: Students with disabilities who require accommodations for access and participation in this course must be registered with the Office of Disability Services (ODS). Please contact ODS a 312/413/-2183 (voice) or 312/413-0123 (TTY).

Disclamer This syllabus is intended to give the student guidance on what may be covered during the semester and will be followed as closely as possible. However the instructor reserves the right to modify, supplement, and make changes as course needs arise.