

CSC 2427/ MAT 1500 The Probabilistic Method
Spring 2025

Topics Covered:

The probabilistic method, pioneered by Erdos in the 1950's, is now one of the most important and broadly used proof techniques in graph theory and combinatorics. It also has wide applications in other areas of math and theoretical computer science.

Roughly speaking: In order to prove the existence of an object with certain properties (eg a colouring of a graph), we devise a way to generate that object randomly, and then prove that the desired properties hold with positive probability.

This course will cover some of the most important tools in this area including: the first moment method, the Lovasz Local Lemma, random graphs, and concentration inequalities.

Required Background:

- A solid background in graph theory, for example a standard undergraduate course in the area.
- Nimbleness with basic discrete probability, including comfort in computing expected values and a good intuition about randomness.
- Strong foundations in mathematical proofs. The ability to recognize, when presented with some key pieces of a proof, whether they can be fleshed out into a full proof.

Text: *The Probabilistic Method* by Alon and Spencer. And some additional readings.

Grading Scheme:

50% - Assignments

50% - Final Exam

There will be either three or four assignments, depending on enrolment and how the course progresses. The assignment problems will primarily involve writing mathematical proofs. The problems will be challenging and the proofs will require clever ideas on top of mastering the proof techniques taught in class. Students will be permitted to work with a partner on some, but not all, problems. Due dates to be announced.

The Final Exam will be written and will also involve writing mathematical proofs.