

MATH688 Graduate Combinatorics I, Fall 2023

Lectures MWF 12:40PM-1:35PM Memorial Hall 107

Please attend each class if possible, pay attention (so silence your phones), and ask questions.

Studying in graduate school is about learning and going through problems and topics a bit each day so that the knowledge from the courses becomes yours for the rest of your life. Another difference from undergraduate to graduate school is that the quality of the work in graduate school is higher.

Instructor Information Prof. Sebastian (Sebi) Cioabă, **Instructor Pronouns** he/him
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I am originally from Romania, but I spent half of my life there and half of it in North America (Canada and US). I have been at UD since 2009 and I have taught Math688 multiple times. This course is related to my research areas (graph theory and combinatorics). I set high standards for the students in my classes and I try my best to help the students achieve them. Most importantly, the bulk of the work and motivation has to come from the students.

Office Hours Mondays and Wednesdays 11-12am Ewing 506 or by appointment.

Please come prepared to discuss problems from exams, homework or lectures. Work on the problems before coming to office hours.

Textbook *A First Course in Graph Theory and Combinatorics* by Sebastian M. Cioabă and M. Ram Murty, 2nd edition, Hindustan Book Agency/Springer, 2022. The PDF of the Springer version of the book is available for free via the UD online system.

<https://link.springer.com/book/10.1007/978-981-19-0957-3>

The course materials (homework, exams, solutions etc.) will be posted on a google drive folder that will be shared with you. I posted some videos on YouTube from a few years ago when I taught Math688. The videos may not correspond to the lectures we will do this year, but you may find them helpful.

Topics Basic properties of graphs, trees, matchings, matrices, connectivity, coloring graphs, planar graphs, basic counting, generating functions. We will cover the important parts of chapters 1-6,8,10.

*Graphs are the quintessential objects of study in discrete mathematics. They are usually described as a set of vertices, V , that are connected by a set of edges, E , each of which is a pair of vertices. Graphs encode connections and are one of the most commonly used representations of data.*¹

The objectives of this course are studying and understanding the fundamental concepts of graph theory and combinatorics. We will discuss algorithmic and computational methods to investigate problems in graph theory and combinatorics. Ideally, after taking this class, you should be able to do research in discrete mathematics and understand how to apply combinatorial and graph theoretic tools to other problems.

¹Daniel Spielman *Graphs, Vectors and Matrices*, Bulletin of the American Mathematical Society
<http://www.ams.org/journals/bull/2017-54-01/S0273-0979-2016-01557-6/>

Grading

- **Homework** (45% of the final grade). I will assign homework every week or so. The homework questions will be harder than the ones on the exams, but you are encouraged to discuss them with me during office hours. For the homework, no joint work between the students is allowed. Your lowest homework score will be dropped.
- **In-term take home exams** (30% of the final grade). There will be three take-home exams that will take place during the weeks of September 18, October 16 and November 13. For the take-home exams, no joint work between the students is allowed.
- **Final take home Exam** (25% of the final grade). We will have a take home final during the exam period (December 13-15). You are encouraged to discuss the exam problems with me during office hours. For the homework, no joint work between the students is allowed.
- **Proof-reading** Any typo or error that you find in the book (2nd edition) will bring you 0.5% for the final grade. You can email or contact me directly with the details (including page number and/or section number).

I will use the best of the following grading schemes:

Homework (45%)+ In-term take home exams (30%)+ Final exam (25%)+Typos

Homework (45%)+ Best Take home exams (20%)+Final Exam (35%)+Typos

- Your letter grade for this course will be determined from the following scheme:
A: 90-100, A-: 85-90,
B+:80-85, B: 75-80, B-: 70-75,
C+: 65-70, C: 60-65, C-:55-60,
D: 50-55, F: 0-50

Communication

I will send any announcements related to this class via email or during lectures.

Attendance

Absences on religious holidays listed in university calendars are recognized as an excused absence. Nevertheless, you are urged to remind me of your intention to be absent on a particular upcoming holiday. Absences on religious holidays not listed in university calendars, as well as absences due to athletic participation or other extracurricular activities in which you are an official representative of the university, shall be recognized as excused absences when you informs me in writing during the first two weeks of the semester of these planned absences for the semester.

Student Mental Health

College students often experience things that may interfere with academic success such as academic stress, sleep problems, juggling responsibilities, life events, relationship concerns, or feelings of anxiety, hopelessness, or depression. If you are experiencing any of the above in a way that is negatively impacting your ability to participate fully in the learning activities for this class, I

strongly encourage you to get in touch with me. Additionally, I have provided information from other campus-wide units below.

- Contact me (If you are struggling with this class, please check-in during office hours or contact me by email at cioaba@udel.edu).
- Check-in with your academic advisor or the Assistant Dean for Student Services in your college (If you are struggling in multiple classes, unsure whether you are making the most of your time at UD, or unsure what academic resources are available at UD.)
- UD's Center for Counseling & Student Development (CCSD), TimelyCare, and UD Helpline
 1. UD's Center for Counseling & Student Development (CCSD) provides cost-free and confidential mental health services promoting psychological wellbeing so that students can be more successful in their academic, personal, and career pursuits. CCSD provides in-person services including walk-in urgent visits, scheduled individual and group counseling, and consultation for students, parents, and faculty.
 2. CCSD partners with TimelyCare <https://sites.udel.edu/counseling/timelycare> to provide scheduled counseling and health coaching via telehealth.
 3. For 24/7 mental health support, students have the option of calling the UD Helpline at 302-831-1001 or accessing TimelyCare's Talk Now service through the TimelyCare app or online. Visit CCSD's website <https://sites.udel.edu/counseling/services/> for additional information and resources.
 4. UD's Crisis Text Line (Text "UDTEXT" (or "STEVE" for students desiring to connect with a professional who specializes in supporting students of color) to 741741 for confidential text message support.)
 5. Division of Student Life (Explore the Student Life's Wellbeing webpage <https://sites.udel.edu/studentlife/wellbeing/> for a comprehensive listing of wellbeing resources, activities, and services available to all students.)

Academic Honesty

Please familiarize yourself with UD policies regarding academic dishonesty. The Academic Honesty Policy <https://www.udel.edu/content/dam/udelImages/student-life/StudentGuide.pdf> states:

Students must be honest and forthright in their academic studies. Students are expected to do their own work and must give proper credit for any work not their own. Students may neither give nor receive unauthorized assistance. Engaging in academic dishonesty, or allowing other students to do the same, corrupts the educational process and diminishes the quality of a University of Delaware degree.

View the university's procedures

<https://www.udel.edu/students/community-standards/conduct-process/>

for resolving academic dishonesty concerns. Contact Community Standards & Conflict Resolution at communitystandards@udel.edu or (302) 831-2117.

Harassment, Discrimination, and Sexual Misconduct

The University of Delaware works to promote an academic and work environment that is free from all forms of discrimination, including harassment and sexual misconduct. As a member of the community, your rights, resources and responsibilities are reflected in the Non-Discrimination, Sexual Misconduct, and Title IX policy. Please familiarize yourself with this policy at the University's Office of Equity & Inclusion's website <https://sites.udel.edu/oei/>. You can report any concerns to the University's Office of Equity & Inclusion (302) 831-8063 or at titleixcoordinator@udel.edu. You can report anonymously through UD Police (302) 831-2222 or the EthicsPoint Compliance Hotline <https://sites.udel.edu/intaudit/compliance-hotline/>

- Read the full policy
<https://sites.udel.edu/sexualmisconduct/files/2020/09/20200902-NDSM-Policy-final.pdf>
- File a report <https://sites.udel.edu/oei/>

Faculty Statement on Disclosures of Instances of Sexual Misconduct

If, at any time during this course, I happen to be made aware that a student may have been the victim of sexual misconduct (including sexual harassment, sexual violence, domestic/dating violence, or stalking), I am a responsible employee, which means I am directed to report any incident of sexual harassment or misconduct to the University's Title IX Coordinator. The Title IX Coordinator will then meet with the student to discuss how the University will respond to the report and the student's rights and options, to offer resources, and to ensure that the student and the campus community are safe. If such a situation is disclosed to me in class, in a paper assignment, or in office hours, I promise to protect your privacy—I will not disclose the incident to anyone but the Title IX Coordinator in a confidential manner. For more information on Sexual Misconduct policies, where to get help, and reporting information, please refer to <http://www.udel.edu/sexualmisconduct>. You can also send an email to the Title IX Coordinator at titleixcoordinator@udel.edu. At UD, we provide 24/7/365 crisis assistance and victim advocacy and counseling. Contact 302-831-1001 to get in touch with a sexual offense support advocate, as well as confidential and anonymous counseling services for other concerns.

Accommodations for Students with Disabilities

Any student who may need disability-related accommodations should contact the Office of Disability Support Services (DSS) office as soon as possible. For more information, please visit

<https://sites.udel.edu/dss/students/registration-process-2/>

Contact DSS by phone: 302-831-4643; fax: 302-831-3261; website: www.udel.edu/dss; email: dssoffice@udel.edu; or visit 240 Academy Street, Alison Hall Suite 130 during business hours (8-5 M-F).

Non-Discrimination

The University of Delaware does not discriminate against any person on the basis of race, color, national origin, sex, gender identity or expression, sexual orientation, genetic information, marital status, disability, religion, age, veteran status or any other characteristic protected by applicable law in its employment, educational programs and activities, admissions policies, and scholarship and loan programs as required by Title IX of the Educational Amendments of 1972, the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973, Title VII of the Civil Rights Act of 1964, and other applicable statutes and University policies. The University of Delaware also prohibits unlawful harassment including sexual harassment and sexual violence. For inquiries or complaints related to non-discrimination policies, please contact: Office of Equity & Inclusion- oei@udel.edu, (302) 831-8063 For complaints related to Section 504 of the Rehabilitation Act of 1973 and/or the Americans with Disabilities Act, please contact: Office of Disability Support Services, dssoffice@udel.edu, Alison Hall, Suite 130, Newark, DE 19716 (302) 831-4643 OR contact the U.S. Department of Education - Office for Civil Rights <https://www2.ed.gov/about/offices/list/ocr/docs/howto.html>