Math 4032: Combinatorial Analysis

Syllabus

Days:	Mon/Wed
Time:	12:30–1:45PM ET
Location:	Skiles 257

Instructor:	Dr. Corrine Yap	**Office:**	Klaus 2111
Email:	cyap35@gatech.edu	**Office Hours:**	Tues/Fri 1:45–3pm
Website:	canvas.gatech.edu		

About this class: Combinatorics is a broad subject that mainly deals with the counting, construction, and optimization of discrete objects. Such problems are near the intersection of mathematics and computer science; many can be solved using algorithms, but many cannot! We will study different types of combinatorial problems and the techniques used to answer these problems, which form the foundations of today's research in discrete mathematics.

This class is not lecture-based but discovery-based. Much of class time will be spent in developing and exploring key concepts by working on problems in groups. Why? Because discovering ideas for yourself and discussing them with others can help you understand them more deeply. But we will always follow up on our discoveries with class check-ins and presentations of ideas and solutions.

The primary forms of assessment will be problem sets and expository writing projects. The latter is meant to serve as practice in distilling and summarizing technical concepts, as well as a precursor to theoretical research for any students who may pursue that direction.

Course Materials: We will explore a variety of topics in the course so there is no one textbook we will use. Any recommended references will be available online, either via Canvas or as open source textbooks.

Our skill-oriented goals for the semester:

- Discover combinatorial concepts by generating examples and making conjectures.
- Communicate about mathematics in a clear and articulate manner, both orally and in writing, in large discussions and in small groups.
- Apply the theorems and proof techniques discussed in class to discrete problems.

Our virtue-oriented goals for the semester:

- Develop persistence to struggle through problems and learn from that struggle.
- Approach new and unfamiliar problems strategically but with an openness to creativity and imaginative solutions.

Some Guidelines:

Math does not exist in a void. Each of you will enter the class with different math-and-life experiences. I do not expect us to leave our identities at the door - they inform how we learn, view, discuss, teach, and internalize math. No matter what, you are capable of excelling in this course, and I am here to help you.

Attendance and participation are important, especially since much of class time will consist of activities that will help you discover new material or understand material more deeply. Repeated absences will affect your grade in the course. If your absence is unavoidable (e.g. religious holiday, personal emergency), speak to me beforehand about turning in work, and speak to me and your classmates about the material you missed.

Late submissions for homework and projects will generally not be accepted, unless due to an unavoidable circumstance. But I would prefer you turn in homework late, rather than plagiarize someone else's work in order to hand it in on time. If you find yourself having to make this choice, talk to me.

Academic integrity is taken seriously. All students are expected to comply with the Georgia Tech Honor Code which can be found at http://osi.gatech.edu/content/honor-code. In particular, copying work from the internet or another student and submitting it as your own is a violation, and it will not help you succeed in this course.

Collaboration is not the same as copying. You are encouraged to work with other students when solving problems, but when you write up a solution to be handed in, you should do so on your own, without the aid of others.

Feedback is more than welcome. If you have any thoughts on how the course is going, or personal circumstances that are affecting your ability to participate, I want to know. **Email me**, and I will try to answer as soon as possible, but give me 48 hours before expecting a response.

Course Outline: (subject to change; a schedule will be posted on Canvas and updated frequently.)

- Weeks 1–2: Combinatorial Foundations (Review of combinatorial proofs, bijective proofs, and induction; binomial coefficients, balls and boxes counting)
- Weeks 2–4: Enumeration (sequences, recurrence relations, generating functions)
- Weeks 5–8: Probabilistic Combinatorics (review of discrete probability, the probabilistic method, linearity of expectation, random graphs)
- Weeks 8–11: Extremal Combinatorics (extremal graph theory, Ramsey theory, posets)
- Weeks 11–14: Linear Algebraic Methods (brief review, intersecting set systems, combinatorial designs)

Assessments:

- Problem Sets: assigned every 3ish weeks 30%
- Mini Projects: 3–4 short research projects assigned throughout the semester 50%
- Final Presentation: a short presentation based on a selected set of topics/problems 20%

More details about the projects and presentation will be provided in class. Any miscellaneous assignments (e.g. surveys, reflective writing) will be added to the problem set or mini projects categories. The final project and/or problem set may be due on April 22nd. Final presentations may take place during our final class or assigned final exam time, which is Wednesday, May 1 from 11:20AM–2:10PM.

Letter Grades:
I reserve the right to change the grade breakdown at the end of the semester. However, the threshold for each letter grade will only stay the same or decrease; it will not increase.

A ..... [90%, 100%]
B ..... [80%, 90%)
C ..... [70%, 80%)
D ..... [60%, 70%)
F ..... [0%, 60%)

Student Resources:

Disability Services
(404) 894-2563 // https://disabilityservices.gatech.edu/
The Office of Disability Services collaborates with students, faculty, and staff to create a campus environment that is usable, equitable, sustainable, and inclusive of all members of the Georgia Tech community. To receive accommodations and services, students must register with the Office of Disability Services, participate in an intake meeting, and present official documentation of their disability. If the documentation supports your request for reasonable accommodations, please have a Faculty Notification Letter sent to me as early as possible. Details are on the website linked above.

Academic Support

- Academic Coaching: https://advising.gatech.edu/academic-coaching
  Appointment-based coaching for academic success
- Communication Center: http://www.communicationcenter.gatech.edu
  Help with writing and multimedia projects
- Advising: http://advising.gatech.edu/
  Academic advisors for your major

Health and Wellbeing:

- The LGBTQIA Resource Center: https://lgbtqia.gatech.edu/
  The LGBTQIA Resource Center has numerous events and programs. The center also has resources to help students in crisis, victims of sexual violence, and more.
- Center for Mental Health Care and Resources: https://mentalhealth.gatech.edu/
  Services include testing and assessment, referral to support services, counseling, crisis intervention, mental health workshops, and consultation for faculty and staff, family and friends of Tech students. All services are confidential and free of charge for all Georgia Tech students.
- STAR (Students' Temporary Assistance and Resources): https://star.studentlife.gatech.edu/ Temporary assistance with food, housing, and financial emergencies
- Academic, Financial and Personal Assistance: https://studentlife.gatech.edu/services/academic-financial-personal-assistance
  Information about missing class, personal leave, and grievances.