CPSC S202 Mathematical Tools for Computer Science

Summer 2025 – Session A

Course Description

Introduction to formal methods for reasoning and to mathematical techniques basic to computer science. Topics include methods of proof, discrete mathematics, linear transformations, and probability theory.

Students are not assumed to have any experience writing proofs. However, emphasis will be placed throughout the course on developing proof writing skills.

Course Format

This course has three live in-person lectures (MWF) each week followed and we will offer weekly Review Sessions (TH) to support student learning.

Teaching Staff - TBD

	Name	**Email**
Primary instructor	Cody Murphey (he/him)	cody.murphey@yale.edu
Course Assistant		
Course Assistant		

Note that Ed Discussions will be the fastest way to get questions answered outside of office hours!

Office Hours Schedule - TBD

Sunday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**

Location: TBD

Prerequisites

No formal prerequisites, but mathematical maturity is expected.

Required Course Materials

The text we will use for this course is:

- *An Invitation to Discrete Mathematics, 2nd Edition* (Jiri Matousek and Jaroslav Nesetril)
    - We will cover Chapters 1, 3, 4, 5, 8, and 10!
    - An online text will be made available for student use

An additional reference made available by the department is Aspnes' canonical course notes:

- http://cs.yale.edu/homes/aspnes/classes/202/notes.pdf

Assessments and Grading

The course requirements consist of class attendance, 4 problem sets, 4 quizzes, and a final exam. Plan on spending between 8-12 hours per week on the course outside of class. The problem sets are an integral part of the course, and are focused on developing your comfortability with formal proofs.

By contrast, quizzes and the course exam will focus on applications of materials to ensure that students acquire both theoretical and practical skill sets.

Final grades in the course are determined by:

- 14% Attendance and Participation
- 24% Quizzes
- 30% Final exam
- 32% Problem sets

At the end of the course, one day of attendance and one quiz will be dropped from your grade. For problem sets, we will replace your lowest problem set score by the average of ALL problem set scores.

Late Submission Policy

To allow for the exigencies of computer failures and personal crises, each student has 2 discretionary late days for homework assignments. It is acceptable to use both late days for a

single assignment, turning it in up to 2 days late. These late days can be used for any reason and there is no need to get special permission to use them.

If both late days have been used, assignments may still be submitted up to 2 days late, but they will incur a 10% late penalty per day (5 minutes after the deadline is still considered 1 day late).

Course Communication

Course announcements and assignments will be handled through Ed Discussion. You are responsible for staying up to date! We will also use Ed Discussions for discussion and Q&A.

Access Ed Discussions using the link in the sidebar on the left.

Rather than using email for questions, you should use this space to discuss the course with classmates and ask questions of the instructors. You may not post answers or code for any assignment, or exam, in whole or in part. You may ask for assistance or provide assistance with homework problems (with respect to understanding what you are required to do), specific language syntax, compilation errors, program environments, topics discussed in class or in the textbook, and other course related matters. You are asked to treat each other with respect. Please do not post or respond with derogatory remarks, or these remarks will be removed at the instructor's discretion.

Accessibility

Our institution values diversity and inclusion; we are committed to a climate of mutual respect and full participation. Our goal is to create learning environments that are usable, equitable, inclusive and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify the instructor as soon as possible. Students are also welcome to contact Student Accessibility Services to discuss a range of options to removing barriers in the course, including accommodations.

Academic Integrity

The homework assignments in this course are intended to give you practice at working through problems independently. Therefore, unless otherwise specified, the homework assignments are your individual responsibility and are not group assignments. Some assignments will specifically tell you that they allow pair-programming. This allows you to work side-by-side with a partner and submit one solution for both of you. In these cases, each pair must still work independently of other pairs and each student within a pair is responsible for understanding the full program being submitted.

Plagiarism is a violation of University rules and will not be tolerated. You must neither copy work from others (at Yale or elsewhere) nor allow your own work to be copied. This also applies to AI generated work. In addition to grade penalties, additional consequences for breaking this policy may be imposed by the Yale College Executive Committee. Note that Gradescope will automatically

check your submissions for code similarity with your peers and past submissions to similar assignments.

You may:

- Ask others or search online for help with high-level course concepts that are not specific to the assignment.
- Ask clarifying questions and discuss specific issues about an assignment with a TA or instructor.
- Seek academic support via posted questions and integrated chat within Ed Discussions
- Query for basic mathematics identities and computations via software like WolframAlpha.

You may not:

- Discuss your individual solution with your peers.
- Receive a printed or electronic copy of anyone else's work for the course from this term or any other term.
- Give anyone else a printed or electronic copy of your work for the course from this term or any other term. This includes posting your work publicly on sites such as Github.
- Seek out solutions to similar assignments online.
- Query for proofs to aid in problem sets or similar assignments via software like ChatGPT.

If you have any questions about this policy or are unsure if you may have crossed a line, discuss it with the instructor as soon as possible.

List of Topics

- Week 1
    - Notation, Sets, Methods of Proof
    - Proof by Induction, Functions
    - Ordered Pairs, Relations, Equivalences
- Week 2
    - Combinatorics, Permutations, Adjacency Matrix
    - Binomials, Inclusion-Exclusion Principle
    - Estimates, Asymptotics, Algorithmic Applications
- Week 3
    - Graphs, Isomorphisms, Adjacency Matrix

    - Graph Scores, Euler Graphs
    - Directed Graphs, Connectivity
- Week 4
    - Trees, Isomorphisms, Spanning Trees
    - Minimum Spanning Trees, Determinants
    - Finite Probability Space, Expectations
- Week 5
    - Case Study: Randomized Algorithms
    - Topics Review