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CAS MA293: Discrete Mathematics, Fall 2024

Dr. Debra K. Borkovitz (she/her/any, dbork@bu.edu, CDS 425)

If a student finds pleasure and joy in finding a solution, in understanding a new concept, then this emotion is a sign of belonging to the mathematical community. Emotions are not fake and this joy provides the evidence that the student is not an imposter.

-- William Yslas Vélez

"Imposter Syndrome," AMS e-Mentoring Network, posted 1/25/2019

What Students Say about MAT293

Teamwork oriented and very engaging.

Project based; learn through experience and practice.

Not stressful, but you'll still learn a lot.

So fun it doesn't feel like a math class.

Unlike any other course I've ever taken.

A good way to learn new math topics without being penalized for mistakes.

Interesting, active, promotes growth.

It will make you love math!

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Welcome and Overview

Welcome to *Discrete Mathematics*! I hope you will enjoy the course as much as I do!

The overarching goal of the course is **for you and all your classmates to grow together as mathematicians**. I use the word *mathematician* to mean someone who actively engages with mathematics, similar to the way that in a writing class you are a *writer*, and in a singing class a *singer*. During class meetings, you and your classmates will actively inquire into meaningful mathematics.



To help you focus more on learning and less on grades, the course uses a portfolio-based alternative assessment system. Throughout the course we will focus on mathematical processes, especially Problem Solving, Reasoning, and Communication. The course topics are divided into three interconnected units: Combinatorial Games; Recursion and Mathematical Induction; and Counting.

All the illustrations in this syllabus are related to course content. What images do you find intriguing? What do you wonder about them? What questions do they suggest? What patterns do you see?

Logistics

Section A: Mon 11:15-12:05, CAS 214; Tue, Thur 11:00-12:15, MCS B29

Section B: Mon 1:25-2:15, CAS 214; Tue, Thur 2:00-3:15, CGS 527

Note that I don't make much of a distinction between "Lecture" and Discussion sections. Please plan on attending both.

Text: You do not have to purchase anything for this course. We will mostly use materials I've written and recorded. We will supplement with two free online textbooks, [*Discrete Mathematics: An Open Introduction*](#) by Oscar Levin, and [*The Book of Proof*](#) by Richard Hammack, as well as other resources.

Drop-In Hours:

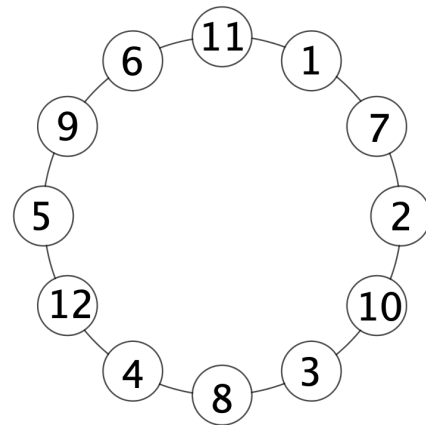
- Tues 4-5 p.m., Fri 2-3:30 p.m. in one of the collaborative spaces on the 4th floor of CDS (the blue one is my favorite). My office is 425. I'll message where we are on GroupMe.
- Note that I am supposed to reserve this Tuesday time for Department Meetings, but we don't have very many of them. In weeks that I have meetings, I'll announce alternatives to the Tuesday Drop-In hours.
- Drop-In Hours (formerly known as Office hours) are just that; feel free to stop by for any reason. There will always be puzzles to try and games to play. I enjoy hosting Drop-In Hours, and you aren't burdening me.
- I will also have some additional Zoom and in-person availability by appointment if these times don't work for you or if you need more privacy.

Communication: We will use Blackboard for assignments and GroupMe for general communication. Please use GroupMe instead of email whenever possible. Note that in general I will check GroupMe more frequently than email, and I will not check email/GroupMe on nights or weekends. If you have a question that a classmate may be able to help you with please send it to the whole group, especially at those times. For planning purposes, I'd appreciate it if you could DM me on GroupMe if you're going to miss class or be late.

Please sign up for our class GroupMe at <https://tinyurl.com/Mat293F24>.

Class Meetings and Groups

Our classes will be active. In many classes, you'll work on a problem or set of problems with a variable group of three students. Some classes will be "Work Days," where you'll have time to work on assignments with classmates or alone, as well as to get informal feedback from me. We'll have in-class time for working on almost every assignment that you turn in. We'll also have interactive whole class discussions; time for peer feedback, reflection, and goal setting; as well as a little bit of lecture.



Variable groups will help you meet your classmates, get many different perspectives on approaching problems, and practice working with different people. The groups will have structured roles, such as reporter, scribe, facilitator, and wanderer, and we'll set up guidelines to keep them respectful, inclusive, and productive.

A few weeks into the semester, I'll also survey your preferences and assign you to a bigger Home Group. You'll work with this group in class on your portfolios and on Excursions. If you're interested, you can also be part of a group that meets out of class.

The Math We'll Study

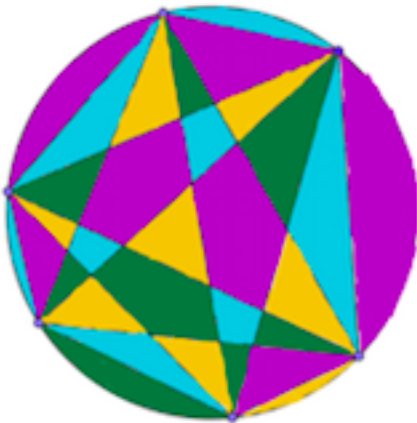
In designing this course, I've chosen depth over breadth. The course focuses on a coherent set of interrelated topics that build skills in problem solving, reasoning, communication, and other processes.

The class material is divided into CORE topics, which are the ones described in this section, and MORE work, which extends the CORE topics.

Units (Timing Approximate)

1. (Weeks 1-4) Introduction to the Course, Combinatorial Games
2. (Weeks 5-8) Recursion and Proof
3. (Weeks 9-13) Counting
4. (Week 14) End of Semester Work Time

Processes and Personal Goals



Growing as a mathematician involves problem solving, reasoning, communicating, and other process skills that can be hard to measure. Students also don't need or want the same things. To accommodate the diversity of students in the class, you'll set personal goals at the beginning of the semester. With these personal goals, you can focus on a few things that matter to you, decide what to keep track of to help you meet these goals, and reflect on your progress throughout the semester. You'll share your goals with your Home Group and support each other in meeting them.

Learning Markers

Early in the semester you'll get a Learning Markers Document with more details about the CORE course material, as well as with Process Learning Markers that will help you set your personal goal

Types of Work

Portfolio

You'll use an electronic Digication portfolio to document your learning, and at the end of the semester, to propose your grade. The portfolio includes artifacts, which can be photos of in-class work, assignments you turned in, homework you didn't turn in, videos, etc., as well as reflection on how these artifacts demonstrate that you've met Learning Markers for the course. You'll update your portfolio several times throughout the semester. You'll give and get peer feedback after each update, and I will make comments on one draft of your portfolio. Be sure to save all your work for possible inclusion in your portfolio.

Excursions

Excursions are interesting and challenging problems or sets of problems that you'll explore individually or with classmates and then write up individually. Excursions go beyond routine application of concepts from class.

For each of the two Excursions, you'll receive feedback from me and/or the grader. If your work isn't yet correct or complete, you'll revise and update it based on the feedback, until it is satisfactory. Revisions are due two weeks after you get your feedback. Sometimes you'll revise more than once, and if your work is close to satisfactory but not there yet, I may ask you to revise for your portfolio without resubmitting.

Consolidation/Practice Assignments

There will be three assignments to help you practice problems similar to the ones we'll do in class to help consolidate your understanding: Recursion, Mathematical Induction, and Counting.

Regular Homework

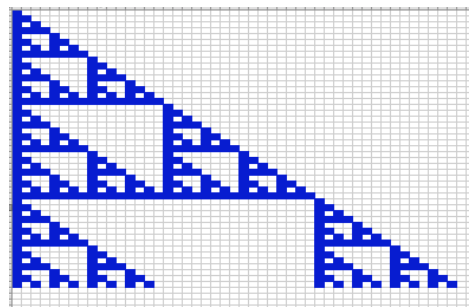
As in most math courses, there will be frequent homework assignments. Some of these assignments will prepare you for activities in the next class, some will follow-up from activities in the last class, some will involve practice, and some will involve sharing something with classmates. Although these assignments won't be collected, they can serve as artifacts in your portfolio.

Peer Feedback

Peer Feedback fits well into our overarching goal of growing together as mathematicians. You can learn a lot from seeing how other people approach problems. Both giving and receiving feedback can help you improve on all the process skills. Some peer feedback assignment will be highly structured, using the PeerMark features of TurnItIn, and some will be less formal.

Quizzes

Most of us are very good at self-deception: it's easy to think we understand something better than we actually do. Low stakes quizzes help they cut through self-deception and promote longer-term retention of knowledge. Most quizzes in the class are self-quizzes where you can check your results right after you submit the quiz; however, the Bubble Tea Quiz at the end of the semester is a challenging (and hopefully fun) quiz that will help you sort through tricky material. You'll get feedback on it and resubmit until it's 100% correct.



Joyful Finale

We will design together a celebration of our work, which will take place during the final exam slot (so please plan to be there). The finale will include Showcase Projects and possibly other activities (which the class will have input on).

MORE

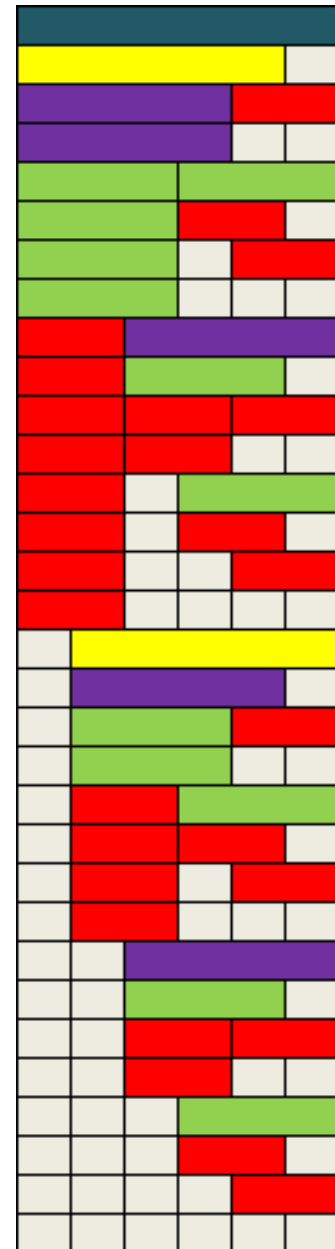
The MORE activities extend the CORE material we'll study. There are lots of choices, and these activities are only required for students aiming for an A in the class. Here are some types of MORE activities; see the MORE folder on Blackboard for more details:

- **Assignment Extensions:** The Excursions, Induction Assignment, and Consolidation/Practice Assignments will all have optional MORE work to do.
- **Extra Excursion:** Excursion 2 will have two choices; you can do both and count one as MORE.
- **Challenge Problems** – These are similar to Excursions, but on a variety of different topics.
- **Videos:** You can make a video to share with classmates.
- **Studying New Topics:** There are many topics that fall under the heading *discrete math* that we won't have time to study. You can study some sections the supplemental texts, watch videos I'll post, or use other resources.
- **Problem Posing:** Try extending some of the problems from class or coming up with your own question to solve and/or share with classmates.
- **Coding:** Class often provides ideas for coding projects.
- **Showcase:** Share a project at the Joyful Finale. You can do alone or with others.

Contributing to the Classroom Community

A strong classroom community will help everyone learn, and you are part of creating that community. If you are a quick thinker or someone who likes to talk, that's great, and that's also not the only way to participate in creating community in the classroom. Here are some ways to help build community:

- Focused engagement in class activities and discussions
- Giving thoughtful peer feedback
- Sharing mistakes, struggles, and successes, and thoughtfully responding when classmates' share theirs.
- Respecting and encouraging classmates.
- Helping classmates achieve their personal goals
- Volunteering to help set up and clean up the classroom, as well as to be a scribe or photographer for whole class activities
- Creating a Showcase Project to engage classmates or engaging classmates in other ways as part of your MORE work



Schedule of Assignments

I may need to tweak the dates in this schedule, depending on how class goes and on unforeseen circumstances. These are only the dates for assignments you turn in, not for regular homework that you don't turn in.

Rewrites for the Excursions and Induction Assignment are due two weeks after your feedback is returned. Bubble Tea Quiz rewrites will require a fast turnaround. I'll fill in the last dates when I have the final exam schedule.

Day	Date	Assignment	Feedback Type
Thu	Sept 12	Portfolio Update 1	Instructor
Thu	Sept 20	Mini-Excursion	Peer, In Class
Mon	Sept 30	Excursion 1	Grader/Instructor
		Excursion 1 rewrite(s), as necessary	Grader/Instructor
Mon	Oct 7	Portfolio Update 2	Peer, In Class
	Oct 8-Nov 25	Portfolio for Instructor Comments (sign up for due date)	Instructor
Thu	Oct 17	Recursion Cons/Prac – one problem	Peer, In Class
Mon	Oct 21	Recursion Consolidation and Practice	Peer, Out of Class
Thu	Oct 24	Peer Edits Recursion Cons/Prac	
Mon	Oct 28	Induction Assignment	Peer, In Class
Thu	Oct 31	Induction Assignment	Grader/Instructor
		Induction rewrite(s), as necessary	
Mon	Nov 4	Portfolio Update 3	Peer, In Class
Mon	Nov 11	Excursion 2	Grader/Instructor
		Excursion 2 rewrite(s), as necessary	Grader/Instructor
Thu	Nov 23	Counting Cons/Prac – one problem	Peer, In Class
Mon	Nov 25	Counting Consolidation and Practice	Peer, Out of Class
Tue	Nov 26	Bubble Tea Quiz	Grader/Instructor
	TBA	B.T. Quiz revisions, as necessary	Grader/Instructor
	TBA	Last date submit Excursion Rewrites	
	TBA	Last day submit B.T. Quiz rewrites	
	TBA	Final Portfolio	Instructor

Flexibility/Late Papers Policy:

- Please note that I have three classes and 90 students this semester. My aim is to give each student substantive feedback throughout the semester, while also taking good care of myself. I've scheduled the assignments to give myself a reasonable pace for providing feedback. Turning in your assignments on time will help me keep on pace, and I appreciate it.
- However, I don't want you to endanger your health or be tempted to cheat because a due date is approaching and you're too sick, or in the middle of an emergency, or too overwhelmed to take care of yourself and get your work in on time.
- If you need to turn in an assignment up to a week late, please fill out [this form](#). However, don't use this option to routinely assume the due date is a week later; use it when you need it.
- If you are further behind and need to turn in an assignment more than a week late, please contact me to make a plan.

Assessment/Grades

Feedback is critical to helping you grow as a mathematician; grades are not. There is a lot of research that shows that students pay less attention to feedback if there is a grade attached. In designing the assessment system, my hope is to relieve enough anxiety about grades so that you can focus on growing as a mathematician, rather than on scheming to get a good grade.

For your Final Portfolio, you'll write a Grade Proposal. Below are guidelines for the grades A, B, and C; you need to complete everything on the list for a particular grade. However, if your work doesn't match the guidelines exactly, you

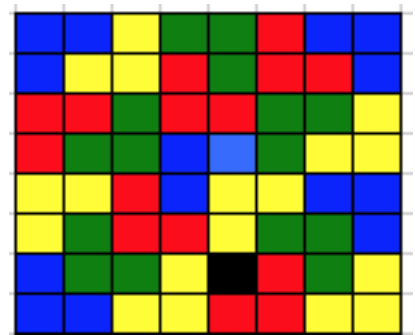
can propose grades with plusses/minuses and/or explain why you think you've done equivalent work.

Guidelines for an A:

- Demonstrates solid understanding of almost all aspects of the CORE learning markers.
- Satisfactory on both Excursions, the Induction Assignment, and the Bubble Tea Quiz.
- Thoughtful, organized portfolio that includes everything in the assignment
- Consistent contributions to the classroom community.
- Spends at least eight hours over the course of the semester working on MORE topics, with strong portfolio artifacts and a thoughtful reflection about what you learned from the work.

Guidelines for a B:

- Demonstrates solid understanding of at least 80% of the CORE learning markers.
- Satisfactory on one Excursion, with strong work on the other.
- Satisfactory Induction Assignment.
- Strong work on the Bubble Tea quiz.
- Thoughtful, organized portfolio that includes almost everything in the assignment
- Many contributions to the classroom community



Guidelines for a C:

- Demonstrates solid understanding of at least half the CORE learning markers.
- Strong work on at least one Excursion
- Some contributions to the classroom community.

Five Promises

1. Wholeness: You and I are whole human beings, who are embodied, have complex emotions, are embedded in networks of relationships, and have responsibilities and interests beyond this course. We have identities and histories that impact how we see ourselves and how others see us. My first promise to you is to see you as a whole person, to honor you, and to value your physical and mental wellbeing independent of your performance in this class.

2. Power/Trust: As your professor, I have power in our relationship, and my second promise to you is to be responsible and accountable in using this power. I will start by trusting you and assuming that you want to learn and are doing the best that you can do right now. I don't expect you to start by trusting me, but I hope that I will earn your trust. It is possible that I will lose trust in you, but I will not expect this outcome.

3. Success: I want you to do well in class, and I will work with you to meet your access needs (whether or not you have official accommodations). I know that sometimes issues in other parts of your life can make it hard for you to do your best work and that you are more than what I see in this class. If you are struggling, I will start by assuming there is a good reason for those struggles.

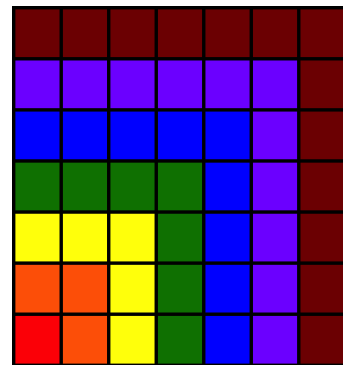
4. Boundaries: My fourth promise is to set boundaries so that I can take care of myself. I can only see you as a whole person if I also see myself as a whole person. In order to be both energetic and calm as your teacher, I need rest and time for myself and for my relationships.

5. Joy, Wonder, and Connection: My last promise is to share my love of math with you and to teach in a joyful way that promotes wonder and helps us connect with each other

Advice

From Me

- Think! In order to grow as a mathematician, you have to think -- You can't just mimic, Google, ask ChatGPT, or memorize. Enjoy thinking for yourself. Play with ideas.
- Persist. Engage in productive struggle. Tolerate being stuck or confused; it's part of the process.
- Make mistakes and learn from them. Perfection is neither possible nor required.
- Prepare for class, and as you are able, attend class (on time).
- Establish a steady rhythm of work outside of class. In this class the workload will be relatively consistent. Working in shorter sessions (20 minutes to an hour – depending on the person) followed by breaks can help you retain knowledge better. Going back to a problem after a break can yield fresh insight.
- Work with others from the class outside of class. Groups working together can often easily find small mistakes, so the group can spend their time on more substantive matters.
- Visit me at Drop-In Hours or make an appointment.
- There are many things outside of our control, and we can't always do our best work, despite our efforts. It can be quite disappointing to not be able to do as well as you know you are capable of. Know that I never interpret poor performance as saying anything intrinsic about who you are and what you are capable of doing.



From Fall 2022 Students

- Talk to partners! Ask questions! Don't be afraid to be wrong
- Place more importance on learning than just merely completing the assignments
- Attendance is key!
- Enjoy group discussion -- grow together with others.
- Keep trying hard.
- Stay on top of your work and start working on the portfolio early
- Take pictures of every class board from the start; I missed out on a lot of good portfolio stuff since I only took photos sporadically.
- Be friendly. Group work (which is a lot of the class) is a lot more manageable when you can smile and laugh with people you've never met before.
- This class is about discrete math but it is not just doing calculations and remembering formulas, and you need to take more time on explaining your idea and solutions.
- Make sure to have someone or a group of people that you could work with outside of the class because it would help with your understanding of the assignments. Also, make sure to take advantage of the revisions to fully understand the problems and concepts.
- TAKE PICTURES. TAKE PICTURES. TAKE PICTURES. Also try to work in as big a group that you can, just to try the experience and if you don't like it work in progressively smaller groups until you find the best fit for yourself. This class is one of the rare opportunities in college for self-driven learning in a classroom environment for a semester so try to make the most of it.
- The course is what you make of it for many aspects and if you are interested in exploring a certain topic further the resources are there.

More Policies and Information

Attendance: Our classes will be active, and as a student said above, attendance is key! Please plan on coming to class, on time, whenever you are able to. If you miss class, check Blackboard.

If there's something in your life that's interfering with your ability to engage in the course, please feel free to talk to me about it, to see if there's a way I can help make the class work better for you. You only need to share the details you want to share. You don't need to bring me a doctor's note; I don't read them. Please note that I have considerable experience with chronic illness and how it impacts academic life.

Academic Conduct: All writing for this course must be solely your own, unless the assignment is explicitly a group assignment. Larger assignments will include an acknowledgement section, where you can credit your classmates by name for ideas you learned from them or work you did together, and if allowed, you can also cite external resources you used. Plagiarism will be addressed according to the [Boston University Academic Conduct Code](#). We will discuss academic conduct as it applies to specific assignments when appropriate.

Internet, AI, Other External Resources: In many cases, I do not want you to do internet searches or use AI tools such as ChatGPT, as they will remove the joy and learning involved in solving a problem by yourself or with classmates. However, I was away last year, and have not taught much since AI tools have become widely available. I am open to exploring with you how these tools might support our goal of growing together as mathematicians. Certainly there are interesting possibilities for MORE projects involving AI.

Incompletes: If you have health issues, an emergency, or find yourself in other difficult circumstances that affect your performance in the course, you may be eligible for an incomplete, where you would finish the work after the semester ends. Please feel free to talk to me about this possibility.

Access Needs/Accommodations: I am committed to doing what I can to make the class accessible to you, whether or not your access needs are officially documented. Please feel free to talk to me about ways we can make the class work better for you.

If you have a documented disability or believe you might have a disability that requires accommodations, please contact the Office for Disability Services (ODS) at (617) 353-3658 or access@bu.edu to coordinate any reasonable accommodation requests. ODS is located at 19 Buick Street.

Changes: I reserve the right to make changes to this syllabus to better meet the needs of students in the class. If appropriate, students might have input into these changes. Any changes will be clearly documented with sufficient notice for students to adapt.

WELCOME!