Course Syllabus

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CMPS/MATH 2170.01 Discrete Mathematics

Spring 2025

Class Description

In the game Minecraft, the universe is composed of tiny cubes, called voxels. These voxels are discrete, meaning that there is no voxel between two adjacent voxels. In contrast, many theories about our physical universe posit a continuum of spatial positions. Unlike the discrete universe of Minecraft, between any two points, there is a third. In order to understand our universe, physics motivated the development of continuous math: calculus, differential equations.

But around 1950, everything changed with the advent of digital logic and our subsequent transmigration into digital realms like Minecraft. In this , discrete digital world, mathematics becomes elegant. We avoid issues related to limits, infinities and Zeno's paradox and discuss questions that are more directly linked to our digital existence. Ultimately, it's all 0's and 1's.

This course is an introduction to discrete mathematics, which includes several areas of mathematics that are particularly useful in computer science. The topics include:

- Propositional and predicate logic
- Boolean functions
- Sets and functions
- Proofs
- Mathematical induction and recursion
- The Wilf-Zeilberger technique
- Counting
- Number Theory
- Graphs
- Tableaus and Permutations

Prerequisites

Calculus I (MATH 1210 or MATH 1310 or MATH 1150) or Probability & Statistics (MATH 1110). In lieu of prerequisites please contact the instructor for consideration.

Time & Place

There are 2 sections of the lecture. Students can attend either section.

Lectures: MWF 11:00am - 11:50am, ST 302
MWF 1:00pm - 1:50pm, ST 302

There are also 2 sections of the lab. Students can attend either section.
Lab1: T 8:00am - 9:15am, GI 126
Lab2: T 12:30pm - 1:45pm, GI 126

Students may choose to attend either lab.

Textbooks

Required:

Discrete Mathematics Zybook. Please subscribe to it by clicking on "Zybook" in **Resources (https://tulane.instructure.com/courses/2289942/modules/3835666)** .
(Find PDF online) Kenneth H. Rosen, *Discrete Mathematics and Its Applications*, McGraw-Hill. Any edition, such as the **7th (http://highered.mcgraw-hill.com/sites/0073383090/information_center_view0)** or the **8th (https://www.mheducation.com/highered/product/discrete-mathematics-applications-rosen/M9781259676512.html)** .

Optional:

Concrete Mathematics,
A=B,

Instructor

Victor Bankston
Stanley Thomas, 312
E-mail: **lbanksto@tulane.edu (mailto:lbanksto@tulane.edu)**
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Teaching Assistants

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Technologies

There are many technologies that are used throughout the course. They all do different things and have funky names, so it can be confusing. Here is a rundown of the technologies that are used in the course.

- **Canvas**
  Canvas is the learning management software that hosts this syllabus. It houses all official information about this course, like grades. Gradescope and Zybooks (see below) interface with Canvas. You must already have an account if you are reading this.
- **Zybooks**
  Zybooks is the interactive textbook where regular readings will be completed. The readings will have questions that automatically update your grade in Canvas. You should **sign up (https://learn.zybooks.com/zybook/TULANECMPS2170MATH2170Spring2025)** .
- **Gradescope**
  Gradescope (https://www.gradescope.com/courses/946945) is a tool that assists in grading the homeworks. You will upload your homeworks digitally as PDFs, and we will grade it. The grades will automatically update Canvas. You should create an account. Our course has entry code: NYKGGJ
- **Mathematica**
  Mathematica is a computer algebra software that we will use to perform calculations. It is available for free using a Tulane email. See the instructions **here (https://tulane.instructure.com/courses/2289942/files/120116406?wrap=1) (https://tulane.instructure.com/courses/2289942/files/120116406/download?download_frd=1)**
- **Overleaf**
  Overleaf is a cloud-based Latex service. Latex is a system for writing technical documents, and Overleaf allows you to use this system over the cloud. You don't need to register or subscribe.

Policies

Class Schedule

The **class schedule (https://calendar.google.com/calendar/u/0?cid=MjMwYjA3Mjg3NDJhOWY0ZTcwMmUwYmEwNDNkODc2NmRiMGFmM2U5YTFkYjBhZWZjZDJkNDQ4YW** shows the topics that are covered in the lectures and labs each day, as well as due dates for readings and homeworks. The readings are intended to be done before the associated class. The class schedule is subject to change, 2 weeks or more into the future. If the class schedule is changed, then we will make an announcement on Canvas. Most likely, it will change once during Mardi Gras break.

Zybook and Readings

We are using a Zybook textbook. **Please subscribe/enroll by clicking on "Zybook" in the Resources module (https://tulane.instructure.com/courses/2289942/modules/3835666) .** (Do not go to the zyBooks website and create a new account). A subscription is $64 and will last until May 14, 2025. If you have any problems with ZyBook, let me know. The ZyBook customer service is really helpful.

Labs

Lab sessions will be held in person.

There will be short quizzes in some of the labs.

Homework Assignments

There will be weekly homework assignments each worth 25 points that are due within one week. Homeworks will be posted on Canvas in the form of a link to an overleaf document. Once the homework is submitted, I will not edit the problems without explicitly writing "EDIT."

You are encouraged to submit homeworks in **groups of two (but not three).** Each group should turn in a single homework submission with two names. In Gradescope, you will make 1 submission with a group of 2. You are allowed to discuss rough ideas and thoughts about a homework assignment with your other classmates, but you have to **write up your solution on your own (with your group partner)**. You may change partners between assignments.

The best way to write up solutions is to create a PDF using Latex. It is also acceptable to neatly handwrite solutions and take a picture.

Exams

There will be a midterm and a final exam. The midterm will be non-comprehensive, but the final exam will be comprehensive. You will be allowed to prepare 5 single-sided pages for the midterm exam. The final will be take home and open-notes.

Late Policy

Homeworks will be due at a regular time. The deadline is enforced automatically by Gradescope. It will mark all assignments submitted after the deadline as "late." The homework on Gradescope that is marked late will not be graded, unless the student has an excuse. After a secret (but constant) amount of time on the scale of days, Gradescope will no longer allow submissions.

Readings may not be completed late.

In extra-ordinary cases, contact the instructor **prior** to the due date to get an extension. If you miss the deadline for a reading, you are encouraged to still complete the reading in order to make up the material you have missed.

If possible, I will give credit for late readings at some point in the semester.

Grading

Grading will be based on the following weighted scale:

- 25% Homeworks (~13 homeworks each worth 25 points. The lowest few HW grades are dropped until 10 HW grades remain).
- 25% Readings (120 points subtracted from total points possible). Capped at 100%.
- 10% Quizzes (~10 quizzes each worth 10 points. The lowest few quiz grades are dropped until 8 quiz grades remain.)
- 20% Midterm
- 20% Final

The weighted average will determine your letter grade roughly as follows:
A >= 90%; B>=80%; C >= 70%; D >= 60%; F < 60%.

Other than the readings, no portion is capped at 100%.

Regrade Requests

You may request a regrade on particular problems if you think there has been a mistake. Gradescope provides functionality for this. Please reserve this for cases where you believe there has been a mistake. For example, if you actually got the problem correct, and it was marked incorrect, or if it is obvious that the rubric was applied incorrectly in awarding partial credit. Don't request regrades if you believe the rubric itself is too harsh.

Extra Credit

I reserve the right to assign extra credit assignments. It's hard to think of good problems that are related to the discussions and are interesting but not too difficult, yet not something that you could just ask an LLM.

Academic Integrity

The Code of Academic Conduct applies to all undergraduate students, full-time and part-time, at Tulane University. Tulane University expects and requires behavior compatible with its high standards of scholarship. By accepting admission to the university, a student accepts its regulations (i.e., **Code of Academic Conduct (https://college.tulane.edu/academics/academic-integrity/code-of-academic-conduct)** and **Code of Student Conduct (https://conduct.tulane.edu/resources/code-student-conduct)**) and acknowledges the right of the university to take disciplinary action, including suspension or expulsion, for conduct judged unsatisfactory or disruptive.

You are strongly encouraged to turn in homeworks in **groups of two**. In addition, you are allowed to discuss rough ideas and thoughts about a homework assignment with your other classmates, but you have to **write up your solution on your own (with your group partner)**. You are not allowed to read, copy, or rewrite the solutions of exactly the homework problems written by others (in this or previous terms or from the web). You may search for information on the internet that is related to the homework questions, but you must disclose any sources that were significantly helpful. For example, if you find the solution to a similar (but not the exact question), you may read this solution and think about modifying it. You may use LLMs or other resources, but you incur the extra burden of justifying their unreliable outputs. You are encouraged to use Mathematica. You may discuss Zybook reading activities with your other classmates, but should complete them on your own. Quizzes and exams have to be completed entirely on your own.

All incidents of academic dishonesty will be reported to the Associate Dean of Newcomb-Tulane College. If several people are involved in sharing solutions then all parties (e.g., the copier and the copiee) will be held equally responsible.

Attendance Policy

Students are expected to attend all classes and labs in person, unless they are ill or prevented from attending by exceptional circumstances. Students who find it necessary to miss a class or lab session are responsible for obtaining notes on material covered in the session.

Students are responsible for notifying instructors about absences that result from serious illnesses, injuries, or critical personal problems. Medical excuses are issued by the Student Health Center in the following instances: illnesses or injuries that involve hospitalization, a partial or complete withdrawal due to medical reasons, or a missed final examination for a medical condition being treated by the Student Health Center. In all of these instances, medical information will be released only with the student's written permission.

With the approval of the Newcomb-Tulane College dean, an instructor may have a student who has excessive absences involuntarily withdrawn from a course with a WF grade after written warning at any time during the semester.

Goals and Teaching Philosophy

The Modern World: "Information Overload"

ChatGPT has exacerbated a problem that has existed for a long time: how to sort the deluge of information, some of which is inaccurate or poorly written? In the prescient words of Johnny Mneumonic: "Information overload". The ancients knew the solution. Euclid's book, The Elements, was the first that time knowledge had been organized into a system of propositions, proofs and axioms. For two thousand years, mastering The Elements was a cornerstone of Western education. The point was not just to teach facts of geometry, but to instill an ethos that knowledge is possible.

But just when we needed them most, The Elements vanished from the curriculum. It's too tedious. Our attention spans suck. Thank you for reading this. Yet we still need knowledge and a system to verify that knowledge. Luckily, with modern technology we can achieve these results. This is one reason that we will use Mathematica.

The other reason to use Mathematica is its power. As part of my PhD research, I needed to reduce a complicated summation that was claimed in a paper. But there was no proof. The author said the proof was gone, and he had retired. I asked many leading experts, and they were stumped. It was a piece of lost knowledge, irretrievable. Eventually, I asked Dr. Amdeberhan in the math department and his solution was astonishing. He knew of a special technique to solve practically any summation. The method doesn't just give the answer. It also gives an irrefutable justification, also called a proof. And it's completely mechanical- you just enter the summation into a machine and the solution -and its justification- comes out routinely. This is the Wilf-Zeilberger technique that we will study.

The lesson that I took away from that experience is that the value of skills has changed. Students should embrace modern tools and focus on literacy.

Goals

My goals for this class is for students to be able to:

1.) Answer numerical and True/False questions
2.) Use modern tools like Mathematica
3.) Read and write mathematical arguments
4.) Identify flaws in arguments

Group Work

Working in groups is beneficial to learning. The reason for this is that working in groups requires communication between group members, and so is a step toward achieving goal 3. Many of the rules about writing proofs or notations may seem arbitrary and pedantic. My hope is that communication with a partner gives some motivation to the need for clarity and standard definitions.

Students also benefit from the opportunity to see how others work, and potentially adopt useful work habits. For this reason, consider rotating partners throughout the semester.

Explaining the Course Structure

Homeworks

The primary vehicle for achieving these goals is the homeworks. Because regular practice is key, the problem sets should go out weekly. Some problems in each should be difficult, but the students may use modern resources and work in groups. One reason for having difficult problems is that they are intended to stimulate discussion and thought. Easy problems don't create much room for thought. I will not give any unsolvable or open problems as homework problems. One week, I might give a reading assignment instead of problems.

Lectures

The lectures are intended to contextualize the homework problems. I will not take attendance, but I hope that you will come to class because it's easy. Unlike the homeworks, you don't have to do anything. I won't cold-call on anyone. You have the opportunity to ask questions. Anything could happen.

Readings

There are readings that accompany the lectures, mostly in the interactive textbook Zybooks. They come with simple questions. The Zybooks questions should be much easier than the homework problems. These readings must be completed prior to the lecture that they accompany, as indicated on the calendar. The point of the readings is to promote literacy and provide an additional channel to convey the material from the lecture. I will select certain readings not associated with Zybooks. I will give 1 or 2 videos.

Labs

This course comes with a lab component. I will work with the TAs to create Mathematica notebooks that illustrate a particular concept. By tweaking the notebook, you will be able to answer a quiz question. The point is to provide a check that you understand the concept and how it is expressed in the Notebook.

Exams

There will be 2 exams: a midterm and a final exam. One reason to have exams is to provide an opportunity to review all of the material so that it is easier to see how the individual topics fit together. The exam questions should emphasize understanding rather than memorization or calculation. Good exam questions should be variants of homework problems or general questions about the significance and relationships between topics. The students should get practice exams.

Choice of Topics

I cannot anticipate the particular skills that students will need when they enter the "real world." Instead, my aim is to provide enough core knowledge and and literacy skills so that students are capable of

independent learning. To this end, the topics in this class can be partitioned into three:

- Foundational topics:
  - Propositional and predicate logic
  - Boolean functions
  - Sets and functions
  - Proofs

  These topics establish a common epistemic perspective. Without them, knowledge is impossible. Where would we be without logic? If knowledge is a "true justified belief" as the philosophers claim, then what are the rules of justification? What does it mean to "prove" something? How can knowledge be certain when error is always possible?
- Core topics
  - Induction and Recursion
  - Counting
  - Probability (Updated, March 9th, 2025)
  - Number Theory
  - Graphs

    These are basic skills and concepts that most educated people should know. The point is that new concepts can be explained in terms of familiar core topics. For example, most people describe a unicycle as a bicycle, but with one wheel. The new concept (unicycle) has been explained in terms of the familiar concept (bicycle). These core topics are part of a canonical knowledge base that "everybody knows."
- Advanced topics
  - The Wilf-Zeilberger technique
  - Tableaus and Permutations

    The advanced topics build on core topics and certify that the core topics really can be useful. They provide examples of how the core topics can be extended to something more interesting or practical. You may not have a use for the particular advanced topics that we cover. However, it should not be hard to imagine that the particular skills that you do need can be explained in terms of core topics, similarly to the advanced topics that we cover. Based on this, you will be able to teach yourself the skills that you need.

Topics that are not covered:

"Discrete math" describes a rich variety of ideas. It is not possible to cover all of them. Here are some topics we will not cover that could reasonably be covered in this course.

- ~~Probability Theory: This topic is so important that it has been designated to its own required class, Probability and Statistics. We will cover counting, which is equivalent to probability theory in the discrete setting.~~ Edit: Actually, probability is not a required class. We will cover it a little.
- Algebra/Group Theory: These are important topics, but they take a lot of time and are covered by designated math courses.

- Partial orders and lattices: Maybe we should teach this. This is 1st on the list to promote if there's time.
- Error Correcting Codes: Should be its own course.
- Turing Machines: Sometimes covered in Algorithms.

ADA / Accessibility Statement

Any students with disabilities or other needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and should contact the Goldman Center for Student Accessibility: **http://accessibility.tulane.edu (http://accessibility.tulane.edu/)** or 504.862.8433.

Title IX

Tulane University recognizes the inherent dignity of all individuals and promotes respect for all people. As such, Tulane is committed to providing an environment free of all forms of discrimination including sexual and gender-based discrimination, harassment, and violence like sexual assault, intimate partner violence, and stalking. If you (or someone you know) has experienced or is experiencing these types of behaviors, know that you are not alone. Resources and support are available: you can learn more at **allin.tulane.edu. (https://allin.tulane.edu/)** Any and all of your communications on these matters will be treated as either “Confidential” or “Private” as explained in the chart below. Please know that if you choose to confide in me I am mandated by the university to report to the Title IX Coordinator, as Tulane and I want to be sure you are connected with all the support the university can offer. You do not need to respond to outreach from the university if you do not want. You can also make a report yourself, including an anonymous report, through the form at tulane.edu/concerns.

Confidential	**Private**
Except in extreme circumstances, involving imminent danger to one’s self or others, nothing will be shared without your explicit permission.	*Conversations are kept as confidential as possible, but information is shared with key staff members so the University can offer resources and accommodations and take action if necessary for safety reasons.*
**Counseling & Psychological Services (CAPS)	(504) 314-2277**	**Case Management & Victim Support Services	(504) 314-2160 or srss@tulane.edu (mailto:srss@tulane.edu)**
**The Line (24/7)	(504) 264-6074**	**Student Affairs Professional On-Call (24/7)	(504) 920-9900**

Student Health Center | (504) 865-5255	**Tulane University Police (TUPD) | Uptown - (504) 865-5911. Downtown – (504) 988-5531**
Sexual Aggression Peer Hotline and Education (SAPHE) | (504) 654-9543	**Title IX Coordinator | (504) 314-2160 or msmith76@tulane.edu (mailto:msmith76@tulane.edu)**

Emergency Preparedness & Response