

Discrete Structures I COMP 1805 (Fall 2023)

Course Information

Introduction to discrete mathematics and discrete structures. Topics include: propositional logic, predicate calculus, set theory, complexity of algorithms, mathematical reasoning and proof techniques, recurrences, induction, finite automata, and graph theory. Material is illustrated through examples from computing. **Prerequisites** additional credit for MATH 1800. **Prerequisite(s)**: one Grade 12 university preparation mathematics course. **Minimum grade of C-** in COMP 1805 is required in order to take COMP 2804, COMP 3005, COMP 3007, or COMP 4001.

Instructor	Alexa Sharp (she/her) --- call her Prof Alexa			
Email	alexasharp3@cunet.carleton.ca – read email doc first			
Lectures	A	Thurs & Tues	2:35pm - 3:55pm	hyflex
	B	Wed & Fri	1:05pm - 2:25pm	hyflex
	C	videos	anytime	asynchronous
Tutorials	A1 & A4	Wed	8:35am - 9:25am	in-person
	A2	Wed	10:35am - 11:25am	in-person
	A3	Wed	9:35am - 10:25am	in-person
	A5	Wed	1:35pm - 2:25pm	in-person
	B1	Tue	10:35am - 11:25am	in-person
	B2	Tue	4:35pm - 5:25pm	in-person
	B3	Tue	1:35pm - 2:25pm	in-person
	B4	Tue	11:35am - 12:25pm	in-person
	B5	Tue	12:35pm - 1:25pm	in-person
	C	videos	anytime	asynchronous
Classroom	see Carleton’s public class schedule for most up-to-date location			
Student Hours	schedule on brightspace held on discord voice channel			
Course Website	https://brightspace.carleton.ca/d2l/home/			
Course Resources	lecture zoom link	posted on brightspace		
	lecture recordings	posted on brightspace and course schedule		
	piazza	piazza.com/carleton.ca/fall2023/comp1805		
	topic schedule	posted on brightspace		
	gradescope	https://www.gradescope.ca/courses/11068		
Q&A Forums	piazza (primary, structured), discord (non-anonymous, informal)			
Textbook	David Liben-Nowell’s <i>Connecting Discrete Mathematics and Computer Science</i> . A free PDF version is https://cs.carleton.edu/faculty/dln/book/ .			

Inclusivity Statement. I am committed to fostering an environment for learning that is inclusive for everyone regardless of gender identity, gender expression, sex, sexual orientation, race, ethnicity, ability, age, class, etc. All students in the class, the instructor, the course staff, and any guests should be treated with respect during all interactions.

Learning Outcomes and Topics Covered

A detailed list of topics to be covered, including dates, deadlines, and required reading for each week, are posted on our [course schedule](#).

By engaging with the course material through practice, a student should:

1. become comfortable reading and using mathematical terminology (i.e. vocabulary)
 - sets, functions, propositional and predicate logic, asymptotic notation, recursion, graphs, trees, relations
2. become comfortable reading and writing beautiful mathematical proofs
 - direct proofs, proofs by counterexample, proofs by construction, proofs by contradiction, proofs by contrapositive, proofs by induction
3. improve problem solving and critical thinking skills, such as
 - using examples, counter-examples, diagrams, simpler cases, similar problems, etc., to better understand a mathematical statement;
 - recognizing a broken/false start and using it to find a new approach; and
 - thinking critically about which proof paradigm is most appropriate.

Workflow

This course is meant to introduce you to the language of discrete mathematics. As with any language, you must learn vocabulary and rules in order to speak the language, and then you must practice, practice, practice. Lectures provide the vocabulary and rules; drills, tutorials, and problem sets provide the opportunity and incentive to get practice with varying degrees of guidance. Every aspect of the course serves the final goal of enabling you to speak (discrete) mathematics fluently, so that you are a kick-ass problem solver. But you must practice.

In a **perfect** world, your weekly course workflow (10h outside of lecture) would be:

- Before lecture, *skim* the [reading for that lecture](#) in the [textbook](#), and look over the [The More You Know document](#) for some lecture-specific math review (10 mins/lecture).
- Attend or watch the week's lectures to be exposed to the new material (80 mins/lecture).
- Each week, do [drills](#) to practice the vocabulary, notation, and high-level concepts (e.g. what does that word mean? When is this approach better than the previous?) (1h/week).
- Each week, attempt the tutorial problems, [watch](#) and/or attend tutorial, then complete accompanying [exercises](#), to get hands-on practice with some guidance (e.g. make one sentence at a time using new vocabulary and rules) (3h/week).
- Each week, complete a problem set to get more independent practice (e.g. write an essay using your new vocabulary and new ideas) (6h/week).
- Reference the [textbook](#) and [lecture notes](#) as needed.

Of course, this workflow won't work for you all, but it is something to aspire to.

Lectures

Whatever your course delivery preference for a given day, there is an option for you.

If you want to attend **in-person**, you are welcome to attend Section A or Section B's lectures. Prof Alexa believes that in-person lecture is the most engaging and effective way to learn the material, but understands that flexibility is important to you.

If you want to attend **live over zoom (hyflex)**, you are welcome to attend Section A or Section B's lectures over zoom. This is not as good as attending in person, as you cannot see all boards at the same time, and **Prof Alexa cannot effectively take your questions**, but it is good enough given the circumstances. You can find the most up-to-date zoom lecture link on brightspace; please do not share this link with anyone outside of this course. Please mute your microphone; if you have questions, please ask by typing it in the chat; Prof Alexa will get to it if she can. Do not use the chat for irrelevant comments so that Prof Alexa has a chance to see your questions.

If you want to view **asynchronous recordings** (on your own schedule), Prof Alexa has recordings posted on brightspace and the [course schedule](#).

If you switch between modalities (which is ok!), you may encounter minor variation in the schedule and presentation. We try to stick to the plan, but each lecture experience is unique to the students in attendance and Prof Alexa's current state of mind.

Tutorials

In-person (interactive) tutorials are preferred, but brightspace has videos for those wishing an asynchronous option. There is no hyflex option for tutorials (too much overhead for our TAs). You may attend any tutorial that suits you, regardless of your registered section.

Asynchronous Learners

Note that while almost all of this course may be taken asynchronously, you must be available synchronously (but not in-person) for our final test, which is scheduled by Carleton.

Community Guidelines

The following values are fundamental to academic integrity and are adapted from the International Center for Academic Integrity¹. In our course, we will seek to behave with these values in mind:

¹ This class statement of values is adapted from Tricia Bertram Gallant, Ph.D.

	As students, we will...	As a teaching team, we will...
Honesty	<ul style="list-style-type: none"> • Honestly demonstrate our knowledge and abilities on assignments and exams • Communicate openly without using deception, including citing appropriate sources 	<ul style="list-style-type: none"> • Give you honest feedback on your demonstration of knowledge and abilities on assignments and exams • Communicate openly and honestly about the expectations and standards of the course through the syllabus, and with respect to assignments and exams
Responsibility	<ul style="list-style-type: none"> • Complete assignments on time and in full preparation for class • Show up to class on time, and be mentally/physically present • Participate fully and contribute to team learning and activities 	<ul style="list-style-type: none"> • Give you timely feedback on your assignments and exams • Show up to class on time, and be mentally & physically present • Create relevant assessments and class activities
Respect	<ul style="list-style-type: none"> • Speak openly with one another, while respecting diverse viewpoints and perspectives • Provide sufficient space for others to voice their ideas 	<ul style="list-style-type: none"> • Respect your perspectives even while we challenge you to think more deeply and critically • Help facilitate respectful exchange of ideas
Fairness	<ul style="list-style-type: none"> • Contribute fully and equally to collaborative work, so that we are not freeloading off of others • Not seek unfair advantage over fellow students in the course 	<ul style="list-style-type: none"> • Create fair assignments and exams, and grade them in a fair, and timely manner • Treat all students equitably
Trust	<ul style="list-style-type: none"> • Not engage in personal affairs while on class time • Be open and transparent about what we are doing in class • Not distribute course materials to others without authorization 	<ul style="list-style-type: none"> • Be available to all students when we say we will be • Follow through on our promises • Not modify the expectations or standards without communicating with everyone in the course
Courage	<ul style="list-style-type: none"> • Say or do something when we see actions that undermine any of the above values • Accept a lower or failing grade or other consequences of upholding and protecting the above values 	<ul style="list-style-type: none"> • Say or do something when we see actions that undermine any of the above values • Accept the consequences (e.g., lower teaching evaluations) of upholding and protecting the above values

Online Community Expectations

Please be considerate and respectful while engaging with peers and course staff and remember that we are all humans, and that your words matter. This includes in the zoom chat and on any course-related forums such as piazza and discord. It is not acceptable to use offensive language nor disparage a person or group, no matter the intent. We recommend you read over our piazza posting etiquette as well as our discord #rules-please-read channel. You are responsible for behaving within these parameters.

If any student witnesses or experiences harassment, I encourage you to reach out to me. Alternatively, you can contact [Ombuds Services](#) or [Carleton Equity and Inclusive Communities](#).

Course Work & Evaluation

Schedule, Readings, Deadlines, Lecture Notes & Recordings

The [course schedule](#) is a detailed document with textbook readings, lecture notes, lecture and tutorial recordings, as well as links to and deadlines for problem sets, drills, tutorials, and any other coursework. You'll want to bookmark the page. For information about Carleton's academic year, including registration and withdrawal dates, see [Carleton's Academic Calendar](#).

Important Dates & Deadlines

Note: 3:00pm weekday deadlines ensure that Prof Alexa is available should things go awry.

Drill Practice	3:00pm Wednesdays (covers week up through Tuesday)
Tutorial Practice	3:00pm Fridays (covers that week's Tues/Wedns tutorial)
Problem Set 1	3:00pm Monday Sep 18
Problem Set 2	3:00pm Monday Sep 25
Problem Set 3	3:00pm Monday Oct 2
Problem Set 4	3:00pm Tuesday Oct 10 (pushed for Thanksgiving)
Test 1 Part 1 (timed)	3:00pm Friday Oct 13 60 mins (your choice) - available Tue Oct 10 9am
Test 1 Part 2 (take-home)	3:00pm Monday Oct 16 (no lates) - available Fri Oct 13 3:00pm
Problem Set 5	3:00pm Monday Oct 30
Problem Set 6	3:00pm Monday Nov 6
Problem Set 7	3:00pm Monday Nov 13
Test 2 (take-home only)	3:00pm Monday Nov 20 3:00pm (no lates) - available Thu Nov 16 3:00pm
Problem Set 8	3:00pm on Monday Nov 27
Problem Set 9	3:00pm on Monday Dec 4
Final Test (synchronous)	TBA

Grade Breakdown

Drills (best 8)	10%	Test 1	10%	Bonus	3%
Tutorials (best 8)	10%	Test 2	10%		
Problem Sets (best 7)	49%	Final	11%		

Drills (10%)

While the end goal of this course is to get you comfortable writing your own full-blown proofs, there are a lot of necessary “building block” skills to pick up first. Just as a soccer player prepares for matches with passing and shooting drills, you will prepare for your proof-based problem sets with focused drills that target vocabulary, notation, and approaches you need to solve problems and communicate your solution. The drills aim to make the “smaller stuff” second nature, so that you can more easily put it together into masterful, comprehensive proofs.

Each week of lecture has an associated drill [due](#) on brightspace within a few days of the scheduled lectures. These comprise of 4-15 lecture-related “drill” questions on brightspace. Multiple attempts within the week are allowed and encouraged with the highest score kept, to keep the assessment low-stakes and true to its purpose of drilling the material. Think of this as duo-lingo for discrete math. The regular, tight schedule of the drills encourages you to keep up with the course. As further incentive to do the drills regularly, ~10% of test 1 and ~20% of the final are drawn directly from the drills (with minor adjustments).

There are 12 drills (1 per week). To account for emergencies and life conflicts, the best 8 are worth 1.25% each; the remaining 4 are dropped (or, more specifically, used as bonus).

Tutorials (10%)

While drills provide specific, fine-tuned practice, they do not involve writing proofs. Tutorials guide you through writing proofs to new problems and ask you to practice on your own.

Each week of lecture has an associated tutorial that consists of 2-3 proof-based problems—posted on brightspace—that you are encouraged (but not required) to look over in advance of either attending tutorial in-person, or watching the video. During tutorial you can work through the problems with the guidance of a TA. You don’t hand anything in from this part; you are evaluated on the multiple-choice style brightspace questions that are based on the tutorial proofs, [due](#) within a few days of the tutorial. Two attempts within the week are allowed, with the highest score kept. As further incentive to engage with the tutorials, ~10% of test 1 and ~20% of the final are drawn directly from the tutorial exercises (with minor adjustments).

There are 11 Tutorials (1 per week, minus week of Test 1). To account for emergencies, the best 8 are worth 1.25% each; the remaining 3 are dropped (or, more specifically, used as bonus.)

Problem Sets (49%)

The best computer scientists are the ones with the most (effective) practice. Problem sets in this course give you the opportunity to practice the topics of this course in a way that is challenging yet also manageable. **You should be out of your comfort zone** (but not overwhelmed.) At times you may struggle and at others it may seem more straight-forward; just remember to keep trying and practicing, and over time you will improve. Everyone learns differently; be patient with yourself. There is no substitute for practice and experience.

While you are encouraged to collaborate with your peers, you should formulate and write up your solutions on your own. Guidance regarding outside sources are in the section on [academic integrity](#). If you are struggling, [we have many ways to help!](#)

Problem set solutions in PDF format are due at 3:00pm on Mondays on [gradescope.ca](#). You may hand-write your solutions, but you are responsible to ensure they are legible. **Illegible, poorly scanned, or photographs of solutions will not be marked**; it is your responsibility to ensure we can read your solutions before the deadline.

There are 9 problem sets. To account for emergencies, the best 7 are worth 7% each; the lowest problem set grades will be dropped (or, more specifically, used as bonus.) **Please “save” your dropped problem sets for unforeseen emergencies.** `I cannot drop 3 problem sets.`

Tests & Final (10%, 10%, 11%)

While tests aren't particularly representative of how you may use your computer science knowledge in practice, they provide some advantages:

- Studying for the tests improves your memory for faster recall of fundamentals.
- Tests encourage you to review all the course material, not just what is needed for the problem sets, tutorials, and drills.
- Tests are the only coursework that evaluates you as an individual.

Having said that, both the tests and the final are worth around as much as a problem set.

The tests are worth 10% each and the final is worth 11%. Test 1 has 2 parts: the first part consists of multiple-choice-style questions that must be answered on brightspace during a 60-minute time-bounded period of your choice during [the week in question](#) (I recommend your tutorial time). Test 2 and the second part of Test 1 consist of written questions that you have 3-4 days to complete independently. The final is cumulative, and contains multiple-choice-style questions that must be answered on brightspace during our scheduled final time (TBD). More information about the tests will follow on piazza at least a week before the test in question.

20% of test 1 and 40% of the final will be drawn from the drill and tutorial exercises, so you will know a bit what to expect. You do not need to pass the tests or final to pass the course, but if you don't take them they count as a 0.

Late Policy, Emergencies, and Accommodations for Missed Work

Late drill and tutorial exercises are not accepted.

Late problem set solutions are accepted within 24 hours at a -5% penalty, after which no lates are accepted, no exceptions. This is due to posted solutions and TA grading assignments.

In lieu of requiring students to submit a self-declaration form in the case of an emergency, I prefer the following, more flexible, policy. You can, without explanation, not complete up to 4 drills, 3 tutorials, and 2 problem sets. **Please save these for emergencies such as personal or family illnesses.** Note that these accommodations are for short-term concerns related to missed work; if you are experiencing chronic, ongoing challenges which necessitate a broader solution, I recommend reaching out to the Paul Menton Centre and/or the Care Support team. You need to do a minimum amount of proofs practice in this course in order to deeply engage with the material, as such, further accommodations will not be available.

Proofs

This course is about learning enough discrete mathematics to be able to read, write, appreciate, and find the logic flaws in a variety of mathematical proofs. As such, you will see that over the course of the semester, at least 50% of the marks overall will be for your mathematical proofs. Writing your own proofs will likely feel awkward and even overwhelming, as any new endeavour can feel. I encourage you to acknowledge the struggle, ask for help, and just put in the practice. With practice you will improve, but you cannot improve without practice.

Bonus (a.k.a. Extra Credit)

There are many opportunities for bonus points, if you have the time and inclination. Any [problem sets](#), [tutorials](#), and [drills](#) outside of your best submissions (as described above) are available for bonus, as well as other opportunities throughout the semester. The bonus opportunities and the weights associated with them will be tracked in a piazza post labeled "Bonus Opportunities."

Bonus points are completely optional, so ignore them if they are not for you. Bonus points will add at most 3% to your final mark, and they cannot be applied to an F grade.

Late Registration

While the registrar will allow you to register for this course as late as Tuesday September 20th, I **strongly discourage registration past September 13th**, as it is difficult to miss more than a week of class and still catch up. We do not wait until September 20th to start the material; we start on September 6th! If you choose to join the course late, it is your responsibility to [read the following document](#) to get caught up. There are no special accommodations for late registrants.

Necessary Equipment, Accounts & Software

You will need

- an internet-enabled device (laptop/desktop/tablet)
- access to reliable internet
- free accounts on [piazza](#), [gradescope.ca](#), and discord; please use your preferred (recognizable) name on all of these platforms
- zoom software if you intend to attend the HyFlex lectures
- a way to produce high-quality pdf documents (Google Docs, Microsoft Office, a good pdf scanner, or [LaTeX](#)). Photographed, non-pdf, or poor quality solutions are not accepted.

How to Get Help

There are many ways to get help on your work in this course that do not violate the course's academic integrity policy. Please use these resources; they are there for you!

- Reference the [problem solving tips](#) sheet (on brightspace, the schedule, and each PS)
- Check the Q&A Forum on [piazza](#) and ask questions there
 - please read the posting etiquette so that you get the fastest, most useful answer
- Go to Student Hours on discord/in person (schedule on [piazza](#) and on this [spreadsheet](#))
 - dedicated times through the week for the course staff to meet with YOU. Pop in to introduce yourself, ask questions about the course, or discuss course content.
 - good for questions not suited to piazza (e.g. that require more back-and-forth),
 - some student hours are in-person, some on discord.
- Check the Q&A on discord (ideally after you've checked piazza).

Emails to Prof Alexa

Prof Alexa has 600 students this semester. To help her provide the best service where it is most needed, please read [the following document](#) before sending her email, in case your inquiry can be better and more promptly answered by another means or person. Also note that there is a student (e.g. cmail) email account that **does not reach Prof Alexa**. You must send any email to the cunet email listed at the top of the Syllabus. Prof Alexa tries not to work in the evenings and weekends so during those times please use a piazza post to Instructors if possible.

Academic Integrity

Every student should be familiar with the Carleton University student academic integrity policy. A student found in violation of academic integrity standards may be awarded penalties which range from a reprimand to receiving a grade of F in the course or even being expelled from the program or University. Examples of punishable offences include plagiarism and unauthorized

collaboration. Any such reported offences will be reviewed by the office of the Dean of Science. Information on this policy may be found on the ODS Academic Integrity page [here](#).

Plagiarism. As defined by the Senate, "plagiarism is presenting, whether intentional or not, the ideas, expression of ideas or work of others as one's own". Such reported offences will be reviewed by the office of the Dean of Science. Standard penalty guidelines can be found [here](#).

Unauthorized Co-operation or Collaboration. Senate policy states that "to ensure fairness and equity in assessment of term work, students shall not co-operate or collaborate in the completion of an academic assignment, in whole or in part, when the instructor has indicated that the assignment is to be completed on an individual basis".

You **may** talk with peers and TAs at a high-level. But **you must formulate and write up your solutions on your own**. A solution that is basically word-for-word as a peer's is too close.

You **must not** show or otherwise share your solution with your peers or on the internet.

You **must not** use the internet (including, e.g. chatGPT) to search for or solicit approaches or ideas, unless otherwise told it is okay (as on some problem sets.)

You **must not** post any of the assessments or their solutions online (to sites like Chegg, CourseHero, OneClass, etc.) at any point in time. You are never permitted to post, share, or upload course materials without explicit permission from your instructor.

Any violation of these rules is a very serious offence and will be treated as such; they are reported to the Dean of Academic Integrity, who launches an investigation. Academic integrity is upheld in this course to the best of Prof Alexa's abilities, as it protects the students that put in the effort to work on the course assessments within the allowable parameters.

Note that contract cheating sites are known, unauthorized, and regularly monitored. Some of these services employ misleading advertising practices and have a high risk of extortion.

Statement of Accommodation

The Carleton University Information on [Academic Accommodation](#) applies to this course. Here is [information on how to apply for academic accommodation](#). If you are allowed extra time on tests, ventus should take care of it (and it is your responsibility to confirm such accommodations.) If there is anything Prof Alexa can do to help you succeed, please let her know as soon as possible so that she can accommodate accordingly.

Copyright

Lectures and course materials (including all assessments, videos, and similar materials) are protected by copyright. Prof Alexa is the exclusive owner of copyright and intellectual property of all course materials. **You may not reproduce or distribute lecture notes, problem sets, solutions, or any other course materials publicly for any reason, or allow others to, without express written consent.**

Land Acknowledgement

I would like to acknowledge that the land on which we gather is the traditional, unceded territory of the Algonquin nation. In doing so, I acknowledge that I and Carleton University have a responsibility to the Algonquin people and a responsibility to adhere to Algonquin cultural protocols. More information about how Alexa is trying to take some responsibility can be found on piazza in the post titled "Beyond the Land Acknowledgement."

Undergraduate Academic Advisor

The Undergraduate Advisor for the School of Computer Science is available in Room 5302 HP, or by email at scs.ug.advisor@carleton.ca. The undergraduate advisor can assist with information about prerequisites and preclusions, course substitutions/equivalencies, understanding your academic audit and the remaining requirements for graduation. The undergraduate advisor will also refer students to appropriate resources such as the Science Student Success Centre, Learning Support Services and Writing Tutorial Services.

Mental Health

If you are struggling, please do not hesitate to reach out. I am happy to listen, and/or direct you to resources that might help. In terms of class, if you need extra help or missed a lesson, don't stress! There is a lot of flexibility built into the grading scheme. Remember that Carleton also offers an array of mental health and well-being resources, which can be found [here](#).

University Policies

Carleton is committed to providing academic accessibility for all individuals. Please review the academic accommodation available to students: <https://students.carleton.ca/course-outline/>.

SCS Tech Support

Technical support information can be found at: <https://carleton.ca/scs/technical-support/>. Technical support is available in room HP5161 Monday to Friday from 9:00 until 17:00 or by emailing SCS.Tech.Support@cunet.carleton.ca.