Discrete Structures I
COMP1805 (Early Summer 2024)

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. **Precludes** 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**
Lectures	Tuesday & Thursday 5:35pm - 8:25pm 3 options: live in-person, live over zoom, or asynchronous recordings
Tutorials	Tuesday & Thursday 8:35pm - 9:25pm 1 option: live in-person
Location	see Carleton's schedule for up-to-date location (if in-person)
Student Hours	schedule held both in-person and on discord voice channel
Course Website	https://brightspace.carleton.ca/d2l/home/
Course Resources	lecture zoom link posted on brightspace lecture recordings posted on course schedule and brightspace piazza piazza.com/carleton.ca/summer2024/comp1805 topic schedule posted on brightspace gradescope.ca access your account through brightspace wooclap access your account through brightspace
Q&A Forums	piazza (primary, structured), discord (non-anonymous, informal)
Textbook	David Liben-Nowell's Connecting *Discrete Mathematics and Computer Science*. **Free** PDF and HTML versions of the book are available here.

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.

Land Acknowledgement. I would like to acknowledge that the land on which we gather is the traditional, unceded territory of the Anishinaabe 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 on Prof Alexa's work to take some responsibility can be found on piazza in the post titled "Beyond the Land Acknowledgement."

Learning Outcomes and Topics Covered

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

1. comfortably read, write, and understand mathematical terminology (i.e. vocabulary):
    - sets, functions, logic, graphs, relations, asymptotic notation, recursion
2. comfortably read, write, and understand precise mathematical proofs (i.e. essays):
    - column format, direct proofs, proofs by cases, counterexample, construction, contradiction, contrapositive, induction, and by Pigeonhole Principle.
3. apply specific problem solving and critical thinking skills to solve new math problems:
    - use examples, definitions, and diagrams to first understand the problem,
    - find similar or related problems to compare to and mimic in our approach,
    - consider special cases if the general case is too unwieldy,
    - clearly lay out our assumptions and goals before attempting a proof,
    - recognize a broken proof and use it to find a new approach,
    - think critically about which proof paradigm is most appropriate.

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

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 our live, in-person 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 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**. 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.

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

Asynchronous learners are expected to remain up-to-date with deadlines and due dates. Note that while almost all of this course may be taken asynchronously, **you must be available synchronously (but not in-person) for our midterm and final tests**, scheduled by Carleton.

If you switch between modalities (which is ok!), you may encounter minor variation in the schedule and presentation due to variation in student questions and Prof Alexa's state of mind.

Community Guidelines

The following values are fundamental to academic integrity and are adapted from the International Center for Academic Integrity[1]. We will seek to behave with these values in mind:

	As students, we will…	**As a teaching team, we will…**
Honesty	• Honestly demonstrate our knowledge and abilities on assignments and exams • Communicate openly without using deception, including citing appropriate sources	• 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	• 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	• 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	• Speak openly with one another, while respecting diverse viewpoints and perspectives • Provide sufficient space for others to voice their ideas	• Respect your perspectives even while we challenge you to think more deeply and critically • Help facilitate respectful exchange of ideas
Fairness	• 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	• Create fair assignments and exams, and grade them in a fair, and timely manner • Treat all students equitably
Trust	• 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	• 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	• 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	• 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

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

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; violations will result in loss of access privileges to these course resources, and a report to Student Affairs.

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 (when available), as well as links to 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.

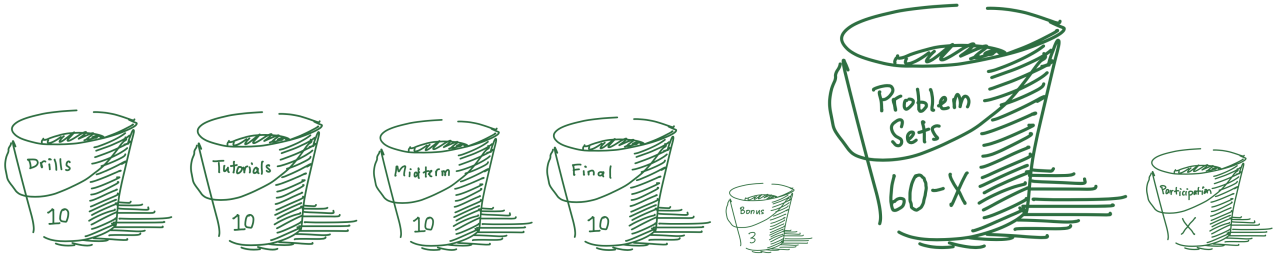
Drill Practice	3:00pm of the **Monday** the week after associated lectures
Tutorial Practice	3:00pm of the **Monday** the week after associated tutorial, or attendance at the tutorial
Problem Set 1	3:00pm on **Wednesday May 15**
Problem Set 2	3:00pm on **Wednesday May 22**
Midterm (e-proctored)	**TBD by Carleton** between May 22nd and June 1st (3h)
Problem Set 3	3:00pm on **Wednesday June 5**
Problem Set 4	3:00pm on **Wednesday June 12**
Problem Set 5	3:00pm on **Tuesday June 18**
Final Test (brightspace)	**TBD by Carleton (3h)**

Grade Computation

Drills	10%	Midterm	10%	Bonus (optional) [3%]
Tutorials	10%	Final	10%	
Problem Sets	[42-60%]	Participation (optional)	[0-18%]	

Buckets

You can think of each assessment category as being a bucket with a given capacity. For example, the Drills, Tutorials, Midterm, and Finals buckets each have capacity 10. The bonus bucket has capacity 3. The Participation and Participation buckets have capacity X and 60-X, respectively, where X is a value of your choice between 0 and 18 (details next section).



Your final mark will be the sum of what you put in your combined buckets, for a max of 103.

Each bucket can be filled by assessments of that type, and most buckets have **more opportunities to fill the bucket than that bucket's capacity** (so you don't have to complete each assessment perfectly to fill a bucket.) For example, there will be 13 available marks with which to fill your drills bucket, 12 available marks to fill your tutorial bucket, and (1.25)(60-X) available marks to fill your problem sets bucket. This provides you with flexibility to skip an assessment (or more) and still fill your bucket, or only do part of an assessment and still have that work count. This is strictly better than a "drop some number of lowest assessments" policy. If you overflow a bucket, that overflow contributes (in a complex way) to your bonus bucket.

Example:

- Suppose you choose X=0. If you do all the problem sets at an 80% average, you will have accumulated (1.25)(60)(80%) = 60 marks, which will fill your bucket. A "drop the lowest PS" policy would've gotten (60)(80%)=48 marks, significantly less.
- Suppose you choose X=18; your PS bucket thus has capacity 42. If your problem sets have an average of 75%, you will have accumulated (1.25)(42)(75%)=39.4 marks out of the 42 available (plus your 18 from the participation bucket, discussed in next section.)

Participation (0-18%)

Research shows that students learn best when their lectures are interspersed with "active learning"—that is, activities designed to engage learners with the course concepts in a hands-on, interactive way. I would like to add such activities to COMP1805 in a formal, systematic way (time permitting), using wooclap (the new poll everywhere.)

Since active learning requires learners to be in-person, and this course can be taken asynchronously, **participation in these activities is not required**. However, for each lecture you choose to attend in-person (and get over 60% on the wooclaps), you gain 1.5 marks in your participation bucket (and increase your participation bucket's capacity, X, by 1.5). This scales your PS bucket down by 1.5 marks (and replaces those 1.5 marks with those participation

marks.) There will be a maximum of 12 opportunities for such participation (12 lectures other than the first, a dry run), for a maximum of 18 points. There may not be participation in every lecture, depending on how it is going for us all.

Example. Suppose you have a 70% average on your PSs.

- If you get participation points for 6 lectures, then X=6*(1.5)=9, 60-X=51, and you will get (1.25)(51)(70%)+9=53.6 out of 60, or 89%, in the combined participation/PS buckets.
- If you get 0 participation marks, you would get (1.25)(60)(70%)=52.5, which is 87%.
- If you get participation points for 12 lectures, then X=18, 60-X=42, and you will get (1.25)(42)(70%)+18=54.75, which is 91%.

This is new this semester, so I ask for your patience and understanding (and feedback!) while I update the course—hopefully for the better. tldr; participation cannot decrease your mark and is beneficial for your learning!

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 make the "smaller stuff" second nature, so that you can more easily put it together into masterful, comprehensive proofs.

Each topic has associated drills due on brightspace within a few days of the lectures. These consist of a handful of topic-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, parts of the midterm and final are drawn directly from the drills (with minor adjustments).

There are a total of 13 marks available over all the drills (~1 mark per lecture). To account for emergencies and life conflicts, we will take your mark out of 10; the remaining 3 points (should you obtain any of them) will count towards bonus.

Tutorials (10%)

While the drills provide specific, fine-tuned practice, they do not involve writing proofs. The tutorials aim to provide you with TA-guided hands-on practice with writing your own proofs.

Tutorials are twice a week; on any given day you can obtain the tutorial mark in one of 2 ways:

1. attend (and participate in) the in-person tutorial 8:30-9:30pm, or;

2. attempt tutorial problems on your own, look over the solutions, then complete the associated tutorial “quiz” on brightspace.

The in-person tutorial will be the best practice for your own problem sets, as it will best mimic the problem solving process and critical skills needed to solve your problem sets problems. However, there is an asynchronous option available for those that cannot make it in person.

There are a total of 12 marks available over all tutorials (~1 mark per tutorial). To account for emergencies, we take your mark out of 10; the remaining 2 points (should you obtain any of them) will count towards bonus.

Problem Sets (42-60%)

The best computer scientists are the ones with the most (effective) practice. Problem sets in this course are meant to give you an opportunity for hands-on practice with 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!

There are 5 problem sets for a total of 75 marks (15 marks each), or a total of (1.25)(60-X) where X is your participation score. To account for emergencies, we will take your mark out of (60-X); any remaining points over this will count towards bonus. **Please “save” your extra marks for unforeseen emergencies**. I cannot drop more than these extra marks.

Submit your problem set solutions on gradescope.ca, which you access through brightspace. While you do not have to type your solutions, we highly recommend you do, as **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. **Lates are accepted within 24 hours at a -10% penalty**, after which no lates are accepted due to posted solutions and TA grading assignments.

Midterm & Final (10%, 10%)

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 hopefully improves your memory so that some of the more fundamental information can be recalled quickly.
- 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, since the remaining coursework can be collaborative to some extent.

The midterm and final are both worth 10%. The midterm is a mix of multiple-choice-style questions and proofs that must be answered during a synchronous time decided by Carleton. The final is multiple-choice-style questions at a time scheduled by Carleton. The final is cumulative. More information about the tests will follow on piazza at least a week before the test in question.

Parts of the midterm and final are drawn from the drills and exercises related to the tutorials, 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. **These will be proctored online with COMAS**; details closer to the tests. You will need a webcam and a reliable internet connection for these.

Late Policy, Emergencies, and Accommodation for Missed Work

Late drill and tutorial exercises are not accepted, no exceptions.

Problem set solutions are accepted within 24 hours with a -10% penalty, after which no lates are accepted, no exceptions. This is due to posted solutions and grading logistics. **Please submit early and often** so that last-minute technical problems don't derail your mark.

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 3 marks of the drills, up to 2 marks of the tutorials, and up to 15 marks of the problem sets. Please, please, please save this 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 practice in this course in order to deeply engage with the material, as such, further accommodations will not be available.

Bonus (a.k.a. Extra Credit)

There are many opportunities for bonus points, if you have the time and inclination. Any drills, tutorial, or problem set marks you achieve over the maximum (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." **They are not one-for-one transferable from other buckets.**

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.

Suggested Workflow

In a **perfect** world, your course workflow would be:

- Before lecture, *skim* the reading for that lecture in the textbook (10-20 mins/lecture), look over the The More You Know document for some lecture-specific math review. Just get an idea for the new terminology we'll be learning and the main results. Or, skim the lecture notes instead.
- Attend or watch each lecture to be exposed to the new material (3h/lecture).
- After lecture, do online drills to practice the vocabulary, notation, and high-level concepts (e.g. what does that word or symbol mean again? When is this approach better than the previous one?) (40-50 mins/lecture).
- Attend the in-person tutorial to attempt the tutorial problems with guidance (e.g. make one sentence at a time using new vocabulary and rules), or read over the posted solutions and complete the accompanying online exercises. (1-2 h/tutorial).
- Complete each problem set to get more independent practice (e.g. write an essay using your new vocabulary and new ideas) (4-15h each).
- 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.

Late Registration

While the registrar will allow you to register for this course as late as Friday May 10th, **we strongly discourage registration past May 8th**, as it is difficult to miss more than one class and still catch up. We do not wait until May 10th to start the material; we start on May 7th! 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) and access to reliable internet. Please review the requirements at https://carleton.ca/scs/scs-laptop-requirement/laptop-specs/.
- a webcam for our e-proctored tests.
- (free) accounts on piazza and discord; use a recognizable name on these platforms.
- zoom software if you plan to attend the HyFlex lectures.
- (optional) (free) accounts on overleaf for (optional) LaTeX typesetting.

Students taking a COMP course can access the SCS computer labs. The lab schedule and location can be found at: https://carleton.ca/scs/tech-support/computer-laboratories/. All SCS computer lab and technical support information can be found at: https://carleton.ca/scs/tech-support/. Technical support staff may be contacted in-person or virtually, see this page for details https://carleton.ca/scs/tech-support/contact-it-support/.

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!

- Peruse the prerequisite reference module on brightspace if you want a refresher of certain topics from primary and secondary school.
- Attend tutorial; it's where you get hands-on practice with problem-set-like problems.
- 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 searched piazza to confirm it hasn't been answered there.)
- Refer to the The More You Know document before lecture to give you a refresher on the specific definitions, notation, and concepts from previous lectures that will be cropping up during this lecture.

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".

Proofs require a lot of creative thinking, which benefits from bouncing ideas off of other people.

You **may** talk with peers and TAs at a high-level. But **you must formulate and write up (i.e. problem solve) your solutions on your own**. A solution that is basically line-by-line the same as a peer's is too close. Helping a peer with logic flaws is allowed, but be careful that it is a slippery slope between simple spot-checking help and giving away too many details of the solutions.

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

You **must not** use the internet or generative AI (e.g. chatGPT) to search for or solicit approaches or ideas. You may use these sources to help with low-level questions (e.g. definitions, examples) or ask about general course concepts (e.g. proof techniques). Think of them as a tutor, not someone doing your work for you.

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 our copyrighted 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.

Automated tools for detecting plagiarism and AI programmers may be employed in this course.

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, you will get an email at least a week before the test to coordinate. 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

Undergraduate Academic Advisor

The Undergraduate Advisor for the School of Computer Science is available in Room 5302C 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/tech-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**.