COMP 1805: Discrete Structures I
Summer 2022
Syllabus

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 Alexa or Prof Alexa
Email	**alexasharp3@cunet.carleton.ca**
Lectures	Tuesday & Thursday 5:35pm - 8:25pm (recordings provided afterwards)
Tutorials	Tuesday & Thursday 8:35pm - 9:25pm (recordings provided afterwards)
Location	AT 302 (live attendance not required) – room subject to change
Student Hours	schedule held on discord voice channel
Course Resources	schedule topics, readings, videos, deadlines piazza piazza.com/carleton.ca/summer2022/comp1805 brightspace https://brightspace.carleton.ca/d2l/home/ gradescope https://www.gradescope.ca/courses/6958 textbook https://cs.carleton.edu/faculty/dln/book/
Q&A Forums	piazza (primary, structured), discord (non-anonymous, informal)

tl;dr

This course is meant to introduce you to the language of discrete mathematics. As with any language, you have to learn a lot of vocabulary and rules in order to speak the language, and then you have to practice, practice, practice. The lectures provide the vocabulary and rules, and the drills, tutorials, and problem sets provide the opportunity and incentive to get this practice with varying degrees of guidance. Every aspect of the course, every question, every evaluation, serves a purpose to get you to our final goal of you being able to fluently speak (discrete) mathematics, so that you can be a kick-ass problem solver. But you must put in the practice.

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

- Before lecture, *skim* the reading for that lecture in the textbook (5-15 mins/lecture), look over the The More You Know document for some lecture-specific math review.
- Attend or watch each lecture to be exposed to the new material (80 mins/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?) (10-30 mins/lecture).
- Attempt the tutorial problems, attend and/or watch tutorial, then complete accompanying online exercises to get hands-on practice with some guidance (e.g. make one sentence at a time using new vocabulary and rules) (2-3 h/week).
- Complete each problem set to get more independent practice (e.g. write an essay using your new vocabulary and new ideas), reflect upon one's improvements in the self-evaluation (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.

Lectures

Whatever your course delivery preference, there is an option for you. Live, **in-person** lecture is available for this course, which is very exciting. Prof Alexa believes that in-person lecture is the most engaging way to learn the material, however, you may view recorded lectures completely asynchronously if you choose. Lecture recordings will be posted on the course schedule within 18 hours of the live lecture.

Tutorials

As with lectures, live, in-person tutorials are available and preferred for this course, but recordings will be provided on the course schedule within 18 hours for those wishing to take the course asynchronously.

Asynchronous Learners

Note that while almost all of this course may be taken asynchronously, you must be available synchronously (but not in-person) for part 1 of the midterm on Tuesday May 31 8:30pm-9:30pm.

Textbook

We will use David Liben-Nowell's *Connecting Discrete Mathematics and Computer Science*. A free PDF version of the book is available at https://cs.carleton.edu/faculty/dln/book/.

Course Work & Evaluation

Important Dates & Deadlines

Drill Practice	2:00pm of the Monday following the associated lecture
Tutorial Practice	2:00pm of the Monday following the associated tutorial
Problem Set 1	2:00pm on **Thursday May 12**
Problem Set 2	2:00pm on **Thursday May 19**
Problem Set 3	2:00pm on **Thursday May 26**
Midterm part 1 (brightspace)	during tutorial on **Tuesday May 31 8:30pm - 9:30pm**
Midterm part 2 (take-home)	**Tuesday May 31 9:30pm - Thursday June 2 2:00pm**
Problem Set 4	2:00pm on **Thursday June 9**
Problem Set 5	2:00pm on **Thursday June 16**
Final Test	TBD

Grade Computation

Drills	10%
Tutorials	10%
Problem Sets	48%
Midterm	16%
Final	16%

If you want to compute your grade yourself, you can make a copy of this spreadsheet and fill in your grades as you go along to know where you stand.

Schedule, Readings, Deadlines & Lecture Recordings

Please refer to the detailed course schedule for suggested textbook readings, lecture and tutorial recordings, as well as links to problem sets, drills, tutorials, and any other coursework. You'll want to bookmark the page.

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 idea is to make the "smaller stuff" second

nature so that you can more easily put it together into masterful, comprehensive proofs. This is what the drills aim to provide.

After each lecture, I will post 4-10 lecture-related "drill" questions on brightspace. These are meant to take a few minutes each, and provide technical practice with new definitions and notations, or hone your intuition for the material. They will often focus on the big picture--on the ability to compare and contrast, and to make quick assessments based on intuition--which should help give you a better sense of direction when attacking a new problem set. Also, they are similar to short-form test questions---in fact, ~10% of each test and ~20% of the final are drawn directly from the drills (with only very minor adjustments).

There are ~12 drills (~1 per lecture). To account for emergencies, the best 10 are worth 1% each; the remaining ~2 are dropped (or, more specifically, used as bonus). Drills (on brightspace) are due by 2:00pm on Monday of the week following the associated lecture. Multiple attempts within the week are allowed.

Tutorials (10%)

While the drills provide specific, fine-tuned practice, they will not involve writing proofs. The tutorials guide you through solving a new problem, and ask you to practice on your own with low-stakes evaluation. As with the drills, ~10% of each test and ~20% of the final are drawn directly from the tutorial exercises (with only minor adjustments).

While each tutorial involves working through 2-3 proofs-based problems, you are evaluated on the multiple-choice style brightspace questions (which are based on the 2-3 problems).

There are ~12 Tutorials (~1 per week, except for midterm week). To account for emergencies, the best 10 are worth 1% each; the remaining ~2 tutorial grades are dropped (or, more specifically, used as bonus.) Ideally you attend the tutorial in-person, or watch the recording. During tutorial you can work through the tutorial problems posted on the schedule with the guidance of a TA. You don't hand anything in from this part. You can then go and complete the tutorial exercises (on brightspace) that are due by 2:00pm Monday of the week of the associated tutorial.

Problem Sets (48%)

The best computer scientists are the ones who have had the most practice. The problem sets in this course are meant to 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 and you will improve. The only way to really practice with the problem solving process is to experience it.

While you are encouraged to collaborate with your peers, you should write up your solutions on your own. You may not use web search/the internet to look for approaches to the problem set; if you need help, we have many ways to do so without violating academic integrity.

There are 5 problem sets. To account for emergencies, the best 4 are worth 12% each; the lowest problem set grade will be dropped (or, more specifically, used as bonus.) **Please "save" your dropped problem set for unforeseen emergencies**. I cannot drop 2 problem sets.

Problem sets are due at 2:00pm on Thursdays on gradescope. While you do not have to type your solutions, we highly recommend it 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.

Midterm & Final (16%, 16%)

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.

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

The midterm and final are both worth 16%. The midterm has 2 parts: the first part consists of multiple-choice-style questions that must be answered during the tutorial time on Tuesday May 31 8:30-9:30pm. The second part consists of free-form questions that you will have ~1.5 days to work on and hand in on gradescope. The final will be multiple-choice-style questions that must be answered during our scheduled final time (TBD). The final is cumulative. More information about the tests will follow.

20% of the tests and 40% of the final will be drawn from the drill and tutorial exercises, with only minor modifications, 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

Drill and tutorial exercises must be submitted by the deadline, no lates accepted.

Problem set solutions may be handed in up to 24 hours late with a -10% penalty, after which no lates are accepted, no exceptions. Once the solutions are posted, it violates academic integrity

to accept any further submissions. Moreover, we need to divide the submissions amongst the graders and we prefer to do that before the weekend.

In the case of an emergency, you can, without explanation, not complete up to ~3 drills, ~2 tutorials, and 1 problem set. Please, please, please save this for emergencies such as family illnesses. If you need more accommodations, please contact Prof Alexa but be aware that dropping more marks is likely not possible. I cannot drop 2 problem sets and still properly evaluate your practice and progress. You need to do a minimum amount of proofs practice in this course in order to deeply engage with the material. For this reason, do not "squander" the emergencies for non-emergencies.

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 remaining problem sets, tutorials, and drills outside of your best submissions (as described above) are available for bonus.

Bonus points are completely optional; *not* doing bonus points will not negatively impact your final grade. Bonus points cannot add more than 3% to your final mark, and it cannot move you from an F to a passing grade.

Learning Outcomes

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
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 proof or a false start and using them to find a new result or approach,
- thinking critically about which proof paradigm is most appropriate.

Necessary Equipment, Accounts & Software

You will need an internet-connected device to access brightspace for drills and tutorial exercises, gradescope for problem sets, and piazza and discord for Q&A and student hours.

You will need (free) accounts on piazza, gradescope, and discord; please use your preferred (recognizable) name on all of these platforms. You may optionally want (free) accounts on overleaf for LaTeX typesetting.

You don't need any special software for this course, but you may want a way of typesetting mathematical symbols and producing a **pdf** document (Google Docs, Microsoft Office, or LaTeX can all do this.) **A photographed, poorly scanned, or non-pdf document will receive 0 marks.**

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:

- Reference the relevant proof paradigm sheets (posted on piazza)
- Reference the problem solving tips sheet (posted on piazza)
- 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 (schedule posted on piazza and on this spreadsheet)
    - good for questions that require more back-and-forth, that cannot be answered on piazza or discord
    - some student hours will be on discord, and maybe some will be in-person. Exact details TBD.
- Check the Q&A on discord (ideally after you've searched piazza to confirm it hasn't been answered there.)

Academic Integrity

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

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

You **must not** use the internet to search for or solicit approaches or ideas.

You **must not** post our problem sets or solutions on the internet, before or after the due date.

Any student that violates academic integrity (intentionally or not) must be reported to the Associate Dean (Undergraduate) who will investigate the matter. The standard penalties for an academic integrity violation are as follows:

- First offence: F in the course.
- Second offence: One-year suspension from the program.
- Third offence: Expulsion from the University.

These are standard penalties. More-severe penalties will be applied in cases of egregious offences. For more information, please see Carleton University's Academic Integrity Policy.

Respect in the Classroom and Forums

Please remember to treat your peers and the course staff with respect. 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. Treat the course spaces as professional spaces and behave accordingly. Behavioural misconduct may be reported to Student Affairs.

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 you feel you have been disrespected or abused either by other students or course staff, please let us know (you can **contact us anonymously and privately on piazza**, for example.)

Pandemic Measures

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are a number of actions you can take to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's symptom reporting protocols.

Masks: On the recommendation of Ottawa Public Health, Carleton will be maintaining the mandatory COVID-19 Mask Policy until further notice. The policy requires masks to be worn in all university buildings, including offices, classrooms and labs.

Vaccines: Further, while proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in cuScreen as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the University's COVID-19 website and review the Frequently Asked Questions (FAQs). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.

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 Alexa can do to help you succeed, please let her know as soon as possible so that she can accommodate accordingly.

Late Policy

Please refer to the Late Policy & Emergencies section above.

Copyright

Lectures and course materials (including any documents, handouts, videos, and similar materials) are protected by copyright. Alexa is the exclusive owner of copyright and intellectual property of all course materials. You may take notes and make copies of course materials for your own educational use. You may not reproduce or distribute lecture notes and course materials publicly for commercial purposes, or allow others to, without express written consent.

Territory Acknowledgement

I would like to acknowledge that the location of the Carleton University campus is on the traditional, unceded territories 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 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.

University Policies

In addition to anything included here, all the standard Carleton University Policies regarding equity and academic regulations apply to this course.

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**.