CSC236H1F 20239 (All Lecture Sections): Introduction to the Theory of Computation

Jump to Today　　✎ **Edit**

🚧 **Still Under Construction!** 🚧
Highlighted elements will be updated during the first two weeks of the term, as we work out the details.

Tutorial Enrolment　　　　　　　　　　　　　　　　↓ **Contents** ↓

Remember that **you MUST enrol in a tutorial section on ACORN**, separately from your lecture section. And you can only enrol in a tutorial section that matches with your lecture section. These constraints cannot be overridden by anyone (not by your course instructor, not by staff in our department, not by staff at your college). This is overall a good thing: the constraints ensure that there is room in all the tutorials for every student in a lecture section. But we understand that it can make it difficult for some students to construct their schedule.

Note that attendance is NOT taken during lectures: they are provided as a support for *your* learning, and it is up to you to make appropriate use of this resource. This means that in principle, you could attend a lecture section for which you are not enrolled — **as long as there is room for you to sit** (legitimately enrolled students have priority), **and that you check with the instructor first**.

However, *tutorial times will be used to write every term test*. Because tutorial room capacity is limited, each tutorial section will have only enough seats and test copies for the students formally enrolled in that section. This means that **you must be enrolled in a tutorial section that you can actually attend**, because there will be no room for you in any other.

If this is problematic, then please keep trying to change your enrolment to a different lecture and tutorial section (up until the first two weeks of the term): waitlists are fairly short, so you have a chance of succeeding. If you are not available for matching lecture and tutorial times, then **please prioritize enrolling in a section when you are available for TUTORIALS**. Then, you can look into the possibility of attending a different lecture.

Finally, **please also make a concrete backup plan** in case this does not work out. Advisors in the department's Undergraduate Office can help you think through the possibilities (you can contact them at **cs.undergrad@utoronto.ca (mailto:cs.undergrad@utoronto.ca)**).

Got A Question?

Please do **NOT** use Quercus messaging!

1. **Before you ask your question**, please *take a few minutes to see if it might already be answered* on this page (or pages linked from it). You will get an answer faster (no need to wait), and it will make the course better for everyone by leaving us more time to answer other questions.
2. In particular, all course announcements will be posted here, on Quercus. *You are responsible for reading all announcements made by the course team (instructors / TAs / staff), and for being familiar with the entire content of this Syllabus.*
3. If your question is NOT already answered on the course website or discussion board, then either:
   - Start a new topic on Ed (the course discussion board), for all questions of *general interest* (whose answer could be useful to other students).

   or:

   - Send email **from your U of T email address** to csc236-2023-09@cs.toronto.edu **(mailto:csc236-2023-09@cs.toronto.edu)** , for all questions that are *personal* (whose answer is useful only to you). **Please include "CSC236" in the subject line, and your full name and UTORid in the body of your message.**
4. In particular, please ask ALL questions about course content and problem sets directly on Ed. This also applies to questions about course administration / logistics, except for very personal questions that are relevant only to your unique situation, where you should use email. For content-related questions, you can use the Spoilers feature to help other students avoid discovering solution elements (click on the little lightning bolt icon in the top-left corner of the message editor), or post *private* messages that will be seen only by course instructors and TAs. **Do NOT post any message that reveals the questions or answers on one of our Term Tests, until at least ONE DAY AFTER the test has been written.**
5. We aim to respond to all email and Ed postings within 48 business hours (not counting weekends and holidays). However, it may take longer, especially near due dates or before the start of classes. If you do not hear back after four days, please do not hesitate to send a follow-up email, or come in person during office hours.

Table of Contents

This page contains LOTS of information, all in one place (to make it easier to search)! The following links may help you find what you are looking for a little faster, but **we strongly recommend that you read this entire syllabus at least once** (during the first week of term would be ideal), to make yourself familiar with the course organization and expectations.

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Overview   ↑ **Contents** ↑

In the Materials column, "Hadzilacos" and "Liu" refer to the **course notes** provided later in this Syllabus. You may want to read the relevant sections before each week's lectures, but *this is NOT required*. Lecture slides will be added week-by-week throughout the term.

Note that every "class week" in the table below starts on a Thursday and ends on the following Wednesday, to match with the start and end dates of the term. You can view a visual representation of this in the following ***one-page term schedule*** ↓ *(https://q.utoronto.ca/courses/314442/files/27319455 /download?download_frd=1) .*

Week-by-week overview of course activities

Dates & Topics	Materials	Assessments
Sep 07 – Sep 13 Intro, Simple Induction	Hadzilacos: Sec 1.2 Liu: pp. 9–13 Slides	

Dates & Topics	Materials	Assessments
Sep 14 – Sep 20 Complete Induction, Structural Induction (**Sep 20:** *last day to enrol)*	Hadzilacos: Sec 1.3; Ch 4 Liu: pp. 13–16 Slides	**Problem Set 1** *(**2%**[*] / Sep 19)*
Sep 21 – Sep 27 Structural Induction, Well-Ordering	Hadzilacos: Ch 4; Sec 1.1 Liu: pp. 16–20 Slides	**Term Test 1** *(**10%**[†] / Sep 27)* Research Survey *(**1%**[§] / TBA)*
Sep 27 – Oct 4 Recursive Runtime	Hadzilacos: Sec 3.1–3.2 Liu: pp. 25–34 Slides	**Problem Set 2** *(**2%**[*] / Oct 3)*
Oct 5 – Oct 11 Divide-and-Conquer, Algorithm Analysis (**Oct 9:** *holiday; no classes*)	Hadzilacos: Sec 3.3; Sec 2.1–2.2 Liu: pp. 34–44 Slides	**Term Test 2** *(**10%**[†] / Oct 11)*
Oct 12 – Oct 18 Recursive Correctness	Hadzilacos: Sec 2.7–2.8 Liu: pp. 44–46 Slides	**Problem Set 3** *(**2%**[*] / Oct 17)*
Oct 19 – Oct 25 Iterative Correctness	Hadzilacos: Sec 2.3–2.6 Liu: pp. 47–51 Slides	**Term Test 3** *(**10%**[†] / Oct 25)*
Oct 26 – Nov 1 Iterative Correctness	Hadzilacos: Sec 2.3–2.6 Liu: pp. 47–51 Slides	**Problem Set 4** *(**2%**[*] / Oct 31)*
Nov 2 – Nov 15 Formal languages, Regex (**Nov 15:** *last day to drop)*	Hadzilacos: Sec 7.1 7.2 Liu: pp. 59–63 Slides	**Term Test 4** *(**10%**[†] / Nov 15)*
Nov 6 – Nov 10	**Reading Week:** No lectures, but there will be regular instructor office hours.	
Nov 16 – Nov 22 DFA, NFA	Hadzilacos: Sec 7.3–7.4 Liu: pp. 63–67, 69–72 Slides	**Problem Set 5** *(**2%**[*] / Nov 21)*
Nov 23 – Nov 29 Closure	Hadzilacos: Sec 7.5–7.6 Liu pp. 68–72 Slides	**Term Test 5** *(**10%**[†] / Nov 29)*
Nov 30 – Dec 6 Pumping Lemma, Review	Hadzilacos: Sec 7.7 Liu pp. 67–68 Slides	**Problem Set 6** *(**2%**[*] / Dec 5)*

Dates & Topics	Materials	Assessments
Dec 7	**Make-Up Day:** Lectures for all sections that missed one hour on Oct 9.	
Dec 9 – Dec 20		**Final Exam (44%)**[‡]

[*] All **Problem Sets** are due **before** 21:00 on their due date. Your total grade on all problem sets is capped at a maximum of 10%.

[†] All **Term Tests** take place **during your regular tutorial time** (and in your regular tutorial room). Your lowest term test mark will be worth only 5%; the others will each be worth 10%.

[‡] The Final Exam will be scheduled by the Faculty of Arts & Science. In order to pass the course, you must earn at least 25% on the final exam. In other words, if your final exam mark is strictly less than 25%, your final mark in the course will be reduced (if necessary) to no more than 45.

[§] Details about the Research Survey will be posted in an Announcement on the first week of classes.

Logistics   ↑ **Contents** ↑

- **This is an in-person course**, meaning that you must be available for in-person activities (lectures, tutorials, and office hours) and assessments (term tests and final exam).
- All lectures, tutorials, and office hours begin *ten minutes past the hour*.
- You are welcome to attend office hours held by any instructor or TA.
- See the **technical advice** further below, for additional information about connecting to online office hours.
- TA office hours will NOT follow a regular schedule. The details will be posted here, usually the week before the office hours take place.
- Recordings will be generated automatically for some of the lecture sections, and can be accessed through the OCCS Student App. *Remember that course videos and materials belong to your instructor and the University, and are protected by copyright.* You are permitted to download videos and materials for your own personal academic use, but *you may not copy, share, or otherwise distribute them* without explicit permission from the instructor.

TA Office Hours   ↑ **Contents** ↑

Day and Time	TA	Room or Zoom
T.B.A.	*T.B.A.*	*T.B.A.*

Course Staff & Office Hours (Sep 7 – Dec 6)   ↑ **Contents** ↑

Who? (Role)	When?	Where?

Who? (Role)	When?	Where?
François Pitt (Instructor)	Tue 09:30–11:00	**Zoom Link (https://utoronto.zoom.us /j/82934891594)** Meeting ID: 829 3489 1594 Passcode: 236236
	Tue 13:00–15:00	BA 7231
Gary Baumgartner (Instructor)	Mon, Fri 16:00–17:00	BA 7172
Ziyang Jin (Instructor)	Thu 10:30–12:00	BA 2272
Amin Gillani (Support Staff)	*(N/A)*	BA 4207

Lecture & Tutorial Schedule   **↑ Contents ↑**

What? (Section)	Who? (Instructor / TAs)	When? (Day & Time)	Where? (Room)
LEC 0101	François Pitt	Mon, Fri 11:00–12:00	UC 140
TUT 0101	[TBA]	Wed 11:00–12:00	GB 304
TUT 0102	[TBA]	Wed 11:00–12:00	SF 3201
TUT 0103	[TBA]	Wed 11:00–12:00	WB 119
TUT 0104	[TBA]	Wed 11:00–12:00	MY 360
LEC 0201	Gary Baumgartner	Mon, Fri 12:00–13:00	MP 202
TUT 0201	[TBA]	Wed 12:00–13:00	BA 2135
TUT 0202	[TBA]	Wed 12:00–13:00	MY 440
TUT 0203	[TBA]	Wed 12:00–13:00	MY 330
TUT 0204	[TBA]	Wed 12:00–13:00	BF 215
LEC 0301	François Pitt	Mon, Fri 13:00–14:00	WI 1016
TUT 0301	[TBA]	Wed 13:00–14:00	HA 410
TUT 0302	[TBA]	Wed 13:00–14:00	BA B024
TUT 0303	[TBA]	Wed 13:00–14:00	BF 215
TUT 0304	[TBA]	Wed 13:00–14:00	BA 1210
LEC 0401	Gary Baumgartner	Mon, Fri 14:00–15:00	MP 203
TUT 0401	[TBA]	Wed 14:00–15:00	BA 2139
TUT 0402	[TBA]	Wed 14:00–15:00	MY 360
TUT 0403	[TBA]	Wed 14:00–15:00	SF 3201

What? (Section)	Who? (Instructor / TAs)	When? (Day & Time)	Where? (Room)
LEC 5101	Ziyang Jin	Wed 18:00–20:00	WI 1016
TUT 5101	[TBA]	Wed 20:00–21:00	BA B024
TUT 5102	[TBA]	Wed 20:00–21:00	BA 2135
TUT 5103	[TBA]	Wed 20:00–21:00	BA 2139
TUT 5105	[TBA]	Wed 20:00–21:00	BA 2159

Marking Scheme

↑ **Contents** ↑

- 1% for a Research Survey *(details will be provided during the first week of classes)*
- 10% for 6 Problem Sets (2% each, capped at 10%)
- 45% for 5 Term Tests (5% for your worst mark; 10% for all others)
- 44% for the Final Exam (you must earn a minimum of 25% on the exam in order to pass the course)

See the **Overview** table for the exact due dates of Term Tests and Problem Sets.

Problem Sets

↑ **Contents** ↑

1. PS 1 Handout / PS 1 Solutions
2. PS 2 Handout / PS 2 Solutions
3. PS 3 Handout / PS 3 Solutions
4. PS 4 Handout / PS 4 Solutions
5. PS 5 Handout / PS 5 Solutions
6. PS 6 Handout / PS 6 Solutions

Links to each problem set handout will be added here as the term progresses (usually two weeks before they are due). Sample solutions will usually be added one week after the due date.

"Aren't you worried students will just wait for the solutions, rewrite them, and send that in to MarkUs?" Not really… Anyone who does this would only receive partial credit anyway, and there are better ways to obtain partial credit (described below). More importantly, doing this completely negates the chance to train yourself on the problem set: anyone doing this would not know what they have trouble with, and would not be able to ask for help and improve, before the term test. Because it's clearly not to anyone's advantage to do this, it's not something we plan to actively try to prevent. We already expect everyone to get mostly full marks on their problem set submissions anyway: this does not change that. *You should plan to lose marks on the problem sets*, so that you can learn and do better on the tests — not the other way around!

The purpose of the problem sets is to clarify what you should know at various points during the course, by reviewing what we covered in lectures and consolidating your understanding. For maximum learning benefit, these *should* be completed *before* your tutorial, but we will use a generous late submission

policy (described under the submission instructions below), to provide you with some flexibility for situations when you might be unable to complete them before your tutorial. Each problem set is also worth a small number of marks to help you stay on track with the course material. In other words, the main purpose of homework is NOT to earn marks, but for you to *learn* and understand the material well enough to be able to *generate* a correct solution for yourself.

Problem sets are an opportunity to practice what you have learned and apply your knowledge and skills to new and more complex problems. **Treat every problem set like a "practice term test"**: a chance to try out your understanding in a context where you cannot lose marks for making small mistakes; an opportunity to find out what you don't know and correct it *before* the following term test. They are typically the most challenging part of this course. *Start problem sets early!* At any point in time, you should be able to read any problem set handout to figure out *what* you're supposed to do, even if you have no clue *how* to do it (yet).

Keep in mind that even if you are unable to solve a problem by the time you submit your answers, **it is still your responsibility to understand how to solve every problem** (except those labelled "Extra"). In other words, you will be expected to solve similar problems on the term tests and final exam, so if there are problems you don't know how to solve, it's not enough to just explain what you don't understand — you might receive partial credit for doing this, but it's not enough for your learning. This should be only the starting point for you to work on figuring out what you are having trouble with (by discussing with other students, your TA and instructor, on Ed and/or during office hours), so that you can be confident that you can solve similar problems on your own.

Completion requirements

Each problem set will be marked for correctness, to provide you with feedback about the level of understanding you have demonstrated. (However, limited TA time means that the type of feedback we are able to provide will also be limited.) Also, because the purpose of the problems is primarily to help you self-assess your understanding of the relevant course material, **your submission need only meet the following conditions to receive credit**.

- A complete and *mostly* correct solution is required for **all** problems — *except* those marked "Extra". What matters is that you have written a solution that addresses all the elements we would expect, even if it contains small errors or omissions. Solutions that contain many errors or omissions (or major ones) may receive less credit, of course.
- *"What if I don't know how to solve a problem?"* Then you have a responsibility to do the necessary readings, to use office hours and Ed, and to do the work required to figure out how to arrive at a solution. Even if you are uncertain about your answer, you can (and should) submit a partial solution. If you have a solution but you are unsure about its completeness, include a brief description of what you are unsure about, together with your partial solution.
- *"What if I'm not able to figure out some problem before the deadline?"* For **half** the marks for that problem, you can submit a description of what you understand about the problem and the related course material (relevant sections from the lecture slides, page numbers from the textbook, etc.), to show that you are at least aware of the relevant material. Then *write a clear statement of at least one question or confusion about this material* that is making it difficult for you to get started. You may submit more than

just one question / concern (and under this condition, you really should for your own benefit), but it will not be required. **Important: just writing "I don't know how to do this" is not enough!** Your responsibility to your own learning requires you to figure out more precisely what you understand and what you do not, so that you are able to formulate at least one concrete question about the material.

Submission instructions

- You must submit all problem sets individually. More precisely, you may freely discuss the problems and their answers with your classmates, and with TAs and instructors, but **you MUST write up and submit your own unique document, and you MUST acknowledge all the sources you used to complete it**. See the section on **Academic Integrity** for details of exactly what is allowed and what is not.

- On weeks when there is a tutorial, your TAs will answer questions about, and discuss how to solve the problem sets for current and previous weeks. Attempting the problem set before your tutorial will help you self-assess your level of understanding of the course concepts, so that you can be best prepared for the following week's term test.

- Problem sets must be submitted online through MarkUs *before* the due date. If you haven't used MarkUs before, give yourself plenty of time to figure it out, and ask for help if you need it! The following **Documentation for Students (https://github.com/MarkUsProject/Markus/wiki/Student-Guide)** may also be useful if you have never used MarkUs before.

- The link to connect to MarkUs is included directly in the navigation menu for the course. When you click on it, you will be taken to a login page where you can use your UTOR username and password OR your Teaching Lab username and password (both will work) — you can find your Teaching Lab account name and set or reset your password at https://www.teach.cs.toronto.edu/account **(https://www.teach.cs.toronto.edu/account)**. Once you have logged in, you will see a page with one tile for each course from this term that is using MarkUs — just click on the tile for csc236.

- You must submit your answers **in a separate document for each problem**, *using the **exact** file name specified on MarkUs*. Each document must be **in PDF**. **Other formats** (e.g., *photos*, Word documents, LaTeX source files, ZIP files) **are NOT accepted** — you must **export**, **compile**, **convert** and/or **combine** documents into **ONE** file in PDF, for each individual problem.

- You may type your answers or hand-write them *legibly*, on paper or using a tablet and stylus, in a separate document or directly on the question paper (if there is space). We encourage you to use LᴬTᴇX if you have the time (it's a good opportunity to practice), but *this is NOT required*.

- Each file you submit must be no larger than 19MB. This may happen if you combine multiple photos into one PDF without any sort of compression, or when exporting longer documents from OneNote; if it does, you should use a PDF compression tool to make your PDF smaller, although please make sure that your PDF is still legible before submitting it. (There are good, free tools you can use for this, like **PDFSAM (https://pdfsam.org/)** or **PDF24 (https://pdf24.org/)**.)

- You can submit your work more than once — and are encouraged to do so! — the most recent version submitted within the deadline is the version marked. However, your final submission should always contain *exactly one file **per question***. In other words, please *never submit multiple files with different names, for the same answers* (or make sure you remove all files except the correct one). In general, you can (**and should**) simply overwrite your last submission with the next one — in other words, submit every file under the same name. MarkUs will replace your old submission with the new one, *but keep a*

record of the previous versions so that we can roll back to them if necessary. You can never lose information this way.

- **The safest way to know that your submission is okay is to try to view it afterwards**: if MarkUs can display your submission **in your browser** *(NOT by downloading it and opening it on your device)*, then everything worked fine; if you are unable to view your submission **directly on MarkUs**, then there was a problem that you must fix.
- All problem sets are due **before** 21:00:00 on their due date. We recognize that unexpected issues sometimes make it difficult to submit problem sets on time, *including* technical issues. For this reason, problem set submissions will be accepted *up to one week late with a penalty of roughly −10% for each day*—**except for the last problem set, which CANNOT be submitted once the final exam period begins on Dec 9**. For added flexibility, there will be NO penalty during the first 48 hours of lateness, then a cumulative penalty of −10% for each additional day, up to a maximum penalty of −50%. To be more precise, lateness penalties will be applied as follows.
    - *On or before 20:59:59 Tuesday (on the due date)*: on-time, NO penalty
    - *Between 21:00:00 Tuesday and 20:59:59 Wednesday*: 1 day late, **NO** penalty
    - *Between 21:00:00 Wednesday and 20:59:59 Thursday*: 2 days late, **NO** penalty
    - *Between 21:00:00 Thursday and 20:59:59 Friday*: 3 days late, **−10%** penalty
    - *Between 21:00:00 Friday and 20:59:59 Saturday*: 4 days late, **−20%** penalty
    - *Between 21:00:00 Saturday and 20:59:59 Sunday*: 5 days late, **−30%** penalty
    - *Between 21:00:00 Sunday and 20:59:59 Monday*: 6 days late, **−40%** penalty
    - *Between 21:00:00 Monday and 20:59:59 Tuesday*: 7 days late, **−50%** penalty
    - *On or after 21:00:00 Tuesday AFTER the due date*: **NOT ACCEPTED**
- *Exceptions will NOT be made for submissions that are "just a few minutes late" (or even just a few seconds).* Please do NOT wait until the last minute (or even the last hour), for your own sake! Submissions are not accepted after more than one week, because by that point you must move on in order not to fall behind in the course. If you face extraordinary circumstances outside your control that disrupt your ability to keep up with your studies, please read the section on **Special Consideration** for advice on how to proceed.
- Note that there will usually be multiple problem sets to which you can submit files. *Double-check and triple-check before you submit to make sure you are submitting your work to the correct problem set!*

Term Tests and Final Exam

↑ Contents ↑

Feeling ill? Complete a self-assessment (https://covid-19.ontario.ca/self-assessment/) before you show up!

Keep in mind that **course instructors cannot grant Special Consideration for Final Examinations**! If you are unable to write the final exam, please contact your **College Registrar (https://future.utoronto.ca/current-students/registrars/)** for the next steps—the process is explained in more detail on the **Sidney Smith Commons (https://sidneysmithcommons.artsci.utoronto.ca/i-cant-make-a-test-or-exam-what-do-i-do/)**.

You are expected to write *every* test. In addition to providing us with a component of your final course mark, each test will provide *you* with valuable feedback on your understanding of a significant portion of the course material. If you are truly unable to write a test, we can make up for the missing marks easily enough, but it is more difficult (and requires more work on your part) to make up for the lost learning opportunity. This places you at a disadvantage for the final exam. The policy described in the next paragraph does NOT mean that you can simply *choose* to "skip a test". Rather, it is meant for *emergencies:* situations where you are truly **unable** to write the test with everyone else (not just when it is inconvenient). You have to judge whether your situation is only an inconvenience (something that prevents you from performing at the top of your abilities but whose real impact on your performance is relatively small), or a major disadvantage (something that makes your performance significantly worse than normal). We understand that sometimes, it can be difficult to make a clear distinction between these two types of situations. We ask that you be realistic about your expectations and that you only request Special Consideration when it is necessary, for your own sake.

What if you miss a test for unexpected reasons outside your control? Please follow the instructions in the **Special Consideration** section. **If you miss one or two tests *for approved reasons*,** we will calculate a mark for the test you missed, based on your performance on the other tests *and on the final exam*, taking into account the class averages on every test and exam. This ensures that you are not unfairly penalized if the test you missed was easier, but also that you do not gain an unfair advantage if you missed a harder test. **If you miss more than two tests**, we will require you to make an appointment with your **College Registrar (https://future.utoronto.ca/current-students/registrars/)** to put in place a concrete plan for the rest of the term, *before* we approve any exception. This ensures that you are realistic about your ability to succeed in the course and that you have thought about how you will manage the risk: after all, missing more than two tests would put you in a situation where you would be taking the final exam with NO feedback on your performance for MORE than half the material of the course. To ensure you do not engage in "magical thinking" (that everything will work out fine, but without a concrete plan), *we will require confirmation from your College Registrar* that you have met with them and that your approach to the rest of the term is realistic. Once we receive this, we can easily put in place appropriate accommodations for all your missed work.

Test & Exam Information
(see the Overview for dates, times, and location)

Test	Coverage	Aids Allowed	Practice	Papers & Solutions
TT1	*(TENTATIVE: Simple Induction; Complete Induction; PS1)*	None	paper / solutions	[TBA]
TT2	*(TENTATIVE: Structural Induction; Well-Ordering; PS2)*	None	paper / solutions	[TBA]
TT3	*(TENTATIVE: Recursive Runtime; Divide-and-*	None	paper / solutions	[TBA]

Test	Coverage	Aids Allowed	Practice	Papers & Solutions
	Conquer; PS3)			
TT4	*(TENTATIVE: Recursive and Iterative Correctness; PS4)*	None	paper / solutions	[TBA]
TT5	*(TENTATIVE: Formal Languages; Regular Expressions; DFA; NFA; PS5)*	None	paper / solutions	[TBA]
Exam	Comprehensive: you are expected to be familiar with **all** the material covered in the course.	None	**Old Exams Collection (https://myaccess.library.utoronto.ca /login?url=https://exams.library.utoronto.ca)**	[COVER PAGE TO BE ADDED]

What to expect (in general terms)

Term Tests will generally contain 3–4 questions, at least one of which is meant to be easy (a more-or-less direct application of course material), and at least one of which is meant to be somewhat challenging (require some creativity in applying the course material).

We know tests are time-limited; we won't ask questions that require a lot of time to figure things out! For example, we are not likely to ask you to solve a completely new "Challenge"-level problem, because that might require you to spend too long thinking about various possibilities to find one that works. But we *could* give you a problem *similar* to a Challenge-level question from a problem set, one where the key insight from the problem set can be applied fairly directly. This would then be considered a reasonably easy question, because you wouldn't need to come up with any new ideas to solve it, just show that you can apply something you have already learned (assuming that you did learn it from working on the problem set, of course).

How to Prepare

First review the materials listed above. Start with the **Problem Sets**, make sure you understand how to solve them, and use this to decide what to review next — focus on the topics and problems that you have more difficulty with. Don't forget to compare your answers against sample solutions (when these are available).

Next, you can try questions from previous years' term tests — see above for some links, but **please read the rest of this paragraph first**! Keep in mind that questions on our test are more likely to be related to problems you have *already* worked on this term than to questions from previous tests. At the same time, these past test problems are a good way to practice your understanding. *For maximum benefit, we strongly suggest the following approach:* try these questions only **after** you have finished reviewing the rest of the materials from this term; **time yourself** to get the benefit of a real "test experience", as a way to verify not

only your understanding, but also your ability to answer questions quickly (this will matter for the actual tests); and finally, *don't look at the solutions* until you have finished working on the questions as if it were a real test.

Make good use of the **Sidney Smith Commons' Exam Toolkit (https://sidneysmithcommons.artsci.utoronto.ca/exam-toolkit/)** . This contains many general resources to help you prepare for term tests and the final exams, including sections on "what to expect", "how to study", and "strategies".

"How should I prepare my aid sheet for the final exam?"

- Most importantly, **do not rely on your aid sheet as a "shortcut" to studying**! The exam will ask you to apply course material to new problems and/or under new situations. We will expect you to have **already** understood this material: you will not have time during the exam to read lots of notes in order to understand something from the beginning.
- Putting together your aid sheet is a good way to structure your review of every course topic. The simple mechanical act of writing down information helps your brain make stronger connections, so that the information becomes easier to remember and understand. But as you review and put together your aid sheet, focus on **understanding** what you are studying (what it means, how it connects to other topics, how to use it to solve porblems), NOT on memorizing it — *that's what the aid sheet is for!*
- You can write anything you want on your aid sheet, but you will not have a lot of time to read it during the exam. We recommend you write down only key definitions and concepts and examples. Focus on those elements of the course that contain many easy-to-forget details, or those that you know you struggle with. Do this as you review: every problem that gave you some difficulty (on a problem set or a test) is a good candidate for information you can add to your aid sheet to help you remember how to solve similar problems.
- If you are going to use past tests and exams to practice, how about putting everything away and trying to answer those questions using only your aid sheet? This will help you find new elements to add to your aid sheet, or increase your confidence that it is ready.

How to write tests (and the exam)

Read the questions! If you answer the wrong question, even if it's because you were nervous and you misread it, there is nothing that we can do. If something is unclear, *please ask*.

Manage your time! Be disciplined, to leave most of your time free for solving problems. In particular, it's fine to give point-form answers with the key elements, instead of spending time writing long, complete sentences.

Show what you know! Your strategy during the test should be:

- to identify the questions that you know how to answer (this means that you must read EVERY question **before** you start answering any of them);
- to answer those questions right away;
- to go back to the questions you're not sure about, and work on them;
- if you get stuck on a question, to move on to the next one and come back later (don't waste your time)

— you can figure out ahead of time how much time to devote to each question (based on how much it's worth), and stick to that estimate as much as possible.

If you have an idea how to solve a question but no time to do it in detail, then of course you should write down your idea. You will get part marks for any question where you have the correct structure (i.e., clearly showing that you know what you are supposed to do), even if you cannot fill in the details. So it always pays off to take a minute to write down a correct outline for your answer — it's worth marks, even if you are unable to do more.

Explain what you're doing! When you give an answer, make sure that you give at least a short statement of what you're doing before giving us the answer: if your answer is incorrect, this can make the difference between getting NO mark (because we can't tell if you understand what you're doing) or getting part marks (if we see that you have the right idea but simply made a small error, or that you have the wrong idea but wrote it up correctly).

Don't ramble! Write concise, to-the-point answers. If you ramble, or if you write an answer for a related (but different) problem with no adjustment or explanation, the feeling it gives us is that you don't know the correct answer. Also, be aware that if you give us a correct answer followed by explanations that are clearly wrong or irrelevant, you will lose marks! So only write down what you know is correct: if you're not sure, either say so explicitly or don't say anything.

On the other hand, if you start writing down an answer and you realize that it's wrong, SAY SO! You'll get more part marks for showing that you understand your mistake, even if you're not sure how to fix it, than if you simply leave it like that (which gives the impression that you don't even realize that what you did was wrong).

On a related note, don't feel like you must fill all the available space: it is quite possible that a correct answer will require only part of the space for some questions.

Take care of yourself! You'll function much better if you are well-rested and relaxed than if you are tired or tense. Take some time to exercise (moderately), to burn off some of your body's stress, leaving you better able to manage your stress levels and better able to perform. Eat a nutritious meal (but not too much) so you're not hungry during the test. And get a good night's sleep the night before.

A related tip I learned from a student: trying to "force yourself to be calm" may not work well, or even backfire, because you're trying to suppress your body's natural response to stress. Instead, trick your brain into thinking that what you're feeling is not stress — it's excitement! The two feelings are similar enough, you can think of it as looking forward to the challenge — the way a trained athlete is primed for a competition, and turning their nervousness into positive stress.

Academic Integrity

All work you submit must be your own. It is an academic offence to copy the work of someone else — even if the other person is not a student — *unless you explicitly and clearly attribute the work to its original*

source. This includes words, sentences, entire documents, and even ideas. Whether you copy or let someone else copy, it is an offence. Academic offences are taken very seriously and can have correspondingly serious consequences.

At the same time, we want you to benefit from working with other students. For this course, you must write up your own individual submission to every problem set — you cannot submit the same answers as another student — but you are allowed to discuss how to solve the problems with anyone you wish. The purpose of the problem sets is to ensure that **you** understand how to solve the problems. Even if you did not generate a solution yourself, you can still receive full credit for writing up a solution in your own words, *together with a list of ALL sources you consulted*: textbooks, web pages, students with whom you discussed the problem, etc. (See the **Problem Sets** section for detailed description of what each submission must contain to receive full credit.)

You are also welcome to freely discuss course material and technology (such as **LATEX**) related to assignments, and we encourage you to do so. For example, you may work through examples that help you understand course material or a new technology, or help each other configure your system to run a supporting piece of software.

Any collaboration on, or sharing of, term test solutions or questions is strictly forbidden!

Please take a few minutes to consult the **Academic Integrity at U of T (https://www.academicintegrity.utoronto.ca/)** website: it contains good information and concrete strategies to help support your learning in ways that follow the principles of academic integrity, in addition to references to formal policies and procedures.

What about ChatGPT?

In this course, you may use generative artificial intelligence (AI) tools (like ChatGPT and GitHub Copilot) as learning aids and to help complete problem sets. *You will NOT be permitted to use generative AI on the term tests or final exam.* While some generative AI tools are currently available for free in Canada, please be warned that these tools have not been vetted by the University of Toronto and might not meet University guidelines or requirements for privacy, intellectual property, security, accessibility, and records retention. Generative AI may produce content which is incorrect or misleading, or inconsistent with the expectations of this course. They may even provide citations to sources that don't exist — and submitting work with false citations is an academic offense. These tools may be subject to service interruptions, software modifications, and pricing changes during the semester.

Generative AI is NOT required to complete any aspect of this course, and we caution you to not rely on these tools to complete your coursework. Instead, we recommend treating generative AI as a supplementary tool only for exploration or drafting content — **always remembering to cite any resource you used to generate your answers**. Ultimately, you (and not any AI tool) are responsible for your own learning in this course, and for all the work you submit for credit. It is your responsibility to critically evaluate the content generated, and to regularly assess your own learning independent of generative AI tools. Overreliance on generative AI may give you a false sense of how much you've actually learned, which can lead to poor performance on the term tests or final exam, in later courses, or in future work or studies after graduation.

Special Consideration ↑ **[Contents](#)** ↑

Feeling ill? Complete a [self-assessment (https://covid-19.ontario.ca/self-assessment/)](https://covid-19.ontario.ca/self-assessment/) before you show up to a class or test!

If you are unable to complete course work or if you miss a test due to major illness or other circumstances outside of your control, please get in touch with us as soon as possible. Special consideration will be evaluated on a case-by-case basis and is not given automatically — we may be unable to grant you exactly the special consideration you seek, so please ensure we have time to discuss your situation.

In order to receive special consideration, you must fill out a **[Request for Special Consideration Form (https://forms.office.com/r/ihkm8kQv0R)](https://forms.office.com/r/ihkm8kQv0R)** . Simply complete and submit the form online as soon as you can, together with supporting documentation. **Accepted forms of documentation have been updated for this year!** They include Absence Declaration (via ACORN), or the University's Verification of Student Illness or Injury (VOI) form, or letters from your College Registrar or Accessibility Services. But be warned that starting this year, **Absence Declaration can be used at most ONCE PER TERM**, and for a maximum of seven consecutive days (this is a new policy). For more information on each type of documentation, including when and how to use it, please read all the details carefully on the new **[Student Absences (https://www.artsci.utoronto.ca/absence)](https://www.artsci.utoronto.ca/absence)** page from the Faculty of Arts & Science.

IMPORTANT: If you know that you will NOT be able to write a term test, just submit the request form as soon as you are able (and have obtained appropriate documentation). It is NOT necessary to send email for "simple" requests due to illness / injury or personal / family emergencies — just the form is sufficient. However, if your situation is particularly unusual or complex, please contact us (by email using csc236-2023-09@cs.toronto.edu **[(mailto:csc236-2023-09@cs.toronto.edu)](mailto:csc236-2023-09@cs.toronto.edu)**) to discuss the details. In that case, **please reach out as soon as you can** (even before you have obtained documentation): it is always easier to resolve situations earlier rather than later.

If you face a situation that is particularly disruptive (especially if it is likely to affect more than one course), please also contact your **[College Registrar (https://future.utoronto.ca/current-students/registrars/)](https://future.utoronto.ca/current-students/registrars/)** — they are best equipped to provide you with general advice and support that goes beyond a single course. They can also help you document your situation and contact each of your course instructors on your behalf, to simplify the process of requesting accommodations.

Remark Requests ↑ **[Contents](#)** ↑

If you believe there was an error in the marking of a problem set or test — or if you just have questions about how your work was marked — you may request that it be remarked. Please complete and submit a Remark Request **directly on MarkUs** (no separate form or email message required). You must give a specific reason for the request, referring to possible errors or omissions by the marker, or asking specific questions

about the feedback (or lack of feedback) you received.

Remark requests must be received within **two weeks** of when the item was returned.

Please note that when we receive a remark request, we may regrade the entire submission, though we will generally focus on the questions that are the subject of your request. Your mark may go up or down as a result of the remark. *This is not meant to discourage you from submitting remarking requests!* Just to acknowledge the reality that errors can be made in both directions in the initial marking: it's possible that TAs misunderstand your solution and penalize it more than appropriate, but it's also possible that TAs forget or miss some mistakes in your solution and do not apply appropriate penalties. When we remark, we correct both types of marking errors.

Creating a Positive Learning Environment　　　↑ **Contents** ↑

We are committed to creating a respectful learning environment in computer science courses for all students and expect that you will adhere to the University of Toronto's **Code of Student Conduct (https://governingcouncil.utoronto.ca/secretariat/policies/code-student-conduct-december-13-2019)** . Please be mindful of how your behaviour influences the atmosphere in our learning community, not just in classes, but also in computer labs, in online forums, and anywhere that you interact with other students and members of the department.

About Masks

If you feel sick (even if you have not tested positive for COVID-19), we kindly ask that you wear a mask during lectures, tutorials, and in-person office hours, as a courtesy to all your classmates (some of whom may live with immunocompromised individuals). Wearing a mask is a simple, non-invasive way to be considerate to your community by reducing the risks of transmission of COVID-19 (and other airborne illnesses), especially in indoor spaces where distancing is not possible.

Accessibility　　　↑ **Contents** ↑

The University of Toronto is committed to accessibility. If you require accommodations for an ongoing disability or an acute issue such as an injury, you should register with **Accessibility Services (https://studentlife.utoronto.ca/service/accessibility-services-registration-and-documentation-requirements/)** (AS). The process of accommodation is both confidential and private. AS provides the information necessary to implement an accommodation and no more, e.g., what is listed in a Letter of Accommodation. Your instructors and other university staff will not reveal that you are registered with AS.

Students who require accommodations for term tests (or the final exam) must register with **Accommodated Testing Services (https://lsm.utoronto.ca/ats/)** (ATS). We will only be providing test accommodations sent to us through that official channel. This helps to guarantee that accommodations are provided in a fair and consistent manner for everyone.

Calendar Information

Course Description

The application of logic and proof techniques to Computer Science. Mathematical induction; correctness proofs for iterative and recursive algorithms; recurrence equations and their solutions; introduction to automata and formal languages. This course assumes university-level experience with proof techniques and algorithmic complexity as provided by CSC165H1. Very strong students who already have this experience (e.g., successful completion of MAT157Y1) may consult the undergraduate office about proceeding directly into CSC236H1 or CSC240H1.

Prerequisites: (60% or higher in CSC148H1, 60% or higher in CSC165H1) / (60% or higher in CSC111H1)

Exclusions: CSC240H1, CSC236H5, CSCB36H3

Learning Outcomes

By the end of this course, you will be able to…

- (With respect to Mathematical Induction)
    - State the principles of simple induction, complete induction, and well ordering.
    - Write clear and correct proofs using simple induction, complete induction, and well-ordering.
    - State the principle of structural induction.
    - Write clear and correct proofs using structural induction.
- (With respect to Algorithm Analysis)
    - Define preconditions, postconditions, loop invariants, partial correctness, termination, and how each of these concepts relate to one another.
    - Write clear and correct proofs of loop invariants.
    - Generate correct and useful loop invariants for iterative algorithms.
    - Write clear and correct proofs of partial correctness and termination of iterative and recursive algorithms.
    - Generate correct and useful preconditions and postconditions for iterative and recursive algorithms.
- (With respect to Divide-and-Conquer Algorithms)
    - Set up and solve recurrence relations for the running time of recursive algorithms.
    - Use the Master Theorem to analyze the complexity of divide-and-conquer algorithms.
    - Write correct divide-and-conquer algorithms to solve simple problems.
- (With respect to Formal Language Theory)
    - Define standard terms used in formal language theory (alphabet, string, language).
    - Define Deterministic and Non-Deterministic Finite-State Automata (FSA).
    - Generate correct DFSA and NFSA for various languages.

- Identify the language accepted by various DFSA and NFSA.
- Define Regular Expressions.
- Generate correct regular expressions for various languages.
- Identify the language accepted by various regular expressions.
- Define Regular Languages.
- Write a clear and correct argument that a language is regular.
- State various closure properties of regular languages.
- Prove that certain languages are not regular.
- Convert between DFSA, NFSA, and regular expressions. [Optional]

Textbooks   ↑ **Contents** ↑

- **Required: Course Notes by Prof. Vassos Hadzilacos** ↓ **(https://q.utoronto.ca/courses/314442/files /26656309/download?download_frd=1)** .
- **Recommended: Course Notes by Prof. David Liu** ↓ **(https://q.utoronto.ca/courses/314442/files /26656308/download?download_frd=1)** . (A supplemental source of explanations, examples, and practice problems.)
- **Optional:** Susanna Epp, *Discrete Mathematics with Applications*. Fifth Edition, Cengage Learning, 2020. (Contains many practice problems about induction and recurrences, but only a few about algorithm correctness and complexity, and formal language theory.)
  - **U of T Library Holding (https://librarysearch.library.utoronto.ca/permalink/01UTORONTO_INST /14bjeso/alma991107278006806196)** for the book.
  - **Discrete Mathematics eBook (https://www.campusebookstore.com/integration/AccessCodes /default.aspx?permalinkId=abe4a724-af2f-4e1b-a3bd-0ed5044b9828&frame=YES&t=permalink)** , from the U of T Bookstore. You can also get print copies at the bookstore.
  - **Discrete Mathematics on Cengage.ca (https://www.cengage.ca/c/discrete-mathematics-with-applications-5e-epp/9781337694193)** — use coupon code CengageW22592 for 10% off when you order directly from Cengage (the code is entered on the shipping and payment details page when you complete your order).

Technical Requirements   ↑ **Contents** ↑

Some course activities (office hours) may be offered online, through Zoom.

- To join online office hours, you must be signed in to your U of T Zoom account.
- "*What U of T Zoom account?*" Glad you asked: the **Zoom Onboarding for Students** provided by the Faculty of Arts & Science Information Commons has all the details you need.
- You will have a much better experience if you use the most recent version of the desktop client for Zoom, instead of accessing it through a web browser.
- More generally, to fully participate in all course activities, you require reliable access to a **full computer**

(*not just a smartphone*) on which you can browse web pages, read lecture slides, and type and submit problem sets.

- To attend online office hours, this computer must have a **microphone**, optionally a webcam, as well as a **reliable, high-speed internet connection**.

LATEX help

LATEX is a standard typesetting program used in computer science, and we encourage you to learn how to use LATEX as part of your work — *though this is **not necessary** to submit work in this course*. The important thing is that you submit documents only in one of the approved formats, no matter how you generated them. In this section, we provide some resources to help you get started with LATEX.

There is no general "course template" for LATEX documents. Time permitting, I may try to post samples here if people run into difficulties generating certain types of content (e.g., graph pictures). Also, you can always ask questions on Ed, where I (and others) will be happy to help.

In particular, to generate nice-looking transition diagrams in LATEX, here is a sample file that shows how to use the `tikz` package, along with the results of typesetting it using a recent installation of TeXLive (it should also work fine with MacTeX, MiKTeX, and other standard distributions): **diagrams.tex** ↓ **(https://q.utoronto.ca/courses/314442/files/26605959/download?download_frd=1)** / **diagrams.pdf** ↓ **(https://q.utoronto.ca/courses/314442/files/26605958/download?download_frd=1)** .

Otherwise, you may find the following links helpful.

- **Overleaf (https://www.overleaf.com/)** is an online application that allows you to edit and compile LATEX files right in your browser, and even collaborate with others — *always while following Academic Integrity requirements, of course*. It also provides some **tutorials (https://www.overleaf.com/learn)** on the basics of using LATEX.
- A detailed, yet simple and accessible online LATEX tutorial **(a great place to start):** `https://www.latex-tutorial.com/` **(https://www.latex-tutorial.com/)** .
- Download LATEX on the official LATEX webpage: `https://latex-project.org/` **(https://latex-project.org/)** (click on "Get" in the top menubar and select an appropriate distribution to download).
- A relatively comprehensive introduction to LATEX **(highly recommended, but long):** `https://ctan.mirror.rafal.ca/info/lshort/english/lshort.pdf` **(https://ctan.mirror.rafal.ca /info/lshort/english/lshort.pdf)** .
- A LATEX wiki (most Google searches lead here): `https://en.wikibooks.org/wiki/LaTeX` **(https://en.wikibooks.org/wiki/LaTeX)** .
- A fantastic application of machine learning; use it to find LATEX commands based on the symbol: `https://detexify.kirelabs.org` **(https://detexify.kirelabs.org)** .
- A graphical LATEX editor (requires downloading and installing the software): `https://www.lyx.org/` **(https://www.lyx.org/)** .
- A different graphical editor (also requires downloading and installing software): `https://texmacs.org/` **(https://texmacs.org/)**

- A forum for asking LATEX-related questions **(highly recommended)**:
  https://tex.stackexchange.com/ **(https://tex.stackexchange.com/)** .

↑ **Contents** ↑

Course Summary:

Date	Details	Due
Tue Sep 19, 2023	📝 **Problem Set 1 (https://q.utoronto.ca/courses/314442/assignments/1108118)**	due by 9pm
Wed Sep 27, 2023	📅 **Term Test 1 (LEC0101) (https://q.utoronto.ca/calendar?event_id=665862&include_contexts=course_314442)**	11:10am to 12pm
	📅 **Term Test 1 (LEC0201) (https://q.utoronto.ca/calendar?event_id=665863&include_contexts=course_314442)**	12:10pm to 1pm
	📅 **Term Test 1 (LEC0301) (https://q.utoronto.ca/calendar?event_id=665864&include_contexts=course_314442)**	1:10pm to 2pm
	📅 **Term Test 1 (LEC0401) (https://q.utoronto.ca/calendar?event_id=665865&include_contexts=course_314442)**	2:10pm to 3pm
	📅 **Term Test 1 (LEC5101) (https://q.utoronto.ca/calendar?event_id=665866&include_contexts=course_314442)**	8:10pm to 9pm
Tue Oct 3, 2023	📝 **Problem Set 2 (https://q.utoronto.ca/courses/314442/assignments/1108119)**	due by 9pm

Date	Details	Due
Wed Oct 11, 2023	📅 **Term Test 2 (LEC0101) (https://q.utoronto.ca /calendar?event_id=665867& include_contexts=course_314442)**	11:10am to 12pm
	📅 **Term Test 2 (LEC0201) (https://q.utoronto.ca /calendar?event_id=665868& include_contexts=course_314442)**	12:10pm to 1pm
	📅 **Term Test 2 (LEC0301) (https://q.utoronto.ca /calendar?event_id=665869& include_contexts=course_314442)**	1:10pm to 2pm
	📅 **Term Test 2 (LEC0401) (https://q.utoronto.ca /calendar?event_id=665870& include_contexts=course_314442)**	2:10pm to 3pm
	📅 **Term Test 2 (LEC5101) (https://q.utoronto.ca /calendar?event_id=665871& include_contexts=course_314442)**	8:10pm to 9pm
Tue Oct 17, 2023	📝 **Problem Set 3 (https://q.utoronto.ca/courses/314442 /assignments/1108120)**	due by 9pm
Wed Oct 25, 2023	📅 **Term Test 3 (LEC0101) (https://q.utoronto.ca /calendar?event_id=665872& include_contexts=course_314442)**	11:10am to 12pm
	📅 **Term Test 3 (LEC0201) (https://q.utoronto.ca /calendar?event_id=665873& include_contexts=course_314442)**	12:10pm to 1pm
	📅 **Term Test 3 (LEC0301) (https://q.utoronto.ca /calendar?event_id=665874& include_contexts=course_314442)**	1:10pm to 2pm
	📅 **Term Test 3 (LEC0401) (https://q.utoronto.ca**	2:10pm to 3pm

Date	Details	Due
	/calendar?event_id=665875& include_contexts=course_314442)	
	📅 **Term Test 3 (LEC5101)** **(https://q.utoronto.ca /calendar?event_id=665876& include_contexts=course_314442)**	8:10pm to 9pm
Tue Oct 31, 2023	📝 **Problem Set 4** **(https://q.utoronto.ca/courses/314442 /assignments/1108121)**	due by 9pm
	📅 **Term Test 4 (LEC0101)** **(https://q.utoronto.ca /calendar?event_id=665877& include_contexts=course_314442)**	11:10am to 12pm
	📅 **Term Test 4 (LEC0201)** **(https://q.utoronto.ca /calendar?event_id=665878& include_contexts=course_314442)**	12:10pm to 1pm
Wed Nov 15, 2023	📅 **Term Test 4 (LEC0301)** **(https://q.utoronto.ca /calendar?event_id=665879& include_contexts=course_314442)**	1:10pm to 2pm
	📅 **Term Test 4 (LEC0401)** **(https://q.utoronto.ca /calendar?event_id=665880& include_contexts=course_314442)**	2:10pm to 3pm
	📅 **Term Test 4 (LEC5101)** **(https://q.utoronto.ca /calendar?event_id=665881& include_contexts=course_314442)**	8:10pm to 9pm
Tue Nov 21, 2023	📝 **Problem Set 5** **(https://q.utoronto.ca/courses/314442 /assignments/1108122)**	due by 9pm
Wed Nov 29, 2023	📅 **Term Test 5 (LEC0101)** **(https://q.utoronto.ca /calendar?event_id=665882& include_contexts=course_314442)**	11:10am to 12pm

Date	Details	Due
	📅 **Term Test 5 (LEC0201) (https://q.utoronto.ca /calendar?event_id=665883& include_contexts=course_314442)**	12:10pm to 1pm
	📅 **Term Test 5 (LEC0301) (https://q.utoronto.ca /calendar?event_id=665884& include_contexts=course_314442)**	1:10pm to 2pm
	📅 **Term Test 5 (LEC0401) (https://q.utoronto.ca /calendar?event_id=665885& include_contexts=course_314442)**	2:10pm to 3pm
	📅 **Term Test 5 (LEC5101) (https://q.utoronto.ca /calendar?event_id=665886& include_contexts=course_314442)**	8:10pm to 9pm
Tue Dec 5, 2023	📝 **Problem Set 6 (https://q.utoronto.ca/courses/314442 /assignments/1108123)**	due by 9pm