Phil 370: Theoretical Logic
Syllabus

Course Information:

Instructor: Dr. Audrey Yap (ayap@uvic.ca)
Office: CLE B307
Class times: TWF 12:30pm–1:20pm.
In Person Tutorial Sessions: W 1:20pm–2:20pm (location TBA)
Zoom Tutorial Sessions: Th 10:30am-11:30am on Zoom (no sign up required)
One on one Office Hours: T/Th 9:30am–10:20am on Zoom (sign up required)

Course Website: Through Brightspace (https://bright.uvic.ca/d2l/home)
Textbook: Abridged Version of http://forallx.openlogicproject.org/ PDF copy available through the course website.
Prerequisites: Phil 203, Math 122, or permission of the instructor.

If you notice any accessibility issues with respect to this class, please let me know and I will do my best to solve them. I would also encourage any students who might benefit from their services to register with the Centre for Accessible Learning (https://www.uvic.ca/services/cal/).

Course Description:

Techniques of formal symbolic logic are used in modeling deductive arguments. We use them most often to model the validity of arguments, and to prove that a conclusion follows from the premises. We have criteria for determining when one sentence is a logical consequence of others, and when one sentence is deducible from others. The *metatheory* of formal logic is the study of these rules and criteria. For instance, we want to make sure that our rules for deduction will always lead us to correct conclusions, and that we have enough rules to ensure that everything that logically follows can also be deduced.

Learning Objectives:

You will learn basic metatheory of first-order logic, as well as some introductory set theory and model theory. However, the main skill we will focus on is writing proofs in English. If you took PHIL 203, you learned how to write proofs *using* first-order logic. This course will teach you how to prove things *about* first-order logic, which is going to require a different set of skills:

- constructing and understanding basic proofs using set-theoretic tools, including facts about sets and their sizes, functions, and relations.

- knowing when and how to apply intermediate proof techniques in the metatheory of first-order logic, including proofs using cases, contradictions, conditionals, and induction.
- understanding and applying the syntax and semantics of first-order logic, including a natural deduction system. This includes being able to correctly apply concepts like satisfaction, validity, provability, and consistency.
- understanding and being able to do proofs using basic model theory, including substructures, isomorphisms, and non-standard models.

Course Logistics:

The textbook is available on the course website as a downloadable PDF file. All assignments will be posted online, and all of your work—problem sets and your final exam—will be turned in through Brightspace. You don't have to type up your problem sets—you can write them out on paper and use any number of free scanning apps, or even just take photos with your phone. All that matters is that I am able to read them.

Tutorials: Most students who take this class find it beneficial to attend tutorial sessions on a regular basis. These will be drop-in times when you can work on your own or with others, and I'll be available to help out with questions. Wednesday tutorials will be held on campus, and Thursday tutorials will be held online over Zoom.

Communication: Email is my preferred method of communication, especially for any official requests. If you ask me a question over email, you can expect a reply within about 1 working day. If you don't hear back from me after that time frame, feel free to try again in case your message went astray. When you do address me (over email or otherwise), please do so as either Professor (Prof.) Yap, Dr. Yap, or Audrey. Please don't use any of Mrs/Miss/Ms/Mr, for a variety of reasons. If you are ever nervous about sending me an email, or asking a question, feel free to include a picture of a puppy with your request. This will not affect whether or not I will be able to help you with your request, but will give you an excuse to look for pictures of puppies. Finally, my pronouns are she/her/hers. If you think I am unlikely to know the name you would prefer to be called, or the pronouns I ought to use for you through the entry that I will see for you through Brightspace, please don't hesitate to make me aware.

Office Hours: I will be available for office hours on Tuesday and Thursday mornings. My default platform for office hours will be Zoom, but if that does not work for you, please feel free to email me in advance to suggest an alternative. You will need to schedule an appointment beforehand using the following link: `https://calendly.com/ayap/office`. Appointments can be scheduled in 15 minute blocks. If you are working with a study group and would like to attend office hours as a group, simply designate one person to reserve the appointment slot, and let me know who else will be attending.

Gradeable Items

Below is the list of things on which you will be evaluated in the course, as well as their percentage value. For each week you successfully earn engagement credit, you will earn one point up to a maximum of 10.

Gradable Item	Description	Value
Engagement	Posting on the course discussion boards	$1\% \times 10$ weeks $= 10\%$
Problem Sets	Weekly problems on the week's material	$5\% \times 11 = 55\%$
Final Exam	Cumulative take home final exam.	35%
		Total $= 100\%$

Engagement: There will be a shared class discussion board to be used for discussion of weekly topics. In order to receive full marks for participation, you will be responsible for posting in 10 out of the 13 weeks of class. Specific guidelines for each week's participation assignment will be given in the forums where the posts are to be made. But the typical format will ask you to explain one thing from the week's material that you found clear, and pose one question about something that you found less clear. You are highly encouraged to learn from each other and discuss your forum responses. Often you will find that explanations from your peers will be helpful in ways that explanations from your instructors are not, as they will be learning the concepts along with you and may better understand where you're at. Since these forum posts are intended to be ways to engage with the material at the same time as your peers, you will have to post them during the week the material is covered in order to receive credit. Any post that satisfies the weekly guidelines will be given full credit.

Problem Sets: There will be 11 short problem sets, each worth 5% of your final grade, one on each of the topics or formal systems we are covering. Each problem set will be due at the start of the week following that topic and will be handed in online through Brightspace. All due dates are listed on the course schedule below, and you can always assume the due time is 11:59pm.

I also know that sometimes things do not go as planned. You are welcome to two day's worth of extensions on assignments. This means you can take two extra days to complete a single assignment, or have one extra day on two different assignments. Please let me know before the due date if you are using an extension. You also do not need to tell me why you need the extension, but if you anticipate needing more than these two days, I highly encourage you to make an appointment with me to talk about how we can plan for you to keep up with the course schedule.

Final Exam: There will also be an open book final exam at the end of the semester, with release and due dates listed on the course schedule below. The exam will be cumulative, and questions will be similar to those that you will already have completed in your problem

sets throughout the semester. This will also be handed in online, just like your problem sets.

All exam and homework questions will be graded out of 10, where numerical scores correspond to the following rubric:

- E (8–10): The work demonstrates a thorough understanding of the concepts, meets the expectations outlined in the assignment, is complete and well documented. This answer could be used as an example for teaching purposes.
- M (6.5–7.5): Correct proof, example, or answer to the homework problem. Some revision or expansion is needed, but no significant gaps or errors are present.
- R (4–6): Some understanding of the concepts is evident, but significant gaps remain. Needs further work, more review, or improved explanations.
- N (≤ 3.5): The work is fragmentary, contains significant errors or omissions, or there are too many issues to justify correcting each one. Not enough evidence provided to assess whether there is understanding of the concepts.

Academic Integrity: You are welcome and encouraged to discuss course material with others in your class, and work through material and ideas together. However, you are not allowed to provide the solutions for someone else's problem sets or exams, or vice versa. If you are ever unsure about what constitutes a violation of academic integrity, more information is provided on the University Calendar: `http://web.uvic.ca/calendar/undergrad/info/regulations/academic-integrity.html`.

Numerical and Letter Grades: Grades will be given as percentile marks. The percentile mark for the course will be converted to a letter grade in the following manner:
A+ = 90 - 100, A = 85 - 89, A- = 80 - 84, B+ = 77 - 79, B = 73 - 76, B- = 70 - 72, C+ = 65 - 69, C = 60 - 64, D = 50 - 59, F = 0 - 49. The A range means exceptional, outstanding and excellent performance. A grade in the B range means a very good, good and solid performance. A grade in the C+ or C range means satisfactory, or minimally satisfactory, performance. A grade of D indicates merely passable or marginal performance. An F indicates unsatisfactory performance.

Schedule of Topics:

- Week One: Short week — Sep 8–12

  Topic: Introduction to Metatheory. Basic Tools: Sets (1.1–1.5, Appendix A is recommended)

- Week Two: Sep 13–19

  Topic: Basic Tools: Sets, Relations, Functions (1.6–3.5)
  Problem Set One completed by Sep 14

- Week Three: Sep 20–26

  Topic: Set Theory: The Size of Sets (4.1–4.3, 4.6–4.10)
  Problem Set Two completed by Sep 21

- Week Four: Sep 27–Oct 3

  Topic: Proofs: Induction and First-Order Logic: Syntax (5.1–5.8, Appendix B)
  Problem Set Three completed by Sep 28

- Week Five: Oct 4–10

  Topic: First-Order Logic: Semantics (5.9–5.14)
  Problem Set Four completed by Oct 5

- Week Six: Oct 11–17 (Oct 11 is a holiday)

  Topic: First-Order Logic: Natural Deduction (7.1, 7.3, 8.1–8.6)
  Problem Set Five completed by Oct 12

- Week Seven: Oct 18–24

  Topic: First-Order Logic: Derivability and Soundness (8.7–8.11)
  Problem Set Six completed by Oct 19

- Week Eight: Oct 25–31

  Topic: First-Order Logic: Proving Completeness (9.1–9.6)
  Problem Set Seven completed by Oct 26

- Week Nine: Nov 1–7

  Topic: First-Order Logic: Completeness and Compactness (9.8–9.11)
  Problem Set Eight completed by Nov 2

- Week Ten: Nov 8-14 (Reading Break is Nov 10-12)

  Topic: Model Theory: Introduction (6.1–6.4)

- Week Eleven: Nov 15–21

  Topic: Model Theory: Substructures and Isomorphisms (10.1–10.4, 10.6)
  Problem Set Nine completed by Nov 16

- Week Twelve: Nov 22–28

  Topic: Model Theory: Models of Arithmetic (11.1–11.3)
  Problem Set Ten completed by Nov 23

- Week Thirteen: Nov 29–Dec 5

  Topic: Review
  Problem Set Eleven completed by Nov 30
  Take home exam distributed Dec 6, completed by Dec 8