

PHIL 115: First-order Logic

Yale University, Fall 2024

Course Website: <https://yale.instructure.com/courses/100904>

Current as of October 23, 2024. Subject to change!

Lead Instructor	Dr Calum McNamara (Email: calum.mcnamara@yale.edu) Office Hours: Mondays, 1:15–2:15pm; Wednesdays, 3:30–4:30pm (or by appointment) Office: 313 in the Philosophy Department (451 College St)
Teaching Fellows	Krister Rasmussen (Email: krister.rasmussen@yale.edu) Office Hours: Thursdays, 9:30–10:30am Office: 101A in the Philosophy Department (451 College St) Dr Kevin Zhang (Email: kevin.zhang.kaz33@yale.edu) Office Hours: Thursdays, 1:30–2:30pm Office: 101A in the Philosophy Department (451 College St)
Meetings	Lectures: Mondays and Wednesdays, 2:30–3:20pm, William Harkness Hall , 207 Section A: Thursdays, 9:25–10:15am, Linsly-Chittenden Hall , 103 Section B: Thursdays, 10:30–11:20am, Linsly-Chittenden Hall , 103 Section C: Mondays, 9:25–10:15am, Linsly-Chittenden Hall , 213 Section D: Mondays, 10:30–11:20am, Linsly-Chittenden Hall , 213
Description	This course is a fast-paced introduction to <i>formal</i> , or <i>symbolic</i> , <i>logic</i> . Roughly speaking, logic is the study of <i>arguments</i> , as well as related concepts like <i>consistency</i> and <i>consequence</i> . In this course, we'll focus mostly on two of the simplest and most important systems of formal logic—namely, classical propositional logic, and its generalization, classical predicate logic (sometimes called ‘first-order logic’, as in the course title). Both of these systems will be examined from several points of view (e.g., syntax, semantics, natural deduction). And along the way, we'll spend a good deal of time talking about philosophical issues arising out of the study of these systems. It will be fun!
Objectives	By the end of this course, you should (i) be familiar with basic logical concepts, like validity, soundness, and entailment; (ii) be able to translate simple natural language sentences into propositional and predicate logic; (iii) be comfortable with truth-tables, models, and natural deduction, as well as proofs using basic mathematical induction; (iv) be able to comprehend meta-logical notions like soundness and completeness.
Prerequisites	None, though some experience with quantitative reasoning would be helpful.

Materials	Our primary reading in this course will be Greg Restall's textbook <i>Logic</i> . It would be helpful if you purchase yourself a copy; you can find it on sale here . Alternatively, if you'd prefer not to purchase a physical copy, the textbook is available freely online, through the university's library website: here . I will also provide detailed lecture notes, when we go beyond material that's covered in the textbook. Occasionally, I will provide some supplementary readings—keep an eye on the course page for those.
Grading	<p>Problem Sets: 30% (due Fridays at 5pm)</p> <p>Midterm Exam: 25%</p> <p>Cumulative Final Exam: 35%</p> <p>Class Attendance and Participation: 10%</p>
Problem Sets	<p>There will 10 problem sets assigned in this course. They will be due most Fridays at 5pm. You can submit the problem sets either electronically, on Canvas, or by delivering them by hand to my mailbox in the philosophy department (451 College St). (If you deliver the problem sets by hand, it's especially important that you do so in a timely fashion: the department may close on Friday nights!)</p> <p>The problem will consist of a mixture of different types of questions: some will require you to give definitions, etc.; some will require you to solve problems; and some will require you to reflect philosophically on the issues that we're discussing in class. At the end of the course, your lowest problem set grade will be dropped.</p> <p>Note that you are <i>encouraged</i> to collaborate with other students on the problem sets—you'll learn a lot by working with each other. However, you <i>must</i> write up your solutions independently. Also, if you do collaborate with other students, please include a list of their names at the top of your problem set.</p>
Lateness Policy	<p>We are willing to grant extensions on problem sets, if those extensions are requested <i>at least 24</i> hours in advance of the deadline. (Requests should be sent by email to Teaching Fellow, cc'ing me, Calum). That said, please don't make a habit of asking for extensions. We will grant one, and maybe another, but that is about as far as we are prepared to go. Granting additional extensions will require you to have some very good reason for the request.</p> <p>Absent a valid extension request, our lateness policy is as follows: if you hand in a problem set within 24 hours of the deadline (but after the deadline itself), then we will detract 10% from your score; within 48 hours (but after 24 hours), we will detract 20%. After that, late problem sets will not be accepted (without a valid excuse).</p>
Honor Code	It should go without saying: don't cheat on the problem sets. (This includes copying answers from other students, or asking an LLM, like ChatGPT, to do the problems on your behalf. LLMs are often not very good at these problems, by the way.) Minor infractions will result in you failing the relevant assignment. Major infractions will be kicked up to the university. And punishments in that case can be severe.

Exams	<p>There will be two exams in this course: a midterm exam, solely on propositional logic, and a cumulative final, on everything covered in the course. Together, the exams are worth 60% of your grade.</p> <p>The midterm exam will be taken in class, at the regular time, on 10/14, right before the Fall Break. Please plan accordingly.</p> <p>The date and time for the final exam are TBD.</p>
Technology	<p>With two exceptions, laptops, phones, and other electronic devices are not permitted to be used in class. Multiple studies have shown that students using laptops, etc., do significantly worse on exams that test their comprehension than students who do not use these things. This is true even when students are not multitasking. Typing shifts you into “transcription mode”, whereas writing by hand requires you to actively process material.</p> <p>The first exception to the technology rule is if you’re going to take notes <i>by hand</i> on a device like an iPad or a reMarkable. That’s allowed. The other exception is if you have a disability that necessitates using a computer, or some other electronic device. If that’s the case, then I’m happy to accommodate you. But if this is so, please speak to me about it as early as you can.</p>
Disabilities	<p>The Americans with Disabilities Act is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Students who require academic accommodations can work with Student Accommodations Services (SAS) to arrange for (among other things) assistive technology or academic coaching. Many students don’t receive adequate diagnoses, or discover only late in their academic careers that they have access to academic accommodations. Thus, if you even <i>suspect</i> that you might need such accommodations, it’s worth reaching out early on.</p> <p>For reasons of privacy and consistency, I ask that you start with SAS; in particular, see here for their Accommodations Request Form. However, please know that whether or not you are able to arrange formal accommodations, I am committed to working with you to ensure that you are able to participate fully in this course. Just speak to me about your needs, as soon as you can.</p>
Mental Health and “Ghosting”	<p>In the past, I’ve had students who stop coming to class or section, and stop handing in assignments, partway through the term. This is usually because the student is overwhelmed with work, facing a difficult personal situation, or struggling with a mental health issue. If you find yourself confronted with any of these issues (or a similar one), please know that you’re not alone. Many college students experience such struggles, and the pandemic has caused and exacerbated many mental health challenges. I strongly encourage you to talk to the university’s counseling service as soon as you can, if you find yourself in such a position; for an appointment call 203-432-0290. They are professionals and they care very much about your well-being. I also encourage you to communicate with me or your Teaching Fellow about any</p>

missing coursework. We're not mental health professionals, but we also care about your well-being, and can better help you manage your assignments if we know what's going on as it's happening, instead of being informed of any issues shortly before (or after) the end of term.

Tentative Schedule	8/28	Introductory Meeting; Propositions and Arguments <i>Reading:</i> Restall, pp. 1–3 and also Chapter 1 (you can read this after class, if you like)
	9/2	No Class (Labor Day)
	9/4	The Language of Propositional Logic <i>Reading:</i> Restall, Chapter 2
	9/9	Truth Tables, Part 1 <i>Reading:</i> Restall, Chapter 3
	9/11	Truth Tables, Part 2 <i>Reading:</i> Restall, Chapter 3 (if you didn't finish it previously). Problem Set 1 due 9/13 at 5pm!
	9/16	Induction! (And Truth Trees review) <i>No reading</i>
	9/18	Truth Trees, Part 1. <i>Reading:</i> Chapter 3 (again—specifically pp. 55–68); note that there are tragic typos on p. 62—see https://consequently.org/logic/errata.html Problem Set 2 due 9/20 at 5pm!
	9/23	Tree Review, and Soundness of Trees <i>Reading:</i> Restall pp. 68–71
	9/25	More Tree Review, and Completeness for Trees <i>Reading:</i> Restall pp. 71–74 Problem Set 3 due 9/27 at 5pm!
	9/30	Derivations, Part 1 <i>Reading:</i> Lecture Notes
	10/2	Derivations, Part 2 <i>Reading:</i> Lecture Notes Problem Set 4 due 10/4 at 5pm!
	10/7	Derivations, Part 3 <i>Reading:</i> Lecture Notes
	10/9	Midterm Review Problem Set 5 due 10/11 at 5pm!
	10/14	Midterm Exam!
	10/16	No Class (Fall Break)

- 10/21 Introducing Predicate Logic!
Reading: Restall, Chapter 8
- 10/23 Models, Part 1
Reading: Restall, Chapter 9, pp 128–139.
- 10/28 Models, Part 2
Reading: Restall, the remainder of Chapter 9.
- 10/30 Trees, Part 1
Reading: Lecture Notes
 Problem Set 6 due Friday 11/1 at 5pm!
- 11/4 Trees, Part 2
Reading: Lecture Notes
- 11/6 Soundness and Completeness for Trees
Reading: Restall, pp. 161–164
 Problem Set 7 due Friday 11/8 at 5pm!
- 11/11 Derivations, Part 1
Reading: Lecture Notes
- 11/13 Derivations, Part 2
Reading: Lecture Notes
 Problem Set 8 due Friday 11/15 at 5pm!
- 11/18 Derivations, Part 3 (Equality and Infinity)
Reading: Lecture Notes
- 11/20 The Undecidability of Predicate Logic—or: Why Alan Turing Invented Theoretical Computer Science
Reading: Lecture Notes
 Problem Set 9 due Friday 11/22 at 5pm!
- 11/25 No class! Thanksgiving break
- 11/27 No class! Thanksgiving break
- 12/2 Looking forward
No reading
- 12/4 Final Exam Review
No reading
 Problem Set 10 due Friday 11/6 at 5pm!