Philosophy 320: Symbolic Logic II

University of British Columbia, Department of Philosophy
Fall 2024
MWF 10:00, Buchanan D219

Instructor	Office	Telephone	E-mail	Office Hours
Paul Bartha	Buchanan E371	822-2621	paul.bartha@ubc.ca	MW 1-2

I. Description and Objectives: This course has two themes: computability and logic. In the first part of the course (chapters 1-8 of our text), we characterize what it means (classically) for a function to be *computable*. We develop three different definitions of computability, using Turing machines, abacus machines and recursive functions. This part of the course concludes by demonstrating that all three definitions are equivalent: any function that counts as computable on one of the definitions also counts as computable on the other two as well. This equivalence result provides some support for *Church's Thesis* (which states that all effectively computable functions are recursive functions).

The second part of the course (chapters 9-14) develops some of the main ideas of intermediate logic. For this part, we assume that you have a solid grasp of predicate logic. That is, you should understand truth-functional connectives and quantifiers; you should be able to symbolize English sentences in a formal language; and you should know how to construct proofs in first-order predicate logic. Rather than doing proofs within a system of predicate logic, our principal aim in this course is to prove important facts about our system of predicate logic itself.

We begin this second part with a careful formulation of two essential elements of first-order predicate logic:

- *Syntax*, the language and formation rules for formulas of predicate logic; and
- *Semantics*, the definition of valid (logically true) formulas in terms of *interpretations*.

We develop the notion of interpretations and models for sets of sentences and prove some important facts about models. We then discuss a third essential element of first-order predicate logic:

- *Proof theory*, the definition of valid formulas in terms of *deductions*.

That these two notions of validity coincide is established by the *soundness* and *completeness* theorems of chapters 13 and 14. Chapters 11-14 also demonstrate other important properties of first-order predicate logic, including the *undecidability* of first-order predicate logic (chapter 11), the (downward) *Lowenheim-Skolem Theorem* and the *Compactness Theorem* (chapter 12).

Chapters 1-14 constitute the core course material. If time permits, we shall discuss additional material from later book chapters. Connections between logic and computability appear in chapter 11, but deeper connections emerge in these later chapters.

II.   **Text:** G.S. Boolos, J.P. Burgess and R.C. Jeffrey, *Computability and Logic, 5th edition* (Cambridge, 2007). Available in bookstore. (Note: Used copies of 4th edition are almost identical and are fine for the course, but not 3rd edition or earlier.)

III.   **Evaluation:**

Four problem sets (5% each)	20%
Five quizzes (quiz grade based on best four)	15%
Mid-term test (in class, Oct. 25)	25%
Final exam (exam period)	40%

Keeping up with the material by reading the text and working through problems is the key to success in this course. This explains the large number of assignments.

Problem sets: These will be posted on Canvas at least two weeks prior to the deadline. Problem sets must be submitted using the Canvas portal. **Each problem set must be submitted as a single .pdf file upload.** It is your choice whether to write your solutions by hand (and then scan them into a file) or to use a device, but either way you should put everything in .pdf form before submission.

Submission deadlines for problem sets are strict; no late submissions can be accepted without prior permission. Solutions will be posted shortly after the deadline.

Working through problems independently is the best way to learn the course material. I encourage you to try the problems on your own, but if you work with other students, **please indicate this on your submitted work**. Please do not use AI or computer tools.

Quizzes: On five dates (usually Fridays), we will have a short (15-minute) quiz. Quizzes help you to keep up with the reading and to identify problem areas quickly. The lowest quiz mark will be dropped.

Missed-quiz policy: There are no make-up quizzes. If you miss a quiz, the next quiz will be counted at double value. A quiz can only be used to make up the grade for the immediately preceding missed quiz, so do not miss two consecutive quizzes.

Mid-term test: This is a 50-minute test during the **October 25** lecture.

Final exam: This in-person test will take place at the end of term, during the examination period.

IV.   **Course Organization.** Please keep up with the material and assignments. The key organizational tool is the Canvas page. Handouts, announcements and solutions will be posted on Canvas. I may also post some lecture notes and links to additional material.

- **Independent reading.** Please read the assigned chapters, following the course schedule at the end of this syllabus.

- **Posted handouts and assignments.** These will all be available on Canvas.

- **Office hours.** In person, MW 1-2. If you need extra help, please contact me and we can meet.

- **Announcements.** Please read carefully all announcements posted on Canvas throughout the term. These include updates, changes to the syllabus, information about upcoming assignments, changes to assignments or due dates, corrections of errors, and important alerts. They will remain posted for the whole term.

- **Grades.** Assignment grades will be recorded and will appear in the Gradebook section of Canvas. Although your individual assignment grades should be accurate, please ignore any cumulative grade scores computed by Canvas. I will use a separate spreadsheet to compute cumulative grades. Please inform me of any discrepancies between assignment grades on Canvas and your own records. If you have concerns about your assignment grades, I will ask you first to contact the marker (if it was the course TA).

- **Course calendar.** The course calendar on Canvas lists all assignment due dates, apart from the final exam. This syllabus also includes a Lecture and Assignment schedule (at the end) that lists assignment due dates, topics and readings for all classes, and holidays.

- **Piazza.** I encourage you to raise issues and questions for general discussion using Piazza. Please do not post solutions (or tentative solutions) to assigned problems prior to the due date.

V. **Prerequisites and Preparation:** The prerequisite for the course is Phil 220 or Phil 222, or equivalent background in logic from a Math or Computer Science course. You should be comfortable with a mathematical style of lecturing and a mathematical style of problem-solving and doing proofs. If you have any doubts, please see me.

VI. **General advice:** The concepts and problems in Phil 320 are *significantly harder* than in Phil 220 (and somewhat harder than Phil 222). We move at a fast pace. The lectures cannot cover every detail or work through as many examples as I might wish to do. You must be able to learn the material **independently** through reading and solving problems, using the lectures (and handouts) as a basis. I suggest that you read the material before it is covered in the lectures, and then return to the text for a more thorough examination afterwards. You may need multiple readings to grasp these ideas. The lecture notes and handouts are a good way to review and reinforce the material, but the key is to attend lectures, read the text and do the problems.

General policies and other matters:

Academic accommodation: UBC Access & Diversity works with all instructors to provide appropriate accommodation for students with disabilities. Please notify Access and Diversity of your situation well in advance of any assignment due dates, and please feel free to discuss with me any way in which I can be of assistance.

Students are responsible for ensuring that they understand and abide by the UBC regulations concerning academic misconduct and **plagiarism**. Plagiarism is a very serious academic offense. If you are unsure about any issues relating to academic integrity, please consult with me or with your academic advising office. In particular, **all work done on tests must be your own**. For Problem Sets, the policy is as stated in section III above.

Statement of UBC values and policies:

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated, nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available here.

Tentative Schedule of Readings and Assignments

Week of	Chapters covered	**Holidays/Assignments
Sept. 2	1-2	**First class Sept. 4
Sept. 9	2-3	Quiz 1: ch. 1 (Sept. 13)
Sept. 16	3-4	Quiz 2: ch. 2 (Sept. 20) [Recorded lecture Sept. 20]
Sept. 23	5	PS #1: ch. 1-4 (Sept. 27)
Sept. 30	6	**No class Sept. 30 Quiz 3: ch. 5 (Oct. 4)
Oct. 7	6-7 (only §7.1)	
Oct. 14	7-8 (only §8.1 and §8.2)	**No class Oct. 14
Oct. 21	9	PS #2: ch. 5-8 (Oct. 21) Mid-term test, ch.1-8 (Oct. 25)
Oct. 28	9-10	
Nov. 4	10-11	Quiz 4: ch. 9-10 (Nov. 8)
Nov. 11	11-12	**No class Nov. 11 PS #3: ch. 9-11 (Nov. 15)
Nov. 18	12-13	
Nov. 25	13-14 (only §14.1 and §14.2)	Quiz 5: ch. 12 (Nov. 29)
Dec. 2	14 and Review	PS #4: ch. 12-14 (Dec. 6) Last day of class Dec. 6