



UNIVERSITY OF CALGARY
FACULTY OF ARTS
Department of Philosophy

Phil 279 Lec 01
Logic I
Summer 2022
MW 13-15:45 MS 211

June 12, 2022

1 Who's teaching this?

Instructor: Gillman Payette (he/him)
Email: ggpayett@ucalgary.ca
Office Hours: Zoom by appointment (not on the weekend)

2 How do I get in touch with you?

1. Your question may already be answered on the course discussion board (or in this outline). Check there first. If it is not, consider posting your question in the discussion board instead of sending an email. The instructor will monitor the discussion boards and attend to questions regularly.
2. If your inquiry is specific to your personal situation, feel free to send an email.
3. Ensure that "Phil 279" occurs in the subject line of your emails about this course. Otherwise there is a strong possibility that your message will be deleted unread as spam.
4. Please make sure your first and last names are clearly included in the body of any email message.
5. If you want to make an appointment please indicate the times when you are available.
6. We will do our best to reply within one business day. Please don't expect responses outside business hours.
7. It is customary to address university instructors by their title ("Dr. Payette" or "Prof. Payette") but I won't be offended if you call me 'Gillman'. Please don't call me 'Mr. Payette' or 'Sir'.

3 What is this course about?

The course will introduce you to the semantics and proof-theory of Truth-Functional logic (TFL) and first-order logic (FOL). We will learn how to "speak" the language of FOL, study the method of truth tables, become proficient in giving formal proofs, and learn how to construct first-order interpretations. These methods provide us with precise ways to make sense of argument validity. The goal is to have you become comfortable with formal methods, and to use them to clarify and make precise logical relationships that are hard to understand or express otherwise. We will also look at some results and notions which are important for the applications of formal logic, such as the expressive power of truth-functional and first-order logic, as well as some important theorems relating semantics and proof theory (soundness, completeness). We will touch on applications of logic to philosophy, mathematics, and computer science.

The kinds of things you will learn are mainly of three sorts: (1) symbolize sentences of English in a formal language, (2) give counterexamples (truth tables, interpretations) that show various things, (3) give formal proofs. Much of this will be completely new and not something that's like anything you've done before. It will not feel like what you might think of as philosophy. There will be lots of symbols. This is a course in **formal** logic, not a course on how to think or how to avoid fallacies. There are similarities to some things in discrete mathematics, but this formal logic is applied to more than mathematics.

4 How will the course be run?

The course will be delivered in a **hybrid in-person/online** model. There will be readings, prerecorded lecture videos, discussion boards, and quizzes on the course website (D2L). The passive content, i.e., me explaining things and working through examples, will be delivered asynchronously (that means: not at a specific time). You can read, watch, and participate in discussions more or less when you choose. There will also be in-person sessions which will be run like tutorials where everyone can participate at the same time:

What?	When?	Where?	Who?
“Lecture”	MW 13–15:45	MS 211	Instructor

Each “lecture” is meant to be mostly active learning time and will be organized accordingly.

5 What prerequisites do I need for this course?

None. There are no prerequisites.

6 What will I learn in this course?

By the end of the course, you should be able to ...

1. work with the formal languages of truth-functional and first-order logic, with the ability to formalize natural language sentences in a formal language.
2. use truth tables to evaluate sentences and arguments in truth-functional logic.
3. understand the basic semantic concepts such as validity, entailment and logical equivalence, when they apply and how they can be used.
4. construct correct derivations in a natural deduction system for truth-functional and first-order logic, with and without identity.
5. use a proof system to determine whether or not a sentence is a logical truth, whether an argument is valid, and whether two formal sentences are equivalent.
6. construct interpretations that make first-order sentences true or false and use them to show that arguments are invalid.
7. appreciate some basic metatheoretic results, such as truth-functional completeness, and soundness and completeness of a natural deduction system for truth-functional logic.
8. be able to articulate clear questions, explain logical concepts, and guide others through logical problems.

7 What will I have to do in this course?

7.1 Visit the D2L/Brightspace site

The course has a [D2L/Brightspace](#) site. You will find (information on) course readings, videos, assignments, quizzes, tests, grades, and a discussion board there. Any updates, including revisions to the course schedule, will be posted there. **To make sure you don't miss a deadline or an important update, please review your [notification settings](#).**

7.2 Watch the lecture videos

Each week, there will be lecture videos. You should watch these videos in preparation for the in-person class meetings. The videos are posted on D2L, as are the slide decks that go with them. I talk kind of slow, so

I recommend watching at 1.5×. I try to keep the lecture segments short (10-15 min.) and focused when presenting concepts. The example videos tend to be longer since I am thinking aloud and trying to guide you through the example.

7.3 Read the textbook

The textbook is:

P.D. Magnus, et. al., *forall x: Calgary. An Introduction to Formal Logic* (Fall 2021 edition).
forallx.openlogicproject.org

It is free and available on D2L in PDF. It comes in two formats, and many of the exercises in it have solutions in the accompanying solutions manual. You may also purchase a paper copy if you like.

Each lecture in the Content section on D2L will tell you which chapters of the book that section covers. The book is more of an accompaniment than a primary source. Not everything in the textbook will be relevant and you will only be evaluated on topics covered in the lectures. Perhaps you are content with my explanations in the videos, but maybe not. Maybe you need to read it rather than hear it, or maybe you just need a different perspective on the material. You're in luck! The book has a different author—and one that I trust—so you can get that other perspective on the material.

7.4 Attend Class

We'll have in-person sessions twice a week. During these meetings, we will work on problems related to the material, often in small groups. I'll assume that you're prepared (i.e., have watched the lecture videos and/or done the reading). There will also be opportunity for Q&A and discussion.

7.5 Work on practice problems

Every week you will complete practice problems, many for credit. Problem sets are designed to practice the techniques covered in the videos and deepen your understanding of the topics covered that week. They will all be completed online, either on D2L or on a site called carnap.io. There will be plenty of these: some ungraded problems for practice, problems we work on together in lecture or tutorial, but especially a weekly problem set.

You only get proficient in logic with practice, so make sure you put in effort and don't just let your friends or whomever else tell you the solutions. (If you do, you won't be able to complete the quizzes and challenge problems...)

7.6 Ask and answer questions on the D2L discussion board

Every lecture will have a dedicated discussion board where you can ask questions. You might want clarification on something in the recorded lecture or the textbook, or you're stuck on an exercise and need a hint or have someone to tell you what the problem with your proposed solution is. Your instructor can help. One of the course outcomes, however, is to make you a better, more collaborative learner and teacher of yourself and others. So feel free to attempt to explain things to others, provide hints for those who get stuck, and **listen** to the explanations of others.

7.7 Complete quizzes and challenge problems

The reading, videos, in-class group work, and work on problem sets will prepare you for the weekly quizzes and challenge problems. Quizzes are multiple-choice and are given on D2L. They will be open book, untimed, and you have four attempts at each. In addition, each major learning outcome has a challenge problem associated with it: this is like a problem (or short set of problems) on the problem set, except that it is timed and you must solve it on your own. Don't let work pile up: there are some deadlines.

8 What do I need for all that?

Big parts of this course will be delivered online. To access the material and complete the assignments you will need a computer and access to the internet (for some things a smartphone or tablet are enough, but a

desktop or laptop with a keyboard, mouse, and large-ish screen will be much more comfortable). You will need an account with the UCalgary IT service, without which you cannot access D2L.

If things go sideways, to participate in synchronous groupwork sessions, and to communicate with your instructor, TAs, and fellow students, you need a Zoom account. To participate with audio and video, you need a microphone and webcam, ideally on a computer with keyboard and mouse. However, attending the synchronous Zoom sessions is not required to pass the course.

Instructions for getting IT and Zoom accounts, accessing D2L, and additional tips for how to best learn online are available at:

taylorinstitute.ucalgary.ca/learning-continuity

9 How will my grade be determined?

There will be no registrar-scheduled final exam.

9.1 Completing activities

The aim of this course is for you to become proficient in the learning objectives listed below. Your success in this will be assessed by the number of activities (problem sets, quizzes, and challenge problems) you complete successfully. There are a total of 12 activities of each kind, two of each kind per week each aimed at a particular learning outcome. Each activity has a minimum level of performance that counts as “complete (✓).” Completing an activity roughly corresponds to earning at least a B on that activity. Problem sets and quizzes have a higher level of performance that earns you a “complete+ (✓+).” Completing a quiz or problem set at this level roughly corresponds to an A.

Instead of earning point scores on each, and then determining your final grade based on some frankly arbitrary system of weights, averages, and cutoffs, your final grade will be determined on the basis of how many activities you complete. This means, more or less, that your final grade is determined by how many of the learning objectives you show proficiency in **by the end of term**.

Problem sets: You have to score 80% on a problem set for it to count as complete. If you score 95%, you earn a “complete+.” (Note: You can check your answers before submitting.)

Quizzes: A quiz counts as complete if you score at least 80% on it, and complete+ if you score 95%. (You have four attempts at each quiz, but you can use tokens to get more attempts.)

Challenge problems: Each week there will be challenge problems to complete. To complete a challenge problem you must score 100% (Many challenge problems only have one question). Challenge problems will be timed (usually 30-60 minutes), but they will be available to complete for several weeks. (You will be able to check your answers before submitting them and you can use tokens to buy additional attempts.)

Yes, that is a higher bar to clear than usual in all of the activities, but proficiency requires demonstrating that kind of result. Remember, you have more than one attempt to clear the bar in many cases. You also get immediate feedback on all of your activities, so you will know right away whether you have completed it. On the quizzes you will not see exactly which questions you got wrong (part of the learning experience is figuring that out), but many are marked right minus wrong, so you may get some idea. On the carnap.io activities, you can check that your answers are correct before submitting them. Overall, you can take your time and learn from your mistakes.

Collaboration: In addition to the learning outcomes, an objective of the course is the development of collaborative study habits. You should become able to ask clear questions about the course material and problem sets in class and on the discussion board, to explain topics to and answer questions of your peers, and to work with others in small groups during class time. You will not formally be assessed on this learning outcome.

9.2 Final grades

Your final grade is a record of how many learning objectives you have achieved, based on how many activities (problem sets, quizzes, challenge problems) you have completed. This mapping of performance on activities to letter grades is more complicated than a points system with percentage cutoffs, but it captures more accurately how much you’ve shown to have learned in the course.

The following table lists how many activities of each type you have to complete in order to earn a given grade. “Total” is the overall minimal number of activities you must complete for that grade. For A-range grades, you must also earn complete+ marks on a sufficient number of activities. You earn the highest grade

you qualify for on the basis of the number of ✓'s and ✓+'s you have earned in each category, and the total number you have earned.

Grade	PS	Q	CP	Total
A+	12✓+	12✓+	12✓	36
A	12✓/10✓+	12✓/10✓+	12✓	36
A-	11✓/8✓+	11✓/8✓+	11✓	33
B+	10✓	10✓	10✓	32
B	10✓	10✓	10✓	30
B-	8✓	8✓	8✓	28
C+	8✓	8✓	8✓	26
C	8✓	8✓	8✓	24
C-	6✓	6✓	6✓	22
D+	6✓	6✓	6✓	20
D	6✓	6✓	6✓	18

For instance, to earn a B-, you must complete 8 of each activity (that's 24 total) but overall must complete at least 28 activities (so e.g., an additional two problem sets and two quizzes, or two problem sets, a quiz, and a challenge problem). For an A, you must complete all activities, and for 10 problem sets and 10 quizzes you must receive a ✓+. (An A+ requires 12 ✓+ on problem sets and quizzes, and an A- requires 11 problem sets and quizzes completed, of which 8 of each must be ✓+.)

Note that the number of activities alone does not guarantee a higher grade. E.g., if you have completed all 12 problem sets and 12 challenge problems, but only 8 quizzes, this earns you only a B-, not a B+ even though you have 32 activities completed in total. Also, ✓+ only play a role in earning A-range grades. So 8 ✓+ on problem sets, 8 ✓+ on quizzes, and 8 ✓ on challenge problems is still just a C.

9.3 Partial credit, retakes, tokens

Grades in this class are based on how many learning objectives you show proficiency in. Proficiency is an all-or-nothing affair: for instance, you have either completed a truth table correctly or you did not. You can think of a learning objective as a hurdle you have to clear; either you clear it or you don't. Your overall performance is determined by how many hurdles you clear throughout the course, and how high those hurdles are. For that reason, **there will be no partial credit**. You won't get half the marks for jumping half as high as necessary.

Every student gets tokens to spend during the term. You may only spend one token per day. To redeem a token, i.e., request a re-take of a challenge problem, quiz attempt etc, send an email to your instructor. Note that re-takes of assessments may have different questions than the originals. Your best attempt will be the one kept.

There are **suggested** deadlines, but what matters is that you achieve the learning objectives, not so much the time-line on which you achieve them. However, it's very important in this class that you don't fall behind and that if you do, you catch up soon (otherwise you will not be able to understand subsequent material).

10 Are there PASS sessions for this course?

Maybe.

11 What course policies should I be aware of?

11.1 Recording Zoom sessions

If things go sideways, in order to allow students to review synchronous sessions, these Zoom sessions will be recorded and the recordings made available to students in the course. Recorded sessions will not be used for any other purpose. Nevertheless, if you object to your image or voice being recorded, you should make sure to turn your video off and set your microphone to mute. (You can use the Zoom chat function to ask questions.) Breakout rooms (small groups) will not be recorded, and as a courtesy to your fellow students, you are encouraged to use video and audio while in a breakout rooms. Tutorials will also not be recorded.

11.2 Conduct

Learning can only happen well if everyone feels like they belong and are free to ask questions and participate in discussions. It is partly on you to make sure our course is such a space. So please be respectful, positive, and constructive in your participation in the course. It should go without saying, but do not post (links to) anything racist, misogynist, or homophobic, or NSFW, and don't stalk or harass your fellow students or instructors. Also, do not share links or passwords to live or recorded Zoom sessions outside the course.

11.3 Late policy

If you do not complete an assignment by its deadline, it counts as not completed. If there are factors beyond your control, and which you could not reasonably have planned for, which prevent you from completing activities (illness, family emergency, etc.) please contact the instructor so we can make arrangements. Please do so **as soon as possible**. You will not have the opportunity to make up work you missed early in the term if you don't tell me until the last week of term.

11.4 Checking your grades and reappraisals of work

University policies for reappraisal of term work and final grades apply (see the *Calendar* section "[Reappraisal of Graded Term Work](#)"). In particular, term work will only be reappraised within 10 calendar days of the date you are advised of your marks. Please keep track of your assignments and your marks (check them on D2L). Grades do not automatically update on D2L; we will typically post an announcement when new grades are available. You should save work you submit, e.g., by taking a screenshot.

12 Ok, what are those learning objectives you've been talking about?

The following learning objectives are divided into twelve general topics. However, the learning objectives do not map perfectly to the respective weeks of term. So, lecture videos and readings might preview some content covered in detail later. Problem sets for a particular week may include problems from those previewed topics or review and continue topics covered earlier, and similarly quiz questions. The challenge problems, however, will only test the topics covered that week.)

Learning objectives numbered (a) and (b) correspond to a basic level of proficiency. Learning objectives numbered (c) are more advanced (roughly, you are expected to show proficiency in them to earn an A). Two harder questions on each problem set and quiz test for learning objectives numbered (c).

1. Arguments and validity in English

- (a) I can correctly state the definitions of validity, equivalence, and joint possibility of English sentences and arguments.
- (b) I can organize English arguments by identifying their premises and conclusions.
- (c) I can correctly apply the definition of validity to some English arguments.

2. Symbolization in TFL

- (a) I can identify correctly symbolized English sentences involving "and", "or", "not", and "if-then", given a symbolization key.
- (b) I can correctly symbolize English sentences involving "neither nor", "not both", "unless", "only if", and exclusive "or."
- (c) I can recognize English sentences that are ambiguous and symbolize different readings in TFL.

3. Notions of logic in TFL

- (a) I can correctly state and apply the definitions of entailment, equivalence, joint satisfiability, and tautology in TFL.
- (b) I can construct the complete truth table for a sentence or sentences of TFL and use it to determine entailment, satisfiability, equivalence, and tautologies, and to find satisfying valuations.
- (c) I can correctly and clearly state and explain relationships between entailment, satisfiability, equivalence, and tautologies.

4. Proofs in TFL
 - (a) I can apply the rules of inference of natural deduction for TFL, identify correct and incorrect proofs, and complete partial proofs.
 - (b) I can give correct formal proofs of arguments and theorems involving \wedge , \vee , \rightarrow , \neg , \perp , and nested subproofs, using proof construction strategies.
 - (c) I can give correct formal proofs of theorems requiring the IP rule.
5. Functional completeness and normal forms
 - (a) I can determine whether a sentence is in CNF or DNF.
 - (b) I can convert a sentence into CNF or DNF using a chain of equivalences and find a sentence in DNF from its truth table.
 - (c) I can show that a set of connectives is functionally complete, and I can prove that some connectives are not functionally complete.
6. Symbolization in FOL without nested quantifiers
 - (a) I can identify correctly symbolized sentences of English involving the quantifier determiners “all”, “some”, “no”, “any”, and “only” involving no quantifier nesting.
 - (b) I can symbolize sentences of English including the quantifiers, indefinite articles, pronouns with quantified antecedents, truth-functional combinations of clauses, and comparatives.
7. Interpretations
 - (a) I can identify the extensions of English predicates given a domain, present them as enumerations and graphical diagrams.
 - (b) I can determine the truth values of sentences of FOL without nested quantifiers in a given interpretation, and construct interpretations for FOL sentences without nested quantifiers.
 - (c) I can construct and/or determine whether interpretations make these simple FOL sentences sentences true or false and apply this to show non-entailment, satisfiability, and non-equivalence.
8. Interpretations for full FOL
 - (a) I can determine the truth value of sentences involving nested quantifiers and identity in given interpretations.
 - (b) I can construct interpretations to make sentences with nested quantifiers and identity true or false.
 - (c) I can apply interpretations to show non-entailment, satisfiability, non-equivalence, and non-validity.
9. Symbolization with nested quantifiers
 - (a) I can identify correctly symbolized sentences involving multiple determiners and donkey sentences.
 - (b) I can recognize scope ambiguity and symbolize all possible readings.
 - (c) I can construct a key suitable for the symbolization in FOL of English sentences.
10. Identity
 - (a) I can identify correctly symbolized sentences involving identity and definite descriptions.
 - (b) I can symbolize sentences with “else,” singular “only,” numerical quantifiers, definite descriptions, and “both” and “neither” used as determiners.
 - (c) I can use connectives of TFL to express properties and relations without predicate symbols given in the symbolization key.
11. Proofs for FOL without quantifier nesting
 - (a) I can apply the rules of inference of natural deduction for FOL, identify correct and incorrect proofs, and complete partial proofs.
 - (b) I can construct formal proofs of arguments in FOL without nested quantifiers and not requiring IP.
 - (c) I can construct formal proofs in FOL requiring IP.
12. Proofs with multiple quantifiers, many-place predicates, and identity

- (a) I can apply the rules of inference of natural deduction for FOL, identify correct and incorrect proofs, and complete partial proofs.
- (b) I can construct proofs with nested quantifiers and identity.
- (c) I can construct proofs with many-place predicates, nested quantifiers and identity, including the IP rule.

13 Important departmental, faculty, and university information

13.1 Academic accommodations

It is the student's responsibility to request academic accommodations according to the University policies and procedures. The student accommodation policy can be found at: ucalgary.ca/policies/files/policies/student-accommodation-policy.pdf

Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities:

ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities.pdf

Students needing an accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to their instructor.

13.2 Absence or missed course assessments

Students who are absent from class assessments (tests, participation activities, or other assignments) should inform their instructors as soon as possible. If the reason provided for the absence is acceptable, instructors may decide that any arrangements made can take forms other than make-up tests or assignments. For example, the weight of a missed grade may be added to another assignment or test.

13.3 Student support and resources

Full details and information about the following resources can be found at ucalgary.ca/registrar/registration/course-outlines:

- Wellness and Mental Health Resources
- Student Success Centre
- Student Ombuds Office
- Student Union (SU) Information
- Graduate Students' Association (GSA) Information
- Emergency Evacuation/Assembly Points
- Safewalk

13.4 Academic Advising

If you are a student in the Faculty of Arts, you can speak to an academic advisor in the Arts Students' Centre about course planning, course selection, registration, program progression and more. Visit the Faculty of Arts website at arts.ucalgary.ca/advising for contact details and information regarding common academic concerns.

For questions specific to the philosophy program, please visit phil.ucalgary.ca. Further academic guidance is available by contacting David Dick (Undergraduate Program Director, Email: dgdick@ucalgary.ca) or Jeremy Fantl (Honours Advisor, Email: jfantl@ucalgary.ca). If you have questions regarding registration, please email Rebecca Lesser (Undergraduate Program Administrator, Email: phildept@ucalgary.ca).

13.5 Writing assessment and support

The assessment of all written assignments—and, to a lesser extent, written exam responses—is based in part on writing skills. This includes correctness (grammar, punctuation, sentence structure, etc.), as well as

general clarity and organization. Research papers must include a thorough and accurate citation of sources. Students are also encouraged to use Writing Support Services for assistance (one-on-one appointments, drop-in support and writing workshops). For more information, and other services offered by the Student Success Centre, please visit ucalgary.ca/ssc.

13.6 Required technology

In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Broadband internet connection.

Most current laptops will have a built-in webcam, speaker and microphone.

13.7 Responsible Use of D2L

Important information and communication about this course may be posted on D2L (Desire2Learn), UCalgary's online learning management system. Visit ucalgary.service-now.com/it for how-to information and technical assistance.

All users of D2L are bound by the guidelines on the responsible use of D2L posted at elearn.ucalgary.ca/commitment-to-the-responsible-use-of-d2l/. The instructor may establish additional specific course policies for D2L, Zoom, and any other technologies used to support remote learning. Instructional materials, including audio or video recordings of lectures, may not be posted outside of the course D2L site. Students violating this policy are subject to discipline under the University of Calgary's Non-Academic Misconduct policy, ucalgary.ca/policies/files/policies/non-academic-misconduct-policy.pdf

13.8 Media recording

Please refer to the following statement on media recording of students: elearn.ucalgary.ca/wp-content/uploads/2020/05/Media-Recording-in-Learning-Environments-OSP_FINAL.pdf.

13.9 Academic misconduct/honesty

Cheating or plagiarism on any assignment or examination is as an extremely serious academic offense, the penalty for which will be an F on the assignment or an F in the course, and possibly a disciplinary sanction such as probation, suspension, or expulsion. For information on academic misconduct and its consequences, please see the University of Calgary Calendar at: ucalgary.ca/pubs/calendar/current/k.html

Intellectual honesty requires that your work include adequate referencing to sources. Plagiarism occurs when you do not acknowledge or correctly reference your sources. If you have questions about referencing, please consult your instructor.

13.10 University policies

The Instructor Intellectual Property Policy is available at:

ucalgary.ca/policies/files/policies/Intellectual%20Property%20Policy.pdf

Course materials created by professor(s) (including course outlines, presentations, assignments, and exams) remain the intellectual property of the professor(s). These materials may *not* be reproduced, redistributed or copied without the explicit consent of the professor. The posting of course materials to third party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course at the same time may be allowed under fair dealing.

The University of Calgary is under the jurisdiction of the provincial Freedom of Information and Protection of Privacy (FOIP) Act, as outlined at ucalgary.ca/legalservices/foip. The instructor (or TA) must return graded assignments *directly* to the student **unless** written permission to do otherwise has been provided.

All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright (<https://ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright.pdf>) and requirements of the copyright act (laws-lois.justice.gc.ca/eng/acts/C-42/index.html).