Introduction to Logic (Philosophy 12A)

Richard Lawrence

First Summer Session 2017

1 Course Description

In a valid deductive argument, the conclusion *follows* from the premises. But what exactly does this involve? Logic aims to answer that question by giving a mathematically precise account of the relation of the premises to the conclusion in a valid argument. In this course we will study two systems of symbolic logic: truth-functional logic, and first-order logic. We will learn how to represent the logical forms of English arguments, and then develop a semantics as well as a system of natural deduction in each system to determine the validity of arguments given such formal representations.

1.1 Course learning objectives

By the conclusion of the course, the student will:

- understand and be able to explain basic logical concepts, including *argument*, *validity*, *entailment*, *proof*, *interpretation* and *counterexample*
- learn a syntax, semantics, and proof system for truth-functional logic
- learn a syntax, semantics, and proof system for first-order logic
- learn techniques for symbolising sentences and arguments from English in formal languages
- learn techniques for constructing proofs and counterexamples in truth-functional and first-order logic
- reflect on these logical systems from a basic metalogical perspective

1.2 Contact information

	Instructor	**GSI**	**GSI**
	Richard Lawrence	Pia Schneider	Yifeng Ding
	richard.lawrence@berkeley.edu	pia_schneider@berkeley.edu	yf.ding@berkeley.edu
Office:	243 Moses	301 Moses	1070 Evans
Office hours:	Thurs., 3:30PM–5:30PM	Weds., 4PM–6PM	Tues., 3:30PM–5:50PM

1.3 Meeting Times

	Day	**Time**	**Location**
Lecture:	Tuesday–Thursday	1PM–3:30PM	GPBB 107
Lab 1:	Friday	1PM–3:30PM	206 Dwinelle/155 Barrows
Lab 2:	Monday	1PM–3:30PM	206 Dwinelle/155 Barrows

2 Texts

Our text is *forall x Calgary Remix: an Introduction to Formal Logic*, by P.D. Magnus et al. (This is an open access introductory textbook.) The text will be made available electronically as a PDF, and for sale via a print-on-demand service.

3 Course Requirements

	Weight in final grade
Quizzes	50%
Problem Sets	30%
Participation in Lab	20%

You will take charge of your own learning in this course. The course is designed so that you will get feedback quickly and frequently, which you can use to improve your understanding at your own pace. Your job is to use that feedback wisely: use the quizzes, the problems, and your classmates to assess how well you understand the material, and figure out where you need to improve.

3.1 Quizzes

The main component of your grade in this course will derive from a series of six quizzes. We will grade the quizzes using **mastery-based grading**. Each quiz will test your mastery of a set of concepts from the course, emphasizing one week's worth of material.

The quizzes will be given one of three grades: **Complete** (2 points), **Almost** (1 point), or **Not Passed** (0 points). The quiz component of your grade will be based on the number of points you accumulate, as follows:

Points	Quizzes grade
12	A
11	A-
10	B+
9	B
8	B-
7	C+
6	C
5	C-
4	D+
3	D
2	D-

If you do not receive the grade of Complete on a quiz, you will have the option to retake it once, during a session of Lab 2. If you wish to retake a quiz, **you must let your GSI know by the end of the day on the preceding Friday**.

3.2 Participation in Lab

There are two sections of **laboratory** each week. Working through problems is an important part of learning logic. Laboratory will give you experience working through problems, in an environment where you can get individual help from your peers and your GSI.

Part of your grade in this course is based on your participation in laboratory. Being a good participant in laboratory requires more than just showing up! **You are expected to take an *active* role in laboratory**, regardless of your background or level of skill. That means:

- asking questions
- answering questions asked by others
- trying problems that you find difficult
- helping others with problems that they find difficult

3.2.1 Lab 1 (Friday)

In Lab 1, you will work in groups to complete problems and prepare for the weekly quiz. During Lab 1, you will **turn in your problem set**, and **take the quiz** on the current week's material. You will be assigned to a lab group by your GSI.

3.2.2 Lab 2 (Monday)

In Lab 2, you will have the chance to evaluate your mistakes on quizzes and further improve your understanding of the assigned problems, working with your peers and your GSI. You can retake quizzes you have not yet Completed during Lab 2.

3.3 Problem Sets

Every week, you must complete a set of problems, to help you understand the material and to prepare for the quizzes. The problems will be in three groups:

A Group These are intended to be *diagnostic* problems. If you can't answer them quickly and easily, then you missed something important in lecture or the reading. You should revisit the material until you can complete these problems almost automatically.

B Group These are problems intended to develop your *mastery* of the material. You will be expected to complete problems at (roughly) this level of difficulty on the quizzes.

C Group These are intended to get you to *reflect* further on the material, from a new perspective. These problems will be more difficult, but thinking about them will be useful for understanding the other problems, and for preparing for more advanced courses.

The problems will be made available at the beginning of the week. You should look at them before lecture, and start working on them as soon as they are made available. You will turn in your solutions to the problems during Lab 1.

3.4 Academic honesty

You are encouraged to work with your Lab group members to prepare your answers on the problem sets. But you must write up your answers on your own, and **you should *never* directly copy another student's work**. (Group work is an *aid* to individual understanding, not a replacement for it!) On quizzes, you must complete all problems on your own, without help from others.

It is your responsibility to ensure that your work in this course accords with the University's standards for academic honesty. Students found to be cheating or misrepresenting their work will be reported to the Center for Student Conduct and may fail the course, at the determination of the instructor. For further information on academic misconduct and how to avoid it, see: http://sa.berkeley.edu/conduct/integrity/definition

4 Schedule

4.1 Unit 1: Basic concepts and Truth-Functional Logic

	Topic	*Chapters*
2017-05-22 Mon	*Lab organizational meeting*	
	Basic logical concepts	1–3
2017-05-23 Tue	Sentences, arguments, and truth values	
	Validity and necessary truth	
	Syntax and semantics of truth-functional logic	4–10
	Atomic sentences and truth-functional connectives	
	Valuations and constructing truth tables	
2017-05-22 Mon	*Academic Holiday (Memorial Day); no lab*	
2017-05-30 Tue	Symbolising English arguments in truth-functional logic	
	Validity and proofs in truth-functional logic	11–19
	Tautologies, consistency, entailment, equivalence	
	Checking validity with truth tables	
2017-06-06 Tue	Natural deduction for truth-functional logic	
	Derived rules for truth-functional logic	

4.2 Unit 2: First-Order Logic

	Topic	*Chapters*
	Predicate structure in sentences and arguments	21–24
	Quantifiers, predicates, constants, and variables	
	Symbolising English arguments in first-order logic	
2017-06-13 Tue	Binary predicates, identity, and multiple generality	
	Syntax and semantics of first-order logic	26–30
	Terms, formulas, and sentences	
2017-06-20 Tue	Constructing interpretations and counter-interpretations	
	Validity and proofs in first-order logic	31–35
	Logical truth, consistency, entailment, equivalence	
2017-06-27 Tue	Natural deduction for first-order logic	
	Derived rules for first-order logic	
2017-06-29 Thu	Final quiz (given in lecture)	