PHIL 305: Introduction to Formal Methods

Brian Weatherson

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Course Description

This course will introduce some important formal tools that are used elsewhere in philosophy. We will look at propositional logic, probability theory and the logic of modals and conditionals. Obviously that's a lot to cover in a short time - the aim here is to make sure you understand the basics, and the symbolism, so you can follow simple applications of these tools, and you have the foundations to understand more complicated applications.

Canvas

There is a Canvas site for this course, which can be accessed from https://canvas.umich.edu. Course documents (syllabus, lecture notes, assignments) will be available from this site. Please make sure that you can access this site. Consult the site regularly for announcements, including changes to the course schedule. And there are many tools on the site to communicate with each other, and with me.

Required Materials

There are three textbooks for the course. All of them are open access, and hence free. The third is on Canvas, the other two have to be downloaded from elsewhere.

- forall x: Calgary by P. D. Magnus, Tim Button, J. Robert Loftis, Robert Trueman, Aaron Thomas-Bolduc and Richard Zach. Available at http://forallx.openlogicproject.org.
- Odds and Ends by Jonathan Weisberg. Available at https://jonathanweisberg.org/vip/.
- Boxes and Diamonds: Ann Arbor remix by Richard Zach and edited by Brian Weatherson. Available on Canvas.

Course Requirements

- There will be 12 weekly quizzes. Of these your best 10 will count towards your grade, with each counting for 8%.
- There will also be a final exam, given through Canvas, that counts for 20% of the grade.

Summary of Grading System

1. Weekly assignments - 8% each, 10 assignments count, 80% total.
2. Final exam - 20%.

Plagiarism

Although team-work, and even co-authorship, is encouraged, plagiarism is strictly prohibited. You are responsible for making sure that none of your work is plagiarized. Be sure to cite work that you use, both direct quotations and paraphrased ideas. Any citation method that is tolerably clear is permitted, but if you'd like a good description of a citation scheme that works well in philosophy, look at http://bit.ly/VDhRJ4.

You are encouraged to discuss the course material, including assignments, with your classmates, but all written work that you hand in under your own name must be your own. If work is handed is as the work of two people, you are affirming that each person did a fair share of the work. (Note that when you're submitting work on Canvas, you have to each submit the paper, even if it is co-authored. That way Canvas knows that everyone has turned in work.)

You should also be familiar with the academic integrity policies of the College of Literature, Science & the Arts at the University of Michigan, which are available here: http://www.lsa.umich.edu/academicintegrity/. Violations of these policies will be reported to the Office of the Assistant Dean for Student Academic Affairs, and sanctioned with a course grade of F.

Disability

The University of Michigan abides by the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973, and other applicable federal and state laws that prohibit discrimination on the basis of disability, which mandate that reasonable accommodations be provided for qualified students with disabilities.

If you have a disability, and may require some type of instructional and/or examination accommodation, please contact me early in the semester. If you have not already done so, you will also need to register with the Office of Services for Students with Disabilities. The office is located at G664 Haven Hall.

For more information on disability services at the University of Michigan, go to http://ssd.umich.edu.

Class Schedule

The readings will all be from the three textbooks. I've produced short videos going over the material in the books, and occasionally other philosophically interesting points. Then the time in class will be entirely spent on questions people have, and going over worked examples. So you should do the reading, and watch the lectures, before the scheduled class.

Most of the readings are from the two textbooks. The other readings are all in the UM library or online. You might have to be logged in to UM to get them though. The names of the papers are links to a source where you can get a copy of the paper.

The video lectures will have a number of the form *x*.*y*, where *x* is the week they are for, and the *y* is their order in the week. You should watch these **before** class, and we can discuss the material in class.

Most weeks have a fairly simple structure. There are in person classes with me on Tuesday and Thursday, and you have a smaller in person class with Mica as well. There are video lectures before each of my classes. And at the end of the week there is a Canvas quiz assigned about the material we covered. But there are exceptions, especially around late January-early February. I'm going to be away on **January 27**, and that leads to the following complications.

- There is no in person class with me on Thursday, January 27.
- The assignment due January 28 will just be about the material through class on Tuesday, January 25.
- There will be no assignment due the following week, i.e., on February 4. I want to make sure you've got plenty of time to cover the material in week 5, which is a bit harder than the rest of the course.
- The assignment in week 6 will be about the material through class on Thursday, February 3.
- The assignment in week 7 will cover the material in weeks 6 and 7.

The week after Spring Break is also going to be a bit different. This will be less problems based and more about the philosophical significance of some of the work we're doing here. There isn't an assignment that week, and it quite literally isn't on the test. But I hope you'll get something out of it, because I think understanding this material is important for understanding a lot of what goes on in contemporary academic work. Anyway, there is no assignment that week.

Week 1: Introduction

Tuesday, January 04

No class, classes haven't started.

Thursday, January 06

Topic Introduction
Reading forall x, Chapters 1-2.
Lectures 1.1-1.3.

Week 2: Symbols and Truth Tables

Tuesday, January 11

Topic Symbolization
Reading forall x, Chapters 4-6.
Lectures 2.1-2.3.

Thursday, January 13

Topic Truth Tables
Reading forall x, Chapters 9-11.
Lectures 2.4-2.6.

Week 3: Validity and Trees

Tuesday, January 18

Topic Truth Tables and Validity
Reading forall x, Chapter 12.
Lectures 3.1-3.4

Thursday, January 20

Topic Truth Trees
Reading Boxes and Diamonds, Sections 2.1-2.3
Lectures 3.5-3.6.

Week 4: Validity and Trees, Continued

Tuesday, January 25

Topic Using Truth Trees
Reading Boxes and Diamonds, Sections 2.4-2.5
Lectures 4.1-4.3b

Thursday, January 27

Topic Introducing Natural Deduction
Reading forall x, Chapter 15 and sections 16.1-16.4.
Lectures 4.4-4.7

Note that there will be no in person class on Thursday; I'm away at a conference. The weekly assignment for this week will just cover the material from Tuesday.

Week 5: Natural Deduction

Tuesday, February 01

Topic Rules for Natural Deduction
Reading forall x, Sections 16.5-16.8.
Lectures 5.1-5.3

Note that there is no assignment this week.

Thursday, February 03

Topic Strategies for Natural Deduction
Reading forall x, Chapter 17.
Lectures 5.4-5.6

Starting on Probability

Tuesday, February 08

Topic Probability Basics
Reading Odds and Ends, chapters 1 and 5
Lectures 7.1-7.3.

Thursday, February 10

Topic Conditional Probability
Reading Odds and Ends, chapter 6
Lectures 7.4-7.5.

There aren't any 6.x lectures - after I'd recorded the later lectures I decided against doing another week of natural deduction.

Tuesday, February 15

Topic Conditional Probability
Reading Odds and Ends, chapter 8
Lectures 8.1-8.5.
Probability and Decision

Thursday, February 17

Topic Base Rates and Multiple Updates
Reading Odds and Ends, chapter 9
Lectures 8.6-8.9.

Tuesday, February 22

Topic Expected Utility
Reading Odds and Ends, chapters 11 and 12
Lectures 9.1-9.4.

Thursday, February 24

Topic Utility and Money
Reading Odds and Ends, sections 12.5 and 13.1.
Lectures 9.5-9.6.

Probability and Learning

Tuesday, March 08

Topic Theories of Probability
Reading Odds and Ends, chapters 4, 15, 16 and 18.
Lectures 10.1-10.5.

Thursday, March 10

Topic Statistical Learning
Reading Odds and Ends, chapters 19 and 20.
Lectures 10.6-10.7.

Introduction to Modal Logic

Tuesday, March 15

Topic Varieties of Modalty
Reading Boxes and Diamonds, sections 3.1-3.3.
Lectures 11.1-11.3

Thursday, March 17

Topic Models and Frames
Reading Boxes and Diamonds, sections 3.4-4.5.
Lectures 11.4-11.7

Proofs in Modal Logic

Tuesday, March 22

Topic Modal Tableau
Reading Boxes and Diamonds, chapter 5.
Lectures 12.01-12.04

Thursday, March 24

Topic Examples
Reading No new reading
Lectures 12.05-12.17

Conditionals

Tuesday, March 29

Topic Varieties of Conditionals
Reading Boxes and Diamonds, chapter 6.
Lectures 13.1-13.4

Thursday, March 31

Topic Counterfactual Conditionals
Reading Boxes and Diamonds, chapter 7.
Lectures 13.5-13.6

Finishing Up

Tuesday, April 05

Topic The Logic of Counterfactuals
Reading Boxes and Diamonds, chapter 7.
Lectures 14.1-14.2

Thursday, April 07

Topic Revision
Reading No new reading
Lectures No new lectures