PHIL 305: Introduction to Formal Methods

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Key Points

- The course has four parts:
    1. Propositional Logic;
    2. Modal Logic;
    3. Probability and Decision; and,
    4. Game Theory.
- Each part of the course has a different textbook.
- All the books are open access; they are freely available and linked through Canvas.
- There are 12 weekly assignments, due each week on Thursday at 5pm. The best 10 count for your final grade.
- There is a final exam, which counts for 20%, and which covers all the material in the course.

Course Description

This course will introduce some important formal tools that are used elsewhere in philosophy. We will look at propositional logic, the logic of modals and conditionals, probability theory and game theory. 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.

Required Materials

There are four textbooks for the course. All of them are open access, and hence free. The second is on Canvas, the other three 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.
- *Boxes and Diamonds: Ann Arbor remix* by Richard Zach and edited by Brian Weatherson. Available on Canvas.
- *Odds and Ends* by Jonathan Weisberg. Available at https://jonathanweisberg.org/vip/.
- *Game Theory* by Giacomo Bonnano. Available at https://faculty.econ.ucdavis.edu/faculty/bonanno/GT_Book.html.

Course Requirements

- There will be 12 weekly assignments. Of these your best 10 will count towards your grade, with each counting for about 8%.
- There will also be a final exam 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%.

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.

Class Schedule

The readings will all be from the four textbooks. You should do the reading before the scheduled class.

Week 1: Introduction

Wednesday, January 07

Topic: Introduction
Reading: *forall x*, Chapters 1-2.

Week 2: Symbols and Truth Tables

Monday, January 12

Topic: Symbolization
Reading: *forall x*, Chapters 4-6.

Wednesday, January 14

Topic: Truth Tables
Reading: *forall x*, Chapters 9-11.
Assignment: Assignment 1 due Thursday, January 15 at 5pm.

Week 3: Validity and Trees

Monday, January 19

Topic: Truth Tables and Validity
Reading: *forall x*, Chapter 12.

Wednesday, January 21

Topic: Truth Trees
Reading: *Boxes and Diamonds*, Sections 2.1-2.3
Assignment: Assignment 2 due Thursday, January 22 at 5pm.

Week 4: Validity and Trees, Continued

Monday, January 26

Topic: Using Truth Trees
Reading: *Boxes and Diamonds*, Sections 2.4-2.5
Assignment: Assignment 3 due Thursday, January 29 at 5pm.

Wednesday, January 28

No lecture, because I'm away at a conference. There will be a discussion section.

Week 5: Introduction to Modal Logic

Monday, February 02

Topic: Varieties of Modality
Reading: *Boxes and Diamonds*, sections 3.1-3.3.

Wednesday, February 04

Topic: Models and Frames
Reading: *Boxes and Diamonds*, sections 3.4-4.5.
Assignment: Assignment 4 due Thursday, February 05 at 5pm.

Week 6: Proofs in Modal Logic

Monday, February 09

Topic: Modal Tableau
Reading: *Boxes and Diamonds*, chapter 5.

Wednesday, February 11

Topic: Examples
Reading: No new reading
Assignment: Assignment 5 due Thursday, February 12 at 5pm.

Week 7: Conditionals

Monday, February 16

Topic: Varieties of Conditionals
Reading: *Boxes and Diamonds*, chapter 6.

Wednesday, February 18

Topic: Counterfactual Conditionals
Reading: *Boxes and Diamonds*, chapter 7.
Assignment: Assignment 6 due Thursday, February 19 at 5pm.

Week 8: Counterfactuals

Monday, February 23

Topic: The Logic of Counterfactuals
Reading: *Boxes and Diamonds*, chapter 7.

Wednesday, February 25

Topic: Puzzles about Counterfactuals
Reading: No new reading
Assignment: Assignment 7 due Thursday, February 26 at 5pm.

Week 9: Starting on Probability

Monday, March 09

Topic: Probability Basics
Reading: *Odds and Ends*, chapters 1 and 5

Wednesday, March 11

Topic: Probability Trees
Reading: *Odds and Ends*, chapter 1
Assignment: No assignment this week.

Week 10: Conditional Probability

Monday, March 16

Topic: Conditional Probability
Reading: *Odds and Ends*, chapter 6

Wednesday, March 18

Topic: Inverting Conditional Probability
Reading: *Odds and Ends*, chapter 8
Assignment: Assignment 8 due Thursday, March 19 at 5pm.

Week 11: Probability and Decision

Monday, March 23

Topic: Expected Utility
Reading: *Odds and Ends*, chapters 11 and 12

Wednesday, March 25

Topic: Utility and Money
Reading: *Odds and Ends*, sections 12.5 and 13.1.
Assignment: Assignment 9 due Thursday, March 26 at 5pm.

Week 12: What are Games?

Monday, March 30

Topic: Games, Payouts and Utilities
Reading: *Game Theory*, sections 2.1 and 2.2.

Wednesday, April 01

Topic: Dominant Strategies and Equilibria
Reading: *Game Theory*, sections 2.5 and 2.6.
Assignment: Assignment 10 due Thursday, April 02 at 5pm.

Week 13: Games and Time

Monday, April 06

Topic: Dynamic Games
Reading: *Game Theory*, sections 3.1-3.3.

Wednesday, April 08

Topic: Backward Induction
Reading: *Game Theory*, sections 3.4 and 3.5.
Assignment: Assignment 11 due Thursday, April 09 at 5pm.

Week 14: Games with Cardinal Payoffs

Monday, April 13

Topic: Nash Equilibria
Reading: *Game Theory*, sections 6.1–6.3.

Wednesday, April 15

Topic: Signaling Games
Reading: No new reading
Assignment: Assignment 12 due Thursday, April 16 at 5pm.

There will be a revision class on Monday, April 20, with no new material, to go over the sample exam.

Extensions

Because we will release the answers to the quizzes at the due date, we won't be allowing extensions on them.

That's why we're only counting the best 10 out of 12 assignments. People who are sick, or have other obligations, can skip up to two assignments without penalty.

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.