Formal Reasoning II

Philosophy 331
Spring 2003
MW: 12:40-2:30
EBH 306

Instructor Information

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Required Text


There will also be several handouts.

Course Overview

- Content

This course is the philosophy department’s continuation of PHL 330. The courseware package includes several software tools that students will use to complete homework, tests, and the self-diagnostic exercises from the text. The software, easy to learn and use, makes some of the more technical aspects of symbolic logic accessible to introductory students and, just as importantly, it is fun to use. The course presupposes a PHL 330 exposure to logic, it does not require having taken 330 in the fall with me. Slight alterations in the content of the course are possible due to student needs and interests. The course can be divided into two parts.

In the first part, we review first-order logic and establish a common framework for our later work in the meta-theory of logic. Also, we develop a familiarity with the software, and pursue themes in the optional sections such as the soundness and truth functional completeness of propositional logic, and the logic of generalized quantification.

The main focus of the second part of the course is on what is called the meta-theory of first-order logic (FOL). In particular, we shall work towards proving the completeness and soundness of FOL and other related theorems considered central to the theorizing about FOL (e.g., compactness and the Lowenheim-Skolem theorem). We start by investigating first-order set theory and mathematical induction, two important resources for proving facts about logic. Set theory will provide the mathematical framework in which the semantics of FOL can be rigorously studied. Using its resources we shall revisit truth and satisfaction and make the PHL 330 characterizations of first-order logical consequence precise. This precision is required for the soundness and complete proofs to follow. Mathematical induction is a method of proof left out in
PHL 330. It is a form of proof that allows us to justify a universal claim, with infinitely many instances, on the basis of a finite proof. It is an important method of proof in meta-theory because we often need to prove that each member of an infinite collection has a property. There will be many opportunities to use mathematical induction in our proofs of the central results in the meta-theory of FOL.

**Primary Course Objectives**

- Deepen your understanding of the concept of logical consequence as well as its relationship to the methods of proof (both formal and informal) that we shall study.
- Facilitate your ability to do proofs both formally and informally.
- Introduce you to first-order set theory and demonstrate its importance to the study of logical consequence. By the end of the course, you will be able to construct proofs of many set-theoretic truths, both elementary and substantive.
- Introduce you to some of the central theorems of logic, including the soundness and completeness theorems of propositional and first-order logic, the Lowenheim-Skolem theorem, and the compactness theorem. By the end of the course, you will understand the foundational and philosophical significance of these and other important results.
- By continuing the discussion in PHL 330, I hope to give you a sense of what a logician does for a living, and to highlight in an informal way the connections between logic and other fields such as mathematics, linguistics, computer science, cognitive science, and philosophy. Among other things, this will prepare you for serious thinking on the nature of logic and what distinguishes it from other abstract disciplines like mathematics and theoretical physics.
- To have fun. Logic is not dry and boring. I have designed this course with the idea that you will both learn from and be entertained by the subject matter.

Please let me know at any point if you think we aren't making sufficient progress toward these goals, or if there are goals that you think we should have.

**Course Requirements**

- Frequent homework assignments. Your average assignment grade will make up 60% of your course grade. Each assignment consists of exercises from the text or exercises devised by the instructor. There will probably be an assignment for every two chapters covered in Part I of the text, and an assignment for each of the Chapters in Parts II and III.
- One research project will be 40% of your final grade. A research project is a 10-12 paged paper on a topic related to course work. More specifically, your project will explore and evaluate if possible an application of a result in logic (e.g., a theorem) to work in a field outside of logic such as mathematics, linguistics, philosophy, computer science, or electrical engineering. I’ll talk more about this in class. A rough draft of your paper is due by class on April 9th. If I don’t get a rough draft by this date, then there will be a full grade deduction. The final copy of the paper is due by 3:00pm on Friday, the 25th of April. The final paper will be evaluated in part by how effective you are in responding to my criticisms. Your paper topic must be approved by me prior to spring break.

I will accept required work that is one class period late, but there will be a full grade deduction. Only in the most exceptional circumstances will late work be accepted after that. Please do not ask me to make an exception to this policy unless you have a VERY special reason.

- **Class Time**
Class time will primarily be spent going over text exercises, and reviewing or expanding on key points from the reading. It is imperative that you keep up with the pace of the course by doing the assigned readings in a timely manner, and by doing enough of the relevant practice exercises to get a feel for one's level of understanding BEFORE coming to class. Class time is your opportunity to clear up those things that you find mysterious or troublesome. So, coming to class unaware of what you don't know is not the best way to use class time.

- **Grading**

Grades on required work will be on a 100-pt. scale. Your final grade will be first determined on a 100-pt. scale, and then converted to a 4.0 scale according to the below tabulations. For example, a final grade of an 83% corresponds to a 3.0 and a 77% corresponds to a 2.5.

- 4.0=90% and above
- 3.5=85--89%
- 3.0=80--84%
- 2.5=75--79%
- 2.0=70--74%
- 1.5=65--69%
- 1.0=60--64%

**Tentative Schedule**

The following schedule is tentative; slight alterations are possible in response to your needs and interests. Also, I cannot give a class-to-class schedule because I can't tell how fast we will proceed until we have worked together.

1/6 to 2/5 Parts I & II in LPL, plus handouts

2/10 to 4/23 Part III, plus handouts

- 2/10 to 3/10 Chapters 15 & 16: Set theory and mathematical induction
- 3/12 to 4/21 Chapters 17-19: Meta-theory of propositional and first-order logic

4/23: Conclusion