

PHIL 250: Symbolic Logic

January 7, 2016

Instructor Carlotta Pavese, PhD

Main Lecture Time Wednesday and Friday 10:05AM - 11:20AM

Main Lecture Location West Duke 108A

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Office West Duke Building, Philosophy department, room 201I

Office Hours Fridays 12-2pm

Website There will be a Sakai site

Course Description This course is an advanced course in Symbolic logic. You cannot take this class unless you have taken PHIL 150 Logic before or an equivalent class. You should ALREADY be quite comfortable doing deductions in sentential as well as in first-order logic. If you are not, this class is NOT for you. If you are in doubt, ask me and I will let you know if you are eligible to take this class. In your elementary logic class — the class you must have taken before this one in order to enroll— you have been exposed to *the art of logic*: you have been trained to prove things in very simple logical systems. But you have not studied the properties of such logical systems. This is what we will do in this class: we will study *the science of logic*. We will try to understand classical logical systems and look at whether they have certain properties that we will learn to appreciate — at whether they are *consistent* and *complete*. We will learn that certain notable systems, such as Peano Arithmetic, are incomplete and we will try to understand the technical and the philosophical significance of this fact. In the final part of the course, we will look at an extension of classical logic — modal logic — that is of special interest for philosophers. We will learn how to do deductions in this logic and will discuss different possible interpretations of the modal language. Most of material covered in this class is technical. Doing the exercises when they are due is paramount. We will schedule an extra weekly hour to go over the tricky ones together. Throughout the class, we will also encounter and discuss a variety of fascinating philosophical questions on the nature of logic, on the nature of languages, and on the nature of meaning.

Required book

Mandatory:

- “Notes on the Science of Logic,” Nuel Belnap (abbreviated throughout as “NoSoL”), which you can download at the following link:
<http://www.pitt.edu/~belnap/nsl.pdf>
- Smullyan’s book on Incompleteness:
<https://www.dropbox.com/s/6j66hlotz1sc3ws/Smullyan%20-%20G%C3%B6del%27s%20Incompleteness%20Theorems%20volume%2019%20of%20Oxford%20Logic%20Guides.pdf?dl=0>
- “Modal Logic for Philosophers,” Garson, which you can download here:
<http://www.franko.lviv.ua/faculty/mechmat/Departments/Logic/EN/Gar.pdf>
Optional but highly recommended:
- “Computability and Logic,” George Boolos, John Burgess and Richard Jeffrey, Fifth Edition, Cambridge University Press 2007.
- “Philosophical Logic,” John Burgess, Princeton University Press 2009.

Other Readings: We will also read stuff from Hodges’ “A Shorter Model Theory,” Cambridge University Press 1997 and other books. But the relevant material from these books will be made available electronically on Sakai. If you want to revise some sentential and first-order logic before the beginning of the semester (you should if it has been a while since you have taken PHIL 150), I recommend you familiarize with Belnap’s “Notes on the Art of Logic,” available here <http://www.pitt.edu/~belnap/nal.pdf>. In some cases, I recommend more than one readings per class. They are labeled “optional”. The point of this is to offer you with more resources to better understand a topic: often different representations of the same problems facilitate comprehension.

Requirements on Exercises: *Unless otherwise instructed*, if pages n to m are assigned from Belnap “Notes on the Science of Logic” as a reading for a given day and those pages contain exercises e_1 to e_n , you are supposed to do all of e_1 to e_n and hand them to me in class that very same day. For the purpose of the final grade, it does not matter AT ALL whether you did them correctly or not. What DOES matter is that you try to do them and hand them to me in class when assigned. If Belnap dabbled an exercise as “Optional”, the exercise is indeed optional for the purpose of this class. If a reading from any other book is assigned, instead, I will make clear in advance whether you are supposed to hand in the exercises therein contained. There will be 7 quizzes spread out through the semester. These are mainly FOR ME to check whether everybody in the class is keeping up with the material.

Grading for Undergraduates:

Midterm 35%

Final Exam 45%

Quizzes 10%

Attendance, class discussion, mandatory office hours, exercises 10% At the end of February, students have to mandatorily meet once with the professor during office hours (Friday 12-2pm).

Grading for Graduate Students:

Midterm 35%

Final TAKE-HOME Exam 45% (due May 7th, by email).

Quizzes 10%

Attendance, class discussion, mandatory office hours, exercises 10% At the end of February, students have to mandatorily meet once with the professor during office hours (Friday 12-2pm).

Policy on Absences: Students are expected to attend all classes. There is no way to learn this material unless you do the exercises every time and come to class.

(Provisional) Schedule

The following schedule is only provisional and most likely subject to changes as we go on.

1st week Friday January 15th 2016 • *Readings:* Chapter I of NoSoL. Chapter II of NoSoL, 2A.

- *Topic:* Introduction to the Science of Logic. Truth Values and Truth Functions.

2nd week Wednesday January 20th 2016 • *Readings:* Chapter II of NoSoL, 2B/2C.

- *Topic:* The Grammar of Sentential Languages.

Friday January 22nd 2016 First quiz

- *Readings:* Chapter II of NoSoL, 2D, selections.
- *Topic:* Semantics for a Sentential Language: Evaluations, Models, Truth, and the Expressive Power of a Language.

3rd week Wednesday January 27th 2016 • *Readings:* Chapter II of NoSoL, 2E.

- *Topic:* Proof Theory and The Structural Properties of Derivability.

Friday January 29th 2016 • *Readings:* Chapter II of NoSoL, 2F, 2F1-2.

- *Topic:* Soundness and a first look at Completeness for Sentential Logic.

4th week Wednesday 3rd February 2016 • *Readings:* Chapter II of NoSoL, 2F3-2F6. 2G.1

- *Topic:* A Closer Look at Completeness, with slow proof of Lindembaum's lemma. Corollaries: Compactness and Finiteness.

Friday 5th February 2016 Second Quiz

- *Reading*: Chapter 3 of NoSoL: 3A-3B. Optional: Boolos and Al: Chapter 9. Hodges, Chapter I (selections).
- *Topic* Grammar for Predicative Logic.

5th week Wednesday 10th February 2016 • *Readings*: Chapter 3 of NoSoL: 3C; Optional: Boolos and Al: Chapter 10. Hodges, Chapter IV (selections).

- *Topic*: Semantics for Predicative Logic: Interpretations, Models, and Truth.

Friday 12th February 2016 • *Readings*: Chapter 3 of NoSoL: 3D.

- *Topic*: Basic Proof Theoretical Definitions, Universal Generalization, Semantic Consequence versus Syntactic Consequence.

6th week Wednesday 17th February 2016 Third Quiz

- *Readings*: Chapter 3 of NoSoL: 3E/3G; Optional: Chapter 14 of Boolos and Al.
- *Topic*: Soundness and Completeness for Predicative Logic and Predicative Logic with Identity.

Friday 19th February 2016 • *Reading*: no new reading.

- *Topic* Review.

7th week Wednesday 24 February 2016 Midterm

Friday 26 February 2015 • *Readings*: Chapter 12 of Boolos and Al. Optional: Hodges, Chapter V (Selections).

- *Topic*: Lowenheim-Skolem, Compactness.

8th week Wednesday 2nd March 2016 • *Readings*: Smullyan, chapter 1. Optional: Boolos and Al, chapter 1-2.

- *Topic*: Introduction to Incompleteness. Incompleteness in its generality.

Friday 4th March 2016 Fourth Quiz

- *Readings*: Smullyan, chapter 2. Optional: Boolos and Al. Chapter 15.
- *Topic*: Towards Incompleteness for Peano Arithmetic: Tarski's theorem.

9th week Wednesday 9th March 2016 • *Readings*: Smullyan, chapter 3-4

- *Topic*: Incompleteness for Peano Arithmetic with and without Exponentiation.

Friday 11th March 2016 • *Readings*: Smullyan, chapter 5.

- *Topic*: Godel's proof based on omega-consistency.

10th week Wednesday 15th March 2016 No class, spring recess.

Friday 18th March 2016 No class, spring recess.

11th week Wednesday 23rd March 2016 • *Readings*: Boolos, chapter 17-18.

- *Topic*: More thoughts about incompleteness.

Friday 25th March 2016 Fifth Quiz

- *Readings:* Garson Chapter 1.
- *Topic* Semantics for Sentential Modal Logic. Natural Deduction.

12th week Wednesday 30th March 2016 Wednesday 6th April 2016 • *Readings:* Garson Chapter 2. Optional: Burgess, Chapter 2.

- *Topic* Extensions of K.

Friday 1st April 2016 • *Readings:* Garson Chapter 3. Optional: Burgess, Chapter 3.

- *Topic* Basic Concepts of Intensional Semantics.

13th week Wednesday 6th April 2016 Sixth Quiz

- *Readings:* Garson's Modal Logic for Philosophers, Chapter 12, selections; Optional: Burgess, Chapter 3.
- *Topic:* First-order Modal Logic.

Friday 8th April 2016 • *Readings:* Garson's Modal Logic for Philosophers, Chapter 12, selections; Optional: Burgess, Chapter 3.

- *Topic:* More First-order Modal Logic.

14 week Wednesday 13th April 2016 Seventh Quiz.

- *Readings:* Garson's Modal Logic for Philosophers, chapter 13; Optional: Burgess, Chapter 3.
- *Topic:* Semantics for first-order Modal Logic.

Friday 15th April 2016 • *Readings:* Boolos and Al: chapter 27.

- *Topic:* The Logic of Provability.