# Phil 120: Symbolic Logic

*Instructor*: Sebastian G.W. Speitel Fall 2017

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| **Schedule** | MWF 12:00pm – 12:50pm; SOLIS 109 |
| **Course page** | TritonEd |
| **Office hours** | MW 1:30pm – 2:30pm and by appointment; H&SS 8033 |
| **Email** | sspeitel@ucsd.edu |

## General Course Information

*Course Content.* Logic studies (deductive) inference and validity, trying to discern good from bad arguments. It is an indispensable tool in reasoning, and a powerful instrument for supporting claims and justifying assertions. As a truly interdisciplinary field of study, impacting many diverse disciplines, including mathematics, computer science, philosophy, linguistics, cognitive science, artificial intelligence, and many more, logic plays a fundamental role in many areas, and acquaintance with its basic techniques, methods, and concepts is thus essential for a wide range of applications.

While the systematic study of logic goes back to at least Aristotle, the field changed and expanded dramatically in the 19th- and 20th century. The goal of this course is to become acquainted with some of the basic concepts and methods of the core system that emerged from these developments: the classical first-order predicate calculus.

*Course Objectives.*

(i) To become familiar with the classical first-order predicate calculus (its grammar, a natural-deduction proof-system, and a set-theoretical semantics for it);
(ii) To be able to formalize arguments in predicate logic, perform proofs in the calculus for the system, and check the validity of arguments by model-theoretic methods;
(iii) To understand important logical concepts in this framework, such as *consequence*, *truth*, *validity*, *equivalence*, *consistency*, and *contradiction*.

*Prerequisites.* An introduction to logic/logical reasoning at the level of Phil 10 or similar, or consent of instructor.

## Course Materials

The textbook for the course will be

Halbach, V., *The Logic Manual*, OUP 2010, reprinted 2015 with corrections (henceforth: LM)

supplemented by handouts that will be uploaded on TED before the relevant lectures. Everything else listed below constitutes optional, supplementary material for those who want to follow up in a bit more depth on things discussed and introduced in the course.

Articles containing additional information regarding material mentioned in the last week of the course can be found here:

`https://plato.stanford.edu/entries/logic-intuitionistic/`

`https://plato.stanford.edu/entries/logic-paraconsistent/`

`https://plato.stanford.edu/entries/logic-higher-order/`

`https://plato.stanford.edu/entries/generalized-quantifiers/`

For a more mathematically oriented introduction to the content of the course, going far beyond the material treated here, the following is a good resource:

Ebbinghaus, H.-D., Flum, J., Thomas, W., *Mathematical Logic*, Springer 1984.

Concerning the historical development, emergence, and importance of the subsystem of logic studied in the present course, the following texts are highly recommended:

Ferreiros, J. "The Road to Modern Logic – an Interpretation", *Bulletin of Symbolic Logic* 7, 2001, pp. 441-484.

Nagel, E., Newman, J.R., *Gödel's Proof*, revised edition with a foreword by Douglas R. Hofstadter, NYU Press 2008.

## Requirements and Evaluation

There will be two components determining the final grade for the course: *exercise sets* and *exams*. In order to pass the class (i) at least three exercise sets need to be submitted, (ii) both exams need to be taken, and (iii) a total of at least 40 points needs to be achieved (see below for details).

*Exercise sets.* Formal logic is something that is best learned by doing. The exercise sets allow you to practise the material from the lectures, and me to assess the progress of the class, and adjust the schedule if needed. There will be *four* exercise sets in total (posted on TED on the dates indicated in the course calendar below, and due one week later). Of these four, *at least three* need to be submitted in order to pass the course. In each exercise set a maximum of *20 points* can be achieved. In calculating the final grade for the course, *only the three best exercise sets* will be taken into account. In other words, if you hand in all four exercise sets, the one with the lowest score will be omitted in calculating your final grade.

The solutions to the exercise sets need to be handed in *as a hardcopy at the beginning of the lecture on the due date*. They can be handwritten or typed (as long as the solutions are legible I will be happy to grade them). For each day that an assignment is late without a valid excuse[1] *5 points* will be deducted from the total score of the respective exercise set. If, without a valid

[1]Disease, personal-, or family-emergency, etc., qualify if they can be demonstrated (doctor's certificate, etc.). If you anticipate handing in an assignment late for a valid reason, *come talk to me in advance* so we can discuss ways to avoid loosing points.

excuse[2], an exercise set is not handed in on the fourth day after the due date (counting the day of the due date) or at all, it will automatically receive a total score of *0 points*.

When working on the exercise sets, you are highly encouraged to collaborate by discussing the material of the lecture, solution strategies, and ways to go about solving the exercises. *However*, you are required to write up the solutions to your exercises individually and by yourself. It is thus perfectly fine to discuss an exercise and work out solutions together, as long as the write-up is done individually. If two solutions turn out to be too similar, they will both receive 0 points. If you choose to discuss exercises and solutions with someone, please note their names at the beginning of the answer sheet you hand in – this is just for me to see and has no effect on grading. I trust you will honor this requirement.

*Exams.* There will be two in-class exams: a mid-term exam during class time on *Monday, November 13th*, and a final exam on *Thursday, December 14th*. Both exams are closed-book and need to be taken in order to pass the course. Each exam will be worth a total of *20 points*. If special accommodations for the exams are needed, please let me know well in advance. Please bring a new bluebook to each exam.

*Grading.* The grade for the course will be determined based on a 100 point scale. Your total point score for the course is calculated as follows:[3] the sum of the points achieved in the three highest scored exercise sets plus the points achieved in the midterm- and final exam. Points correspond to grades in the following way:

| **Points** | **Grade** |
|---|---|
| 98 - 100 | A+ |
| 85 - 97 | A |
| 81 - 84 | A- |
| 76 - 80 | B+ |
| 71 - 75 | B |
| 66 - 70 | B- |
| 61 - 65 | C+ |
| 56 - 60 | C |
| 50 - 55 | C- |
| 40 - 49 | D |
| $\leq 39$ | F |

*Logic requirement*: Graduate students taking Phil 120 to satisfy the Logic I requirement can pass the course by *either* (i) completing and submitting exercise sets 3 and 4 *or* (ii) taking the final exam. If you choose to do both, the better grade will be counted.[4]

[2] See footnote 1.

[3] Exception for graduate students taking the class for the logic requirement; see footnote 4.

[4] The final grade will be determined on the basis of the proportion of the total possible points of the option chosen, i.e. if you choose option (i), the point basis for the final grade will be the sum of the points achieved in the exercise sets multiplied by 2.5; and if you choose option (ii) the point basis for the final grade will be the points achieved in the final exam multiplied by 5.

Graduate students taking Phil 120 to satisfy the Logic I requirement are of course free to take the course under the standard modalities as well.

*Academic Integrity.* UC San Diego is committed to principles of academic integrity, and expects faculty and students to respect and uphold these principles:

> Integrity of scholarship is essential for an academic community. The University expects that both faculty and students will honor this principle and in so doing protect the validity of University intellectual work. For students, this means that all academic work will be done by the individual to whom it is assigned, without unauthorized aid of any kind. Instructors, for their part, will exercise care in planning and supervising academic work, so that honest effort will be upheld.[5]

If you are uncertain whether something constitutes plagiarism, come talk to me *before submitting it*. Anyone caught cheating or submitting plagiarized work will automatically fail the course and be referred to the Academic Integrity Office for further penalties.

## Notes

(i) Please bring a (new) bluebook to the mid-term and final exam.

(ii) If special accommodations are needed, in class or for an exam, please notify me as soon as possible in advance.

(iii) If any exercise due date, exam, or other course related requirement conflicts with a religious requirement or university obligation, please notify me as soon as possible in advance.

[5] Cf. `https://senate.ucsd.edu/Operating-Procedures/Senate-Manual/Appendices/2`

## Tentative Course Calendar

| Date | Content | Notes |
|---|---|---|
| *Week 0* | | |
| F 09/29 | Introduction<br>*Readings*: Syllabus & LM Introduction | *Instructor*: Prof. Samuel C. Rickless<br>Please carefully read the syllabus and obtain a copy of the textbook. |
| *Week 1* | Review of propositional logic I:<br>Grammar, semantics & symbolizations | *Instructor*: Prof. Samuel C. Rickless |
| M 10/02 | The language of propositional logic<br>*Readings*: LM 2.2 | |
| W 10/04 | Semantics of propositional logic<br>*Readings*: LM 2.4 | |
| F 10/06 | Symbolizations<br>*Readings*: LM 3.1 - 3.3 | |
| *Week 2* | Review of propositional logic II:<br>Proof-theory | *Instructor*: Sebastian G.W. Speitel |
| M 10/09 | Natural deduction for propositional logic<br>*Readings*: LM 6.1 | |
| W 10/11 | continued<br>*Readings*: LM 6.1 | |
| F 10/13 | Review & loose ends | Exercise set 1 online |
| *Week 3* | Logical & meta-logical concepts | |
| M 10/16 | Logical concepts<br>*Readings*: LM 2.4; handout | |
| W 10/18 | Theorems *about* propositional logic<br>*Readings*: LM 2.4; handout | |
| F 10/20 | Adequacy of the syntax and semantics | Exercise set 1 *due* |
| *Week 4* | Syntax of predicate logic (PL) | |
| M 10/23 | The language of PL: terms, formulas, sentences<br>*Readings*: LM 4.1-4.3; handout | |
| W 10/25 | continued & Symbolizations in PL<br>*Readings*: LM 4.5 | |
| F 10/27 | continued | Exercise set 2 online |
| *Week 5* | Semantics of PL | |
| M 10/30 | Basic set-theoretic notions: sets, functions, relations<br>*Readings*: LM 1.1-1.4 | |
| W 11/01 | Models, satisfaction, truth, validity, consequence<br>*Readings*: LM 5.1 & 5.2 | |
| F 11/03 | continued<br>*Readings*: LM 5.2 & 5.3 | Exercise set 2 *due* |

| Date | Content | Notes |
|---|---|---|
| *Week 6* | Semantics of PL continued | |
| M 11/06 | Countermodels and logical concepts<br>*Readings*: LM 5.3 & 5.4 | |
| W 11/08 | Review | |
| F 11/10 | no class | Veterans Day Holiday |
| *Week 7* | Natural deduction for PL | |
| M 11/13 | **Midterm exam** | Please bring a bluebook. |
| W 11/15 | Natural deduction rules for the quantifiers<br>*Readings*: LM 6.2 | |
| F 11/17 | continued<br>*Readings*: LM 6.2 | Exercise set 3 online |
| *Week 8* | Natural deduction for PL continued | |
| M 11/20 | Examples<br>*Readings*: LM 6.2 | |
| W 11/22 | Review | |
| F 11/24 | no class | Thanksgiving Holiday |
| *Week 9* | Logical concepts & identity | |
| M 11/27 | Logical concepts<br>*Readings*: handout | Exercise set 3 *due* |
| W 11/29 | continued<br>*Readings*: handout | |
| F 12/01 | Semantics and natural deduction for identity<br>*Readings*: LM 8.2 - 8.4 | Exercise set 4 online |
| *Week 10* | Review & Outlook | |
| M 12/04 | Examples and definite descriptions<br>*Readings*: LM 8.5; handout | |
| W 12/06 | Alternatives & Extensions | |
| F 12/08 | Review | Exercise set 4 *due* |
| *Finals Week* | | |
| Thu 12/14 | **Final Exam**<br>11:30am – 2.30pm; location TBD | Please bring a bluebook. |