

# PHIL0280: Logic and Formal Semantics

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*Unofficial Title: Semantics, Logic, and Cognition*

Using logical and mathematical tools, formal semantics answers the following questions: Why do sentences mean what they mean? How is reasoning possible? How does language structure our understanding of time, change, knowledge, morality, identity, and possibility? We will assess formal semantics as a theory of linguistic meaning and reasoning by comparing its predictions with linguistic and psychological evidence. We will also examine its philosophical assumptions. This course is well suited for students interested in computer science, linguistics, logic, mathematics, philosophy, or psychology. (Some prior familiarity with formal logic is recommended, but not required.)

## 1 General Course Information

Course meeting times and places:

- *Tuesday and Thursday*: 9:30AM-10:45AM in Bicentennial Hall, Room 219
- *Wednesday*: 11:15AM-12:05PM in Twilight Hall, Room 302

Office hours:

- *Wednesday*: 2:30PM-3:30PM in Twilight Hall, Room 303A
- *Thursday*: 11:30AM-1:30PM in Twilight Hall, Room 303A

Other information:

- Email: [kkhalifa@middlebury.edu](mailto:kkhalifa@middlebury.edu). (This is far more reliable than telephone.)
- My website: <http://www.kareemkhalifa.com>
- Course website: <http://sites.middlebury.edu/semlogcog/>. (All relevant information will be posted here.)

## 2 Course Objectives

1. To introduce you to different formal models of various aspects of natural language.
2. To give you a sense of different methodological considerations involved in modeling human reasoning and language-use.
3. To stimulate reflection on these models from different disciplinary perspectives (philosophy, psychology, linguistics, and other cognitive sciences).
4. To introduce you to a number of philosophical debates through these different formal models and multidisciplinary reflections.

## 3 Evaluation

We will meet our course objectives through a variety of assignments:

- Homework assignments (65%)
- Take-home exams (25%)
- Participation (10%)

Alphabetic grades will then be assigned according to the following scale:

–	87.5-89.4 B+	77.5-79.4 C+	59.5-69.4 D	0-59.4 F
94.5-100 A	82.5-87.4 B	72.5-77.4 C	–	–
89.5-94.4 A-	79.5-82.4 B-	69.5-72.4 C-	–	–

There is no rounding up or down of final grades. Rounding occurs only for the final grade, i.e., individual assignments, tests, etc. are not rounded.

### 3.1 Homework assignments

Our review of different formal systems emphasizes breadth over depth. Hence, we will cover many formal systems in a short period of time. Nevertheless, it is important that you get a “feel” for these different systems. So, nearly every week, you will be doing homework assignments that are primarily designed to facilitate this goal. The grading system is structured so that you can struggle with a formal system initially, but still earn high marks through persistence.

The format is as follows

1. First, you type up your homework before the class on which it is due. (We have a few “tree-like” structures. I will provide examples of how I would like these typed up. Also feel free to email me.)
2. Next, we cover at least some of the problems in class. You may write on your homework to correct errors you may have made.

3. You will be graded accordingly:

- If you submit your homework on time, you earn:
  - Full credit for each typed answer that is correct prior to class,
  - Three-quarters credit for each typed answer to which you have devoted adequate effort and that has been corrected in class,
  - Half credit for each typed answer to which you have devoted adequate effort prior to class and that has not been corrected in class,
  - One-quarter credit for each typed answer to which you have exhibited some effort prior to class that is inadequate, even if you have corrected it in class, and
  - No credit for each typed answer to which you have exhibited no effort, even if you have corrected it in class.
- If you do not submit your homework on time, you earn the same grade as you would if you had submitted on time, subject to the following provisos:
  - If you submit your homework after class but on the same day in which it is due, you receive a 2.5-percentage-point penalty.
  - For each 24-hour period thereafter, you receive an additional 2.5-percentage-point penalty.
- You may redo any homework assignment once. For each mistake that you correct, you should provide one paragraph that:
  - explains why you made your initial mistake, and
  - justifies your revision (citations to our readings are strongly encouraged.)

Your grade on this assignment will be the average of your initial grade and the grade you earn on your revision. You are strongly encouraged to meet with me before revising any homework assignment.

### 3.2 Take-home exams

You will have two take-home exams, consisting of several short essays (1-3 pages each) where the emphasis is on the more philosophical aspects of the course. The first of these exams will be due on the Thursday before Spring Break, **March 22**. The second of these exams will be due on the Wednesday of Finals Week, **May 16**. You are strongly encouraged to *discuss* your answers to the questions on these exams with others in the class. At no point should you be *reading* other people's answers to those questions.

### 3.3 Participation

This is a general evaluation of the amount of effort and astuteness you have demonstrated to me in the course. Considerations that are relevant include

promptness, attendance, quantity and quality of both contributions and questions in class sessions, responsiveness to other people's comments in class, discussions outside of class, and appropriate class behavior. This grade reflects your performance in all of those areas of the course other than the graded, written assignments.

If you simply attend all of the required courses, you will receive a 75 (C) on your participation grade. Here are some ways of improving that grade:

- Asking questions about the material. Generally, unless prompted, you should not ask questions such as, "What is the answer to problem 6 on page 235?" in class. Rather, ask something more interesting, e.g., "Can you clarify the difference between the object language and meta-language?"
- Answering your peers' questions. Some of you will find this material easier than others. For those of you who find this easy, don't be passive, don't get bored, etc. Rather, share your knowledge, especially when you have an answer to someone else's questions.
- Don't be shy during discussion sections and office hours. Some of you feel more comfortable in large lecture sections than others. For those who would rather not speak in front of your peers, feel free to swing by office hours or to use discussion section to be more open with your thoughts and concerns.

*General expectations of student behavior:* Participation also includes behaving like an adult. This includes exhibiting the virtues of civility, accountability, responsibility—particularly as these virtues apply to your education. For most of you, this is second nature. However, for the few of you who have not yet shed your adolescent tendencies, please note that failure to behave like an adult will be reflected in your participation grade. This includes taking the required initiative and responsibility of your workload in the event that you need a Dean's Excuse (see below).

*Email etiquette/decorum:* Different professors have different expectations about how they are addressed, and especially how they are addressed in email correspondences. If you are not clear what a professor's expectations are, use the template described here:

<https://medium.com/@lportwoodstacer/how-to-email-your-professor-without-being-annoying-af-cf64ae0e4087>

I consider my norms to be "semiformal," i.e. I expect some form of salutation with some acknowledgment that I'm a professor, but within those constraints, you can be fairly colloquial. For instance, the following are all perfectly good ways to start an email: "Dear Professor Khalifa," "Hey Prof," "Hi Dr. K," "Howdy Most Esteemed Educator," etc. What's not acceptable is an email either lacking a salutation or failing to acknowledge the fact that I'm a professor. This reads as if I'm a waiter taking your order, which is not a good professor-student dynamic. Examples of bad email introductions include diving into your

email without addressing me at all, “Hi,” “Hey,” “Hello,” “Hello Kareem,” “Khalifa,” “Hey Khalifa,” etc.

Also, a general rule: most professors (including myself) are annoyed when they have to answer emails about logistical issues (how something will be graded, how to access a file, when something is due, etc.) in which the student could have read the syllabus, searched the internet, or asked a classmate in roughly the same amount of time it took them to write and wait for a reply to their email. This is not a good use of your time (since you often could get the answer to your question more quickly with a little more effort) and it’s definitely not a good use of my time.

Here’s my rule: if you send me an email that falls short of these expectations, I will send you a YouTube video of an 80s pop song. You have two choices at this point: (1) you can go search for the lyrics to this song, and email them back to me. After that, I will answer your original query. (2) Alternatively, you can spend the same amount of time searching for the answer to your original query.

All in all, I prefer face-to-face interactions, where we’re talking about the content of the course. So, wherever possible, you should try to meet under these conditions.

*Dean’s Excuses:* There are exceptions to certain deadlines (e.g., illness, family emergency). However, they require a Dean’s Excuse. The Dean’s Excuse serves the following functions in my course:

- As official documentation to me that your reasons for handing in a tardy assignment are legitimate;
- A mandate for you to initiate a conversation with me about how you will make up any assignments that you’ve missed.
- A mandate for you to initiate this conversation as soon as possible.
  - In general, I prefer that you speak with me prior to my receiving a Deans excuse.
  - “As soon as possible” should be read “within a week in which I receive the Deans Excuse,” circumstances permitting. If you can attend class, then your circumstances permit you to speak with me about any work you need to make up.

A Dean’s Excuse does NOT serve the following functions in my course:

- A permission slip for you to hand in your assignment at your earliest convenience.
- A mandate for me to seek you out in order to initiate a conversation with you about how you will make up any assignments that you’ve missed.
- Failure to respect these guidelines will result in a reduction of your participation grade AND the relevant assignments.

*Objections to grades:* If you object to a grade you receive, send me an email with the parts of your assignment where you think I was being unfair. Provide reasons why my assessment was not fair. The email should also include times when you can meet over a one-week period. I will not discuss grades without reading an email first. This process should not be adversarial; rather, it is an extended application of your critical thinking skills. These policies are intended to facilitate clarity and communication, as well as to guarantee that I respond as thoughtfully as I can to your queries and concerns.

## 4 ADA Statement

Middlebury College seeks to provide reasonable accommodations for qualified individuals with documented disabilities. Students who have Letters of Accommodation in this class are encouraged to contact me as early in the semester as possible to ensure that such accommodations are implemented in a timely fashion. For those without Letters of Accommodation, assistance is available to eligible students through Student Accessibility Services. Please contact Jodi Litchfield or Courtney Cioffredi, the ADA Coordinators, for more information: Courtney Cioffredi can be reached at [ccioffredi@middlebury.edu](mailto:ccioffredi@middlebury.edu) or 802-443-2169 and Jodi Litchfield can be reached at [litchfie@middlebury.edu](mailto:litchfie@middlebury.edu) or 802-443-5936. All discussions will remain confidential.

## 5 Honor code

You are expected to abide by all the rules of Middlebury College's honor code. If you fail to do so, appropriate actions will be taken.

## 6 Texts

Our main texts will be:

Kearns, K. (2011). *Semantics* (2nd ed.). New York: Palgrave Macmillan.

Machery, E. (2009). *Doing without concepts*. Oxford: Oxford University Press.

Nickerson, R. S. (2015). *Conditional reasoning: the unruly syntactics, semantics, thematics, and pragmatics of "if"*. New York: Oxford University Press.

Priest, G. (2008). *An introduction to non-classical logic: from if to is* (2nd ed.). Cambridge: Cambridge University Press.

Electronic copies of these and other required readings are available on the website under the "Readings" tab:

<http://sites.middlebury.edu/semlogcog/readings/>

This is password-protected. The password is: semlogcog

## 7 Schedule of Readings and Assignments

The schedule of readings and assignments can be found here:

<http://sites.middlebury.edu/semlogcog/schedule-and-supporting-materials/>

This is subject to change, depending on whether certain conversations require more time, we find an interesting side-topic, etc.

### 7.1 Tentative Course Narrative

In what follows, I offer a narrative of how I am imagining the course will proceed. It, too, is subject to change.

*Week 1:* We discuss how linguists conceive of the aims and methods of formal semantics. Conceived as a formal discipline, semantics is primarily about uncovering abstract structural features of language. These features are sufficiently abstract that human psychology plays a minimal role, and is mostly relegated to the study of pragmatics. However, some challenge these assumptions, by claiming that semantics must answer to pragmatics, and that pragmatics will progress by deeper engagement with psychology.

*Week 2:* For linguists and logicians, the standard semantic theory is truth-conditional semantics (TCS). The rough idea is that to understand a statement's meaning is to know the conditions under which it is true (and false.) We begin with the simplest model of TCS, which governs the use of words such as *not*, *or*, *and*, and *if-then*. We end by exploring a deep philosophical question that TCS provokes: what is truth?

*Week 3:* Despite the modest aims of our simple model of TCS—to cover less than a half-dozen words in English—it faces myriad problems. These difficulties are most evident in the mismatches between the material conditional and English if-then statements. We begin by looking at these mismatches as conceived by philosophers and linguists. We turn to the wide variety of psychological experiments that indicate that people do not reason in accordance with the simple model of propositional logic.

*Weeks 4 and 5:* The fact that people do not reason in accord with basic logical requirements raises a question: is logic the wrong description of human rationality? Or is logic essential to human rationality but most people are irrational? We examine opposing answers on this question. We then examine why logicians think that the rules of logic are constitutive of rationality by examining the concepts of soundness and completeness. We conclude with some philosophical puzzles about how we know that logical rules are constitutive of rationality. In particular, how can we provide a noncircular justification of logic? Wouldn't it have to be illogical?

*Weeks 6 and 7:* we enrich our simple propositional TCS model to include different kinds of modalities (necessity, possibility, permissibility, obligation, temporality, etc.) The crucial addition to TCS is the notion of possible worlds. Understood literally, this seems to be positing something very spooky to make sense of very basic features of our language, so we examine philosophical debates about the most plausible interpretations of modal semantics. We also look at a rather surprising psychological discovery about conditional reasoning (see Week 3): that humans do better with conditionals involving permissions and obligations what is called deontic reasoning.

*Week 8:* We return to the problems in Week 3 concerning logic and conditionals. We examine the semantics for conditional logics, which is a TCS model for counterfactual conditionals. We conclude by surveying the psychology of counterfactual reasoning.

*Weeks 9 through 12:* We enrich our simple propositional TCS model to include predicates. This affords us two major advances. First, we add a formal semantics for the logical operators all and some. Second, we have the resources for constructing a semantics for nonlogical vocabulary, such as names and predicates. We then turn to the study of concepts. On the traditional view, predicates are the linguistic analogues of concepts, and logicians and linguists have tended to assume that the structure of concepts is more or less the same as the structure of the words that express them. However, this account of concepts appears inconsistent with psychological accounts of concepts. Moreover, psychological accounts are themselves rather heterogeneous. So, who has the right view of concepts? We conclude the course with Edouard Machery's *Doing Without Concepts* to explore this question.