Linguistics 432 / 732 Intermediate Semantics (4 credits)

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Time and location: MWF 3:35-4:25 in CAS 233 (`https://www.bu.edu/maps/?id=30`)

Why learn semantics? In science, politics, commerce, law, the media, and with friends and family, every day, all over the world, people make statements. Sometimes there is controversy or a lack of clarity as to whether or not a given statement is true. Establishing whether or not a statement is true can have dramatic consequences, determining, for example, whether somebody is sentenced to jail, or takes the wrong medicine. In democracies, fact-checking groups like PolitiFact, who take it upon themselves to establish the truth of claims made by politicians and in the media, arguably play an important role, allowing citizens to form opinions on a common factual basis.

When questions arise regarding the truth of a statement, resolving them often requires determining not only what the facts are, but also what exactly the statement means, and what its logical consequences are. (Some cases even require us to clarify the nature of truth itself: whether there are truth values other than 'true' and 'false', for example, what goes into the determination of truth, and the relationship between truth and meaning. Here linguistics overlaps squarely with philosophy.) The study of semantics, grounded in logic, provides tools and vocabulary to help us disentangle the possible interpretations of an ambiguous statement, and understand their consequences.

A formal semantic theory furthermore specifies the general principles that allow people to understand sentences they have never been exposed to before, building up the meaning of complex expressions from the meanings of their parts. A *good* formal semantic theory does this in a way that captures the logical consequence relations that do in fact inhere among sentences of the natural language being studied. Results from the study of formal semantics can thus be applied in the development of natural language technologies such as question-answering, machine translation, and many other emerging and exciting language-based applications that are rapidly changing the world we live in. They also help us to understand human cognitive psychology. And by studying the semantics of a wide range of languages, we not only lay the groundwork for multi-lingual technologies, we also deepen our perspective on humanity, understanding better how our own language fits into a broader typology. By understanding the ways in which languages differ, we gain a more mature appreciation for the vast and beautiful diversity on earth, as well as what binds us together.

Brief historical background. The study of logic in the West goes back to Aristotle's syllogisms. It enjoyed a rich and intensive period of study during the Middle Ages, which died out at the hands of the Renaissance humanists in the 14th century. Interest in logic was revived in the 19th century by the likes of Gottlieb Frege and Bertrand Russell, who wanted to set mathematics on a firm logical footing. To do so, Frege and Russell developed artificial languages, which, unlike natural languages, are completely unambiguous. In the preface to his *Begriffsschrift*, Frege wrote:

> If the task of philosophy is to break the domination of words over the human mind [...], then my concept notation, being developed for these purposes, can

> be a useful instrument for philosophers [...] I believe the cause of logic has been advanced already by the invention of this concept notation.

As Frege's primary interest was mathematical, his artificial notation was not specifically intended as a way to explicate the meanings of sentences in natural language. Indeed, up until the 1960's there was a broad consensus among philosophers of language from otherwise diverse camps that there was an intractable divide between formal logic and natural language. Noam Chomsky, despite his application of formal language theory to natural language syntax, was also deeply skeptical of the relevance of formal logic to linguistic theory.

But in the 1970's Richard Montague (among others) dared to bridge this divide, beginning one of his most famous articles with the bold claim: "I reject the contention that an important theoretical difference exists between formal and natural language." Montague defined a 'fragment' of English just as formally and precisely as a formal logic, laying the groundwork for a new approach. But the potential of this approach might never have been explored nearly as fully as it has been if it hadn't been for Barbara Partee, a linguist who took an interest in his approach, advocated for it, and extended its frontier. Thanks to her efforts, and those of her students, formal semantics has become a core area of generative linguistics.

Course description. This course explores the logic of ordinary language, asking: To what extent are natural languages like the formal languages of mathematical logic? What sorts of formal languages most accurately capture the properties of natural languages? By what principles do speakers of a language manage to understand sentences they have never heard before? Students taking this course will gain a toolkit for capturing some of the fundamental logical behaviors of English, including compositionality (how the meaning of a complex expression is built up from the meanings of its parts), reference, quantification, variable binding, context-sensitivity, and the various kinds of objects that may be talked about, such as individuals, events, times, and degrees. We will also explore how languages may differ in their logical properties (or just appear to).

Prerequisite: CAS LX 331/ GRS LX 631 Semantics & Pragmatics: Introduction to Linguistic Meaning (or CAS LX 502) or consent of instructor.

Learning objectives. Students who complete this course will:

1. gain familiarity with a diverse range of semantic phenomena (see above) and their empirical characteristics;
2. engage in the incremental construction of a formally explicit theory of truth-conditional semantics that captures these facts;
3. develop the ability to identify and assess the predictions made by this theory regarding novel bodies of data;
4. develop the ability to evaluate and choose between competing analyses of a particular semantic phenomenon; and
5. have an opportunity to apply and possibly extend this theory towards the (further) description and analysis of a semantic phenomenon that particularly interests them.

Students enrolled at the graduate level will, futhermore, take steps toward an original research project in formal semantics.

Course materials

- [BootCamp] Coppock, Elizabeth and Lucas Champollion (ms.). *Semantics Boot Camp.* (Excerpts distributed electronically.)

  > This is a manuscript in progress. Feedback is most welcome. It covers the core of the material in the textbook entitled *Semantics in Generative Grammar* by Irene Heim and Angelika Kratzer, which has previously been used in this course. But it is directed to an undergraduate audience, and presents the Heim and Kratzer theory in a more traditional and formally precise framework, akin to the one laid out in the classic *Introduction to Montague Grammar* by David Dowty, Robert Wall, and Stanley Peters. It has also been designed to align with the Lambda Calculator (see next bullet).

- The Lambda Calculator: This is a software program designed for teaching and learning semantics designed by Lucas Champollion, Josh Tauberer and Maribel Romero. We will use for some exercises. Download it at:

  `http://lambdacalculator.com`

  (It's available for Mac, Windows, and Linux. If it is not compatible with your computer, please let me know!)

- [LPL] Barker-Plummer, Dave, Jon Barwise and John Etchemendy (2011). *Language Proof and Logic*, Second Edition. Stanford: CSLI Publications. (Available as a paperless package for $55 at `https://ggweb.gradegrinder.net/store`.)

  > This includes both a textbook and a really cool software package that lets students build and interact with models against which the truth of logical statements can be checked. The software runs on Mac OS X (versions 10.7 and later), Windows, RPM Linux (64-bit machines), and Debian Linux (64-bit machines). If you do not have access to a computer that you can download and use this software on, let me know!

Grading. Your grade will be determined on the basis of homework assignments (70%) plus a final project (20%) and class participation (10%).

Bonus questions. Many of the homework assignments contain bonus questions. These are *extra credit for students enrolled at the undergraduate level, and required for students enrolled at the graduate level.* Extra credit is an equal opportunity for everyone in the class to improve their grades, so it will not be issued to individual students upon request.

Reading. In the schedule below, the literature corresponding to the topic for the day is indicated. It is recommended that you read the relevant sections, or at least start reading them, before the associated day, so that you are ready to absorb the material presented in class and ask good questions.

Final project. For the final project, you will design a **problem set** about a phenomenon that particularly interests you *in a language other than English*, with a **model solution**.

- Your problem set should be solvable by someone who has taken this class, with the help of the explanations and background you provide, within a reasonably short timeframe. (Students enrolled at the graduate level should aim for a graduate-level audience; *mutatis mutandis* for the undergraduate level.)
- The analytical ideas should build on the tools developed in this course.
- For graduate students, the project should incorporate some original research component, either through original data collection or by improving on existing analyses of published data.
- The linguistic examples you use may come from data you (or someone you know) have collected or from existing literature. Students enrolled at the graduate level are encouraged to incorporate at least some original data collection. Students enrolled at the undergraduate level may either base their project entirely on published data or opt to collect new data. Students who are native speakers of languages other than English may feel free to use themselves as consultants. You might also consider looking into the Endangered Language Alliance (`http://elalliance.org`) for inspiration.
- You are warmly encouraged to come and meet with me to discuss project ideas at any time that suits you.
- A rough topic should be identified by **Monday, Nov. 20th** (e.g. 'pseudopartitives in Passamaquoddy').
- The linguistic examples you will use for the project (published or unpublished) should be identified by **Wednesday, November 29th**.
- A first draft of the problem set will be due on **Wednesday, Dec. 6th**. (You don't need to have completed a model solution by this point.)
- These drafts will be distributed among members of the class for (constructive) feedback. Peer feedback is due **Wednesday, Dec. 13th**. (The quality of the feedback you *give will* affect your project grade. The feedback that you *get* from your peer will *not* directly affect your grade; I will only take it under advisement, the way the editor of a scientific journal treats reviewers' comments. However, you will be asked to take this feedback into consideration in your final version.)
- The final version, complete with model solution, is due on **Wednesday, Dec. 20th**.

Collaboration. Linguistics is a collaborative discipline, and you are encouraged to form study groups to discuss the problem sets. However, each student must write up his/her solutions independently, without reference to the written work of any other student. Any external sources that you consult must be cited in your solution. Also, where possible, give due credit to your collaborators by listing their names at the top of your submission. All of the following constitute unacceptable forms of collaboration: (i) having one or more group members produce a "group draft", which other group members then customize; (ii) individual group members writing up their solutions separately while conferring in real time (whether in person or remotely); and (iii) using another student's completed solutions as a guide to producing your own.

Academic Conduct. Boston University's Academic Conduct Code is acccessible at `http://www.bu.edu/academics/policies/academic-conduct-code/`. The Academic Conduct Code for graduate students is accessible at `http://www.bu.edu/cas/students/graduate/grs-forms-policies-procedures/academic-discipline-procedures/`. Plagiarism in any form (including from online sources) and other academic misconduct is contrary to our goals and will not be tolerated. If you are unsure of any aspect of these policies, please ask!

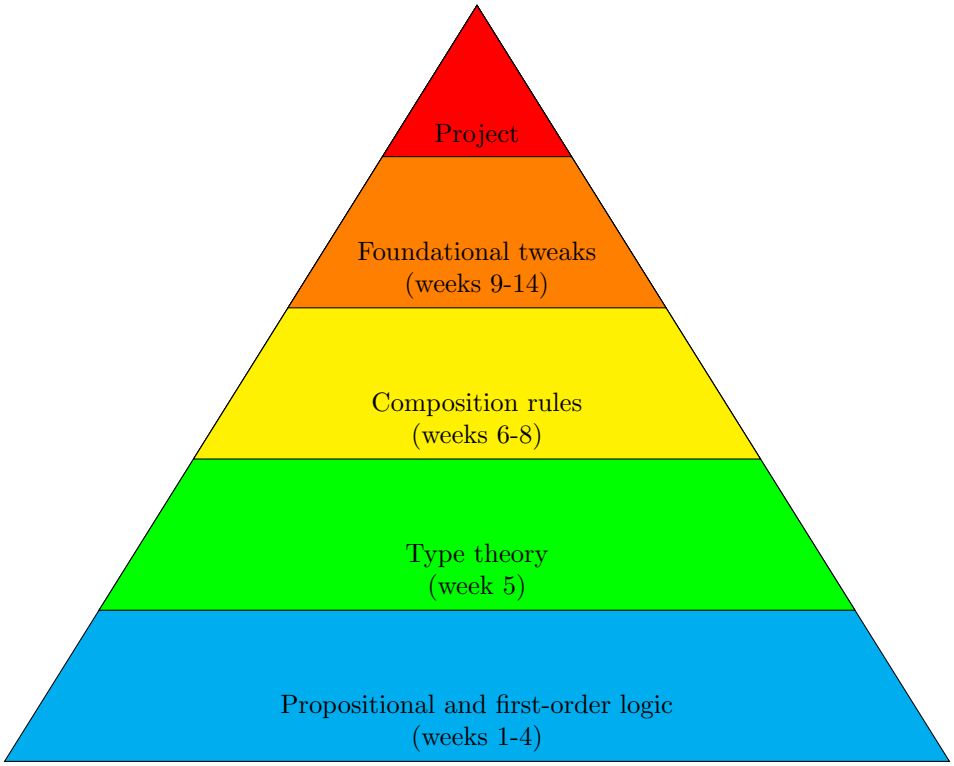
Late policy. Because the material in this class builds up cumulatively, it is important that you stay on track with the homework assignments. Dealing with late homework assignments is also very time-consuming for instructors. Therefore, late homeworks will not be accepted except under extenuating circumstances. (This does not include failure to plan ahead!) If anything stands in the way of your ability to finish your homework on time, please request an extension as soon as possible. Extensions will not be granted less than 24 hours before the deadline except in case of emergency. In general, homeworks are due by the start of class on Wednesdays. A smart strategy is to try to finish by the start of class of Monday so that if you have any questions you can ask them in class on Monday.

Classroom participation. Class time is an important component of your learning process. This is a chance to explore the material more deeply through interactive learning experiences, and learn from your peers; this can't be made up. Therefore, in order to honor this educational opportunity, please come to every class session on time and ready to learn actively. Attendance at each class meeting affects your classroom participation grade, as will the degree to which you are mentally present during class, take active responsibility for your own learning, and help others learn.

Gear. For every class meeting, please bring a notebook and a pen for taking notes. Given the huge potential for distraction, as well as educational research showing that taking notes by hand leads to better results than taking notes on a laptop, electronic devices must be put away, except when we are using laptops for a specific classroom activity.

Well-being. Learning and wellbeing are inextricably linked. In the event that you are experiencing struggles or mental health symptoms, and you need additional support, if you would like, you can speak with me and I will listen and most likely remind you of the many resources here at BU. Actually, as you may already know, BU has a wealth of student support systems in place, with licensed counselors available to speak with you (see `https://www.bu.edu/students/health/counseling/`). As a BU student, help is available to you at 24 hours a day, 7 days a week. Appointments for regular care are available from 8 a.m. to 8 p.m., Monday through Thursday, and 8 a.m. to 5 p.m. on Friday. Phone assistance is available at all times at 617-353-3569 (BUs Behavioral Medicine Services Line). Emergencies are attended to immediately. Crisis intervention counselors are available and coordinated with other counseling resources on campus, such as with BU Psychological Services. These confidential services are easily accessible to help you manage personal challenges that may threaten your well-being and your learning goals. Know that if you do come to me for support, I cannot keep confidential any concerns related to safety (of yourself or others). Overall, taking steps to focus on your well-being, and reaching out for help if needed, are important and courageous things to do – for yourself and for those who care about you.

Overview of the course.



- **Step 1: Propositional and first-order logic**. We will begin with first-order logic, which builds in turn on propositional logic. This is a language in which it is possible to define precise truth-conditions, and when one sentence logically implies another.
- **Step 2: Type theory**. In order to make the connection between natural language (English) and logic, we will need type theory (a.k.a. 'typed lambda calculus' or just 'lambda calculus'). This language is a generalization and extension of first-order logic that has what we need in order to assign meanings to expressions like quantifiers and passive verb phrases, and to glue the meanings of smaller expressions together.
- **Step 3: Composition rules**. At this stage, we will connect natural and formal language, by associating expressions of English with expressions of type theory, and defining rules to compose the meanings of expressions together. The main composition rules we will introduce are: Functional Application, Predicate Modification, and Predicate Abstraction. With these in hand, we can account for logical consequence relations among sentences of English.
- **Step 4: Foundational tweaks**. Natural languages have a number of interesting properties that go beyond what can be expressed in our simple type theory, including various forms of context-sensitivity. We will therefore introduce certain changes to our underlying logic in order to capture a wider range of phenomena.
- **Step 5: Project.** Now you are in a position to broaden the empirical range of the theory further, beyond English, where new foundational tweaks may be required.

Preliminary schedule (subject to change)

Week 1: Getting started				
W	Sept. 6	BootCamp Ch. 1	Preliminaries	HW1, HW2 out
F	Sept. 8	BootCamp 2.1-2.3	Set theory	
Week 2: Introduction to FOL				
M	Sept. 11	BootCamp 2.4	NPIs	
W	Sept. 13	LPL 1.1-3 (19-25)	FOL basics	HW1 due
F	Sept. 15	LPL 1.4-1.6 (26-37)	FOL functions	
Week 3: Validity and Boolean connectives				
M	Sept. 18	LPL 2.1 (41-44), LPL 3.1-3.3 (67-77)	Validity, $\neg, \wedge, \vee$	
W	Sept. 20	LPL 4.1 (93-103)	Tautologies	HW2 due; HW3 out
F	Sept. 22	LPL 7.1-7.2 (179-189)	Conditionals	
Week 4: Quantification in FOL				
M	Sept. 25	LPL 9.1-9.3 (229-236)	Variables, $\forall, \exists$	
W	Sept. 27	LPL 9.4-9.6 (237-252)	$\forall, \exists$ semantics	HW3 due; HW4 out
F	Sept. 29	LPL 11.1-11.2 (298-306)	Multiple quantifiers	
Week 5: Type theory				
M	Oct. 2	BootCamp 3.1-3.2	L_0	
W	Oct. 4	BootCamp 3.3	L_1	HW4 due; HW5 out
F	Oct. 6	BootCamp 3.4	Type theory (L_λ)	
Week 6: Functional Application				
~~M~~	~~Oct. 9~~	*Columbus Day*		
T	Oct. 10			
W	Oct. 11	BootCamp 4.1	Func. Appl.	HW5 due; HW6 out
F	Oct. 13	*No class*		
Week 7: Predicate Modification and Generalized Quantifiers				
M	Oct. 16		θ-roles	
W	Oct. 18	BootCamp 4.2	Pred. Mod.	HW6 due; HW7 out
F	Oct. 20	BootCamp 4.3	Quantifiers	
Week 8: Predicate Abstraction				
M	Oct. 23			
W	Oct. 25	BootCamp 5.1	Rel. clauses	HW7 due; HW8 out
F	Oct. 27	BootCamp 5.2	QR	
Week 9: Anaphora and indexicality				
M	Oct. 30			
W	Nov. 1	BootCamp 5.3	Pronouns	HW8 due; HW9 out
F	Nov. 3	TBA	Discourse refs.	

Week 10: Dynamic semantics and Presupposition				
M	Nov. 6	TBA	Indexicality	
W	Nov. 8	BootCamp 6	Presupposition	HW9 due; HW10 out
F	Nov. 10	TBA	Definiteness	
Week 11: Coordination and plurals				
M	Nov. 13		Exclusives	
W	Nov. 15	BootCamp 8	Plurals	HW10 due
F	Nov. 17		Project ideas	
Week 12: Thanksgiving				
M	Nov. 20			Project topic due
~~W~~	~~Nov. 22~~	*Thanksgiving*		
~~F~~	~~Nov. 24~~	*Thanksgiving*		
Week 13: Degree semantics				
M	Nov. 27		Gradability	
W	Nov. 29		Comparatives	Project data due
F	Dec. 1		Superlatives	
Week 14: Events, tense, and mood				
M	Dec. 4	BootCamp 9	Event semantics	
W	Dec. 6	BootCamp 10	Tense	Project 1st draft due
F	Dec. 8		Modality	
Week 15: The end				
M	Dec. 11		Last day!	

Timeline for the final project:

- Topic due Monday, Nov. 20th
- Data due Monday, Nov. 29th (published or collected)
- First draft due Wednesday, Dec. 6th for peer feedback
- Peer feedback due Wednesday, Dec. 13th
- Final project due Wednesday, Dec. 20th