Intermediate Logic (Phil 305)
Fall 2014
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Course Description

Our goal in this course will be to learn formal methods for theorizing about *logical consequence.* A sentence (a conclusion) is a logical consequence of a number of other sentences (premises) when the truth of the premises guarantees the truth of the conclusion *in virtue of the logical form* of the sentences. For example, consider the following premises:

(1) **If** I become a professional philosopher, I will be poor.
(2) **If** I do **not** become a professional philosopher, I will be poor.
(3) I will **either** become a professional philosopher **or** I won't.

And the conclusion:

(C) I will be poor.

If (1-3) are all true, then the C must also be true. Moreover, the fact that C is a logical consequence of (1-3) has nothing to do with the meaning of the non-bolded words in the above.[1] Compare:

(1) **If** Jack went to the store, he purchased mustard.
(2) Jack went to the store.
(C) Jack purchased a condiment.

Again, if (1-2) are true, C must also be true, but this involves facts about what "mustard" and "condiment" mean. We wish to abstract from these sorts of facts and talk only about the logical form of sentences. We can give the form of an argument by ignoring the particular meaning of the non-logical (here, non-bolded) expressions. We will thus study *logical form* by theorizing about a small class of *logical expressions* such as if, not, or, etc.

To do so, we will construct formal languages and collections of rules for constructing *proofs* using sentences of these languages. Formal languages allow us to precisely model the *logical form* of arguments and systems of proof for these language enable us to demonstrate that some sentence follows from some other sentences in virtue of logical form. Learning to "translate" natural language arguments into these formal languages and to do proofs thus gives us tools to recognize the underlying formal properties of natural language, honing our sense of what follows from what and giving us an answer, sometimes, to why something follows from something else.

We will construct two different formal languages. The first—sentential logic—is a simple formal language adequate to formalize arguments like the example above. It is, however, incapable of representing boring arguments like:

1 Well, almost nothing. The non-bolded words have to be *grammatically appropriate*.

(1) Everyone who has a sister has a sibling.
(C) Everyone without a sibling does not have a sister.[2]

as well as exciting arguments like:

(1) Every marmot is an animal.
(C) Every head of a marmot is the head of an animal.

To represent these sorts of arguments, we will need a more powerful formal language. This language—predicate logic—is adequate to represent a *very* wide class of arguments in natural language. Learning to do proofs in predicate logic will give us a very powerful tool for showing something argued for to be a *logical consequence* of what it is argued from. We will also learn how to demonstrate, in many cases, that a conclusion is not a logical consequence of some premises by generating counterexamples.

As we familiarize ourselves with these formal languages we will see (though usually not prove) how they relate to the sort of arguments we give in natural language and to the relationship of *logical consequence* we want to represent. Serious results in this vein such as *soundness, completeness,* and *compactness* will be discussed and the proof sketched. If there is time, we will look briefly at other approaches to the notion of logical consequence---both supraclassical systems like *modal logic* and *tense logic* and contraclassical approaches like *intuitionistic logic* and *relevance logic*.

Homework

Learning to "speak" a formal language is not entirely dissimilar from learning to speak a new natural language. It is essential to practice formalizing natural language sentences and to construct proof after proof after proof. The more exercises you do, the better off you will be. I will thus assign a lot of practice problems each week. I will not grade every problem (though you will not know in advance which problems I will grade.) You are expected to write up your own solutions, but I have no objection to you discussing *how* to solve a problem with classmates ***before*** writing up your homework.

The assessment for this course will consist of 9 homework exercises and 3 take-home exams. Expect to have either homework or a take-home exam due at the beginning of the first class each week. Late homework will not be accepted except under extreme and verifiable circumstances. Instead, I will drop the lowest two scores on the homework exercises, averaging the rest. The 3 take-home exams will be difficult and time-consuming. I ***do not recommend*** waiting until the last minute to start working on them. Rather, after the take-home exams are distributed, read through them carefully and allow yourself time to work through possible solutions to the problems before attempting to solve them in a final form. Your grade for the course will be broken down as follows: Homework problems (30%), Take-home exams (60%), and Class participation (10%). I will occasionally distribute extra-credit problems during class. Those not attending will miss such opportunities in addition to their class participation grade suffering.

Text

All material you will be expected to know will be covered in class, but there is a textbook that will be helpful for reminding yourself of various details. For this purpose, we will use Paul Teller's *A Modern Formal Logic Primer* which is available for free online at http://tellerprimer.ucdavis.edu/. You will find

2 For a fun initial exercise, try to figure out which word(s) in this argument should be bolded.

this book somewhat austere so I will supplement it with occasional handouts throughout the course. If you miss a class, be sure to email me to get the handout(s) and assignments that you may have missed.

Rough Schedule (subject to revision)

August 30th	Introduction
Week 1:	Sentential connectives
Week 2:	Sentential connectives; truth-tables;
Week 3:	Translations; finding counterexamples;
Week 4:	Sentential proofs; first take-home exam distributed
Week 5:	Proofs, proofs, and more proofs; first exam due
Week 6:	Inadequacy of sentential logic; quantifiers
Week 7:	Proofs in predicate logic
Week 8:	More on proofs in predicate logic; relations
Week 9:	Nested quantifiers; interesting proofs; second take-home exam distributed
Week 10:	Identity; second take-home exam due.
Week 11:	Interesting translations
Week 12:	Semantics for Predicate Logic
Week 13:	Metalogic; final take-home distributed
Week 14:	TBD
Finals Week:	Final take-home due