Intermediate Logic

East College 300, TR 9-10:15
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Office Hours: TR 10:30-11:30, or by appointment

Course Description

The big goal of this intermediate course in logic is to develop a technically and philosophically deep understanding of logical *systems*, especially "classical" logic. In the first part of the course, we will study the meta-theory of propositional logic and first-order (or quantificational) logic. You will learn how to prove that a logical system is correct and complete. In the second part of the course, we will consider philosophical questions about logic, especially concerning logical consequence and logical constants. You will learn compelling arguments for thinking that the "classical" conception of logical consequence is mistaken, as well as plausible responses to those arguments.

Goals

-prove Cantor's theorem
-learn to do proofs by mathematical induction
-learn to do proofs with tableaux
-prove the correctness and completeness of PL and FOL
-explain criticisms of "classical" logic, and some important responses thereto

Texts

Raymond Smullyan, *A Beginner's Guide to Mathematical Logic*, 0486492370
Essays and excerpts on Moodle

Evaluation

Homework 45%

In each chapter of Smullyan's *Guide*, there are Problems and Exercises. To do well in this course, you must work through these very carefully. Each meeting I will collect your solutions to a specific subset of Problems and Exercises from the relevant chapter, specified in the Schedule below. You may type these or write them by hand. If you write them by hand, please make them perfectly legible, and please do not give me your only copy; give me a photocopy or scan instead.

Given that Smullyan provides solutions to all Problems (but not *Exercises*), your challenge is *not* to write down *a* solution to any given problem. Rather, your challenge is to produce a solution *on your own*. Thus, while you are permitted to consult Smullyan's solutions, you should do so only after you have a made a diligent attempt to arrive at a solution on your own. That is the solution I want to see. Upon checking your solution against Smullyan's, if yours appears mistaken to you, then you may write a new one in light of Smullyan's solution. However, I repeat: I want to see the solution that you initially arrived at on your own. You will receive no credit for merely duplicating Smullyan's own solution.

Tests 45%

Test #1 (10%): on sets, Cantor's Theorem, mathematical induction, Konig's Lemma

Test #2 (10%): on Propositional Logic, proofs by the tableaux method, proofs of correctness and completeness

Test #3 (10%): on First-Order Logic, proofs by the tableaux method, proofs of correctness and completeness

Test #4 (15%): on philosophy of logic, short essay questions concerning logical consequence, logical constants, and relevance logic

Participation 10%

Talking with others about the subject matter of this course will help you understand it. Thus, I expect you to intermittently ask and respond to questions, attempt to solve problems, or even pose challenges to claims made by our authors. For each act of participation, you will receive 1 "point." You can receive a maximum of one point per meeting. You need 10 points to earn an 'A' for participation.

Schedule

Meeting #	Date	Topic	Reading (*for class on this day*)	Required Problems & Exercises
Sets, Induction, Trees				
1	1/26 T	Introduction to the course	None	
2	1/28 R	Basic set theory	Smullyan, Ch.1	P2-P6; E2.1-4
3	2/2 T	Infinite sets Cantor's Theorem	Smullyan, Ch.2	P2, P5, P7
4	2/4 R	Mathematical induction	Smullyan, Ch.4 (Skim Smullyan, Ch.3)	P1 (explain your reasoning), P2; E1-E2
5	2/9 T	Konig's Lemma	Smullyan, Ch.4	P11a-b
6	2/11 R	Test #1	Smullyan, Chs.1-2,4.	
Propositional Logic				
7	2/16 T	Symbols and formulas of Propositional Logic Truth tables	Smullyan, Ch.5	P1,P3,P4,P11*, P16
8	2/18 R	Propositional tableaux, a proof method	Smullyan, Ch.6 (pp.81-90)	E1a-c,h,i E2d-e
9	2/23 T	Correctness of Propositional Logic	Smullyan, Ch.6 (pp.90-1, esp. Prob. 2)	P2**
10	2/25 R	Completeness of Propositional Logic	Smullyan, Ch.6	P3**
11	3/1 T	Axiomatic propositional logic	Smullyan, Chs.6-7	P0, P1 (only T_1-T_6), P4
12	3/3 R	Correctness of the axiom system $\mathcal{S}_0$	Smullyan, Ch.7	P5*
13	3/8 T	Review	Smullyan, Chs.5-7	
14	3/10 R	Test #2	Smullyan, Chs. 5-7	
First-Order Logic				
	3/15 T	**Spring Break**	**Spring Break**	

	3/17 R	**Spring Break**	**Spring Break**	
15	3/22 T	Symbols and formulas of First-Order Logic Interpretations	Smullyan, Ch.8	P1-2,P9a-c,P10a-b,P14
16	3/24 R	Correctness of the axiom system $\mathcal{S}_1$	Smullyan, Ch.8	P17**
17	3/29 T	Tableaux for First-Order Logic	Smullyan, Ch.9	E1a-c,e; E2a-c,i*
18	3/31 R	Correctness of First-Order Logic	Smullyan, Ch.9	P2**
19	4/5 T	Completeness of First-Order Logic	Smullyan, Ch.9	P3**
20	4/7 R	Review	Smullyan, Chs.8-9	
21	4/12 T	Test #3	On Smullyan, Chs. 8-9	
Philosophy of Logic				
22	4/14 R	What is logical consequence?	Lewis Carroll, "What the Tortoise Said to Achilles"	
23	4/19 T	Tarski's definition of logical consequence	Alfred Tarski, "On the Concept of Logical Consequence"	
24	4/21 R	Can logical constants (e.g., connectives) be properly defined solely in terms of introduction and elimination rules? What constraints are there on defining a proper logical constant?	A. N. Prior, "The Runabout Inference-Ticket" N. D. Belnap, "Tonk, Plonk and Plink"	
25	4/26 T	Can logical constants (e.g., connectives) be properly defined solely in terms of introduction and elimination rules? What constraints are there on defining a proper logical constant?	Dag Prawitz, "Logical Consequence From a Constructivist Point of View" (through p.678)	
26	4/28 R	A proof-theoretic definition of logical constants and logical consequence	Dag Prawitz, "Logical Consequence From	

			a Constructivist Point of View"	
27	5/3 T	Is the "classical" conception of logical consequence mistaken? How should we take account of *relevance* in defining logical consequence?	Anderson and Belnap, *Entailment*, vol. 1, §§1-4 Robert K. Meyer, "Entailment"	
28	5/5 R	The system EFDE Forced to deny disjunction introduction, or disjunctive syllogism, is relevance logic hopeless?	Anderson and Belnap, *Entailment*, vol. 1, §§15, 16.1. John P. Burgess, "No Requirement of Relevance"	
N	5/9 M	Test #4 **Monday, May 9, 2pm (our final exam slot)**	On philosophy of logic	

Academic Honesty

Any case of suspected academic dishonesty must be reported. Note: "To plagiarize is to use without proper citation or acknowledgment the words, ideas, or work of another. Plagiarism is a form of cheating that refers to several types of unacknowledged borrowing." When in doubt, cite it. For more information, please see the handbook on Community Standards here:
http://www.dickinson.edu/student/files/commstand0809.pdf

Disabilities

I will make reasonable academic accommodations for students with documented disabilities. If you think you are eligible for such accommodation, please first register with Disability Services in Biddle House, specifically Stephanie Anderberg (717-245-1734; disabilityservices@dickinson.edu). If you are eligible, Marni Jones, Director of Learning Skills and Disability Services, will provide you with a letter attesting to that. Once you have that letter, we can meet to discuss what we need to do. All of that must happen in the first three weeks of the semester.