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PHL 233.01: Introduction to Logic - Deduction

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Philosophy 233 Introduction to Logic: Deduction
MWF 9

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Textbook: *Language, Proof, and Logic*, 2nd Edition by Barwise and Etchemendy

DO NOT BUY A USED BOOK!!!! (For reasons specified below)

Introduction:

This course is an introduction to a formal language called First Order Logic (FOL). For people new to logic, this course is more akin to a mathematics course or computer science course than most philosophy courses. We will be doing a good deal of symbolic manipulation and proofs. That said, we will also be studying how FOL, as an abstract formal language is related to the natural language English. Juxtaposing the two highlights the interesting differences between the two, especially the context sensitivity and ambiguity of English in comparison to FOL. What you take away from this course will partly be a matter of your own interests. For mathematicians and computer scientists one will get a solid introduction to FOL that one can use as a basis for leaning the metatheory of FOL. For those with a more traditional philosophical bent, you will learn to tell good argumentation from bad, and sharpen your ability to analyze argumentation, and be able to better formulate arguments yourself.

Learning Goals:

1. Students will know the truth conditions associated with the Boolean connectives as well as universally and existentially quantified statements.

2. Students will be able to complete proofs in propositional logic and first order logic. In particular, they will be able to use the introduction and elimination rules, for conjunction, disjunction, negation, identity, conditionals, biconditionals, as well as universal and existential quantifiers. Additionally, they will be able to complete proofs that require nested subproofs.

3. Students will be able to translate between statements in propositional and first order logic and English. They will be able to translate English sentences that involve multiple mixed quantifiers.

About the book:

This course is taught from a book that is closely tied to a software package. One of the best features of this package is the ability for you to get feedback on homework using a system called Grade Grinder. For many of the homeworks assigned, one may get their assignments graded online before they submit them to me. The homeworks are assessed electronically, and you can get feedback on where you went wrong, if anywhere. This allows you to learn a lot by yourself, and gives you a lot of control over your homework grades.

Here's the big reason why you need a new book: Each book has a registration ID which allows you to access Grade Grinder over the web, using software provided by the book. Without the ID, you will not be able to submit homework over the web, and that is how the majority of homework is graded. PLEASE WRITE DOWN THE REGISTRATION ID IN MULTIPLE PLACES. NOTHING CAN BE DONE IF YOU LOOSE IT.

About homework:

You will have weekly homework that must be submitted before midnight on Sunday if it is to be submitted electronically. If you are to turn in something on paper, you must do so on Monday at the beginning of class. You are encouraged to collaborate with other people on homework, but ***YOU MAY NOT WRITE THE ASSIGNMENT UP TOGETHER***. That means that you may not copy off of a single source for your assignments, nor may you copy and paste from one computer to another. The Grade Grinder can detect such attempts to cheat, and will report that to me. Any such collaboration will result in receiving no credit for the homework in question for the person copying and the person copied. No exceptions will be made.

When you submit an assignment make sure to choose **"To Instructor"**. Also, make sure to **use the instructor email address**: armond.duwell@mso.umt.edu . If I don't receive a copy of the homework before class on Mondays, I will consider it late, and it will not be accepted.

I will be posting the assignments on Moodle as well as any changes in schedule.

Grading and Exams:

Your final grade will consist of 20% HW, 20% (almost weekly) Quizes, 30% Midterms, 30% Final Exam. Homework will be due on Monday before class. No late assignments will be accepted. The midterms are scheduled 3/10 and 4/14 and the Final 10:10-12:10 Thursday May 15th. The midterm dates are tentative, and will be subject to change. The final will be cumulative, with a weight on material from the second half of the course. Make up exams will be given only in the case of extreme circumstances, i.e. severe illness, family death, etc. ***Proof of extreme circumstances is required in order for me to schedule a make up exam.*** For those of you that work, please make arrangements now so there will be no conflict of interest on exam dates.

If you want to do well in this class, you will do your homework every week, turn it in one time, figure out why you didn't manage to get full credit, ***and redo the problems that you missed after we discuss them in class***. If you don't constantly go back and correct deficiencies in understanding, you will get behind and have severe difficulties catching up. I will allow you to redo your homework and turn it in one week after it was due. I will give you half the points back, ***but only if you turn in a perfect assignment.*** I will *not* give you any points back for a less than *perfect* redo assignment.

Classroom courtesy:

Please turn off cell phones when you come into class. If you have to leave early, please indicate that to me before class begins, and let me know why you must leave early.

Special Needs:

Students with disabilities will receive reasonable modifications in this course related to those disabilities. Your responsibilities are to request them from me with sufficient advance notice, and to be prepared to provide verification of disability and its impact from Disability Services. Please speak with me after class or during my office hours to discuss the details. For more information, visit the Disability Services for Students website at www.umt.edu/dss/

Tentative Schedule: The schedule is subject to change. Please consult Moodle for any modifications.

Week 1:
Introduction, Chapter 1, perhaps start Chapter 2

Learning goals*: Understanding formal first-order languages. Syntax of FOL: Predicate symbols, individual constants, function symbols. Examples of first-order languages: the blocks language.

Week 2:
Chapter 2

Learning goals: Understanding logical validity of arguments. How to show arguments are valid: Basic properties of the identity predicate: reflexivity, principle of the substitutability of identicals. Basic properties of other predicate symbols (transitivity, reflexivity, symmetry, inverse relations). Informal proofs. Fitch and formal proofs. How to show that arguments are not valid: the method of counterexamples.

Week 3:
Chapter 3

Learning goals: Translating sentences from English into FOL using the Boolean connectives. Expressive power of the Boolean connectives: "neither . . . nor —" and "not both . . . and —"; how to express complicated things using the blocks language and the Boolean connectives.

Week 4:
Chapter 4

Learning goals: Understanding logical truth, tautologies, and TW-necessities. Tautological equivalence, consequence, and validity. The method of truth tables, tautological equivalences: De Morgan's Laws and other equivalent trans-formations. Proving tautological equivalence by a chain of equivalences. Negation, conjunctive and disjunctive normal forms.

Week 5:

Chapter 5, start Chapter 6

Learning goals: Proving arguments valid by informal and formal proofs. Basic properties of $\wedge$ and $\vee$. Formal rules for $\wedge$ and $\vee$.

Week 6:

Learning goals: Basic properties of $\neg$. Indirect proof and formal proofs with $\neg$. Arguments with inconsistent premises. Informal proofs about FOL. Formal proofs of tautologies. Strategies for formal proofs.

Week 7

Tentative Midterm on Monday.

Chapter 7, start Chapter 8

Learning goals: Truth tables for $\rightarrow$ and $\leftrightarrow$. Translations from English to FOL using the conditionals. Conversational implicature. Rules for formal proofs involving $\rightarrow$ and $\leftrightarrow$.

Week 8:
Chapter 8, perhaps start 9

Week 9:
Chapter 9

Learning goals: Understanding syntax and semantics of quantifiers: well-formed formulas, free and bound variables, satisfaction. The Aristotelian forms. Simple translations.

Week 10: Spring Break

Week 11:

Chapter 10

Learning goals: The truth-functional form algorithm: when are sentences of FOL tautologies? The replacement method. First-order interpretations. First-order validity and consequence. Constructing first-order interpretations. Using Venn diagrams to specify interpretations. Relations between logical notions.

Week 12:

Tentative Midterm on Monday.
Chapter 11

Learning goals: Meaning and use of multiple occurrences of the same quantifier. Translation mistakes: different variables does not mean different objects. Meaning and use of mixed quantifiers. The step-by-step method of translation. Understanding why the order of quantifiers matter, ambiguity. Expressing complicated properties using quantifiers.

Week 13:
Chapter 13

Learning goals: Understanding and applying the introduction and elimination rules for ∃, ∀ . Strategies for proofs with quantifiers. Proofs with multiple and mixed quantifiers. Proofs with identity.

Week 14:
Chapter 14
Learning goals: Understanding numerical quantification: how to express 'there are exactly/at most/at least n things of a certain kind.' Russell's and Strawson's analyses of definite descriptions. How to express 'both' and 'neither' in FOL.

Week 15:

Catch up, review

Week 16
Final 10:10-12:10 Thursday May 15th

* Statements of Learning Goals are taken from Richard Zach's website (U Calgary).