Math 414

Basic information

Time and Location: MWF 11:00-11:50 pm in 141 Altgeld Hall
Instructor: Philipp Hieronymi
Office: 332 Illini Hall
Mail: phierony@illinois.edu
Office hour: TBA
Final exam: TBA

A Illinois Compass site for this course will be available soon.

Course information

Syllabus. This course is based on the second edition of the textbook Mathematical Logic by Ebbinghaus, Flum and Thomas. Most of Part A of the textbook will be discussed. The main goal is to give a full proof of Goedel’s famous Completeness Theorem. Basically, the Completeness theorem says: ‘If every example that satisfies A also satisfies B, then there is a proof that A implies B.’ To give a proof of such a statement, we have to make precise what a mathematical statement is (Chapter II in the textbook), what a mathematical structure is (Chapter III) and what a mathematical proof is (Chapter IV). If time permits, we will also look at Goedel’s (even more famous) Incompleteness Theorem.

A nice non-technical book to read before, during or after this course is Hofstadter’s Goedel, Escher, Bach. It is a fantastic (Pulitzer Prize winning) book describing (among many other things) Goedel’s achievements in Logic. It can even be read without any background knowledge in mathematics.

Prerequisites. Goedel’s Completeness Theorem is one of the major mathematical results of the last century. Its proof is sophisticated and far from trivial. And so is this course! This is not an easy course. This is not just a course discussing the philosophy of mathematics. This is a proper course in high-end mathematics designed for mathematicians and mathematically oriented computer scientists and philosophers. A prerequisite is MATH 347 or MATH 348 or equivalent experience. You don’t need to know that much, but you have to be comfortable with writing and understanding mathematical proofs.

Communications. If you have a question you can contact me either before or after class or during my office hours. If it is urgent, please send me a mail to phierony@illinois.edu. If you think the answer to the question might be interesting to all students in the class, you can either ask it during class or post it on the discussion board on the Compass site. In any case: If I think that your question is of interest to everyone (and I am certain I don’t harm your privacy), I will also post the answer on Compass.
Homework

There will be 8-10 weekly graded homework assignments. They will be assigned on Friday and collected at the beginning of the class each Friday. Each assignment will be announced in class and on the Illinois Compass site of this course. Late homework will not be accepted. If you are prevented from attending the Friday lecture, you can submit your homework by putting it in my mailbox in 250 Altgeld Hall PRIOR to class meeting time.

Writing homework solutions. Solutions must be written clearly and legibly: If we cannot read, we cannot grade it. Since this is a course on mathematically writing, we will also care about the presentation of your work. To get full points, it is not enough that you have the main argument right, you also need to write the proof in a way that is readable and logically correct.

Group work policy. Group work on the problems is fine, and, indeed, encouraged! But you must write up solutions yourself, using your own words. Group work should not be a one-sided affair, and, it also should not be a division of labor, with each group member doing only a subset of the problems and passing out solutions to the rest of the group. Everybody should contribute, and the goal should be for everyone in the group to end up understanding all of the problems.

Exams

There will be two in-class midterm exams, spread out evenly over the semester. There will be a three hour final exam. There will be no make-up exams. Instead, if you miss an exam and have a valid excuse, I will mark the exam as ‘excused’. An ‘excused’ exam means that this exam will not be taken into account in the computation of your grade. Valid excuse must be documented by an ‘absence letter’ issued by the Emergency Dean.

Grading

The course grade will be the average of your homework, midterm exams, and final exam grades, weighted as follows:

- 20% Homework (the lowest homework score will be dropped)
- 20% each Midterm exam
- 40% final exam

Letter grades will be assigned according to: A-/A/A+ 90%, B-/B/B+ 80%, C-/C/C+ 70%, D/D+ 55%, F for less than 55%. This may be adjusted downwards if necessary.

You should feel free to ask me at any time for information about your performance.

How to succeed in this course

Attend the lectures. Reading the text is no substitute for attending the lectures; while I plan to follow the general outline of the text, I will put my own spin on the material, usually using different examples, and emphasizing topics that I feel are particularly important. I will also try to make the class as interactive as possible. I will ask you question during class and I
will try to make you think during the lecture. Math is not a spectator sport, it is best learnt when done.

**Read the book.** For each lecture, I will indicate and post on the Compass site the section in the textbook that we covered in class. But as said before, I promise that going to class will help you to understand the material much better than just through reading the book.

**Take the homework seriously.** The homework is an absolutely essential part of this course. You cannot succeed in this class without taking the homework very seriously. Math - and even more so mathematical reasoning - is learnt by doing, **not** just by reading or listening! Or use to the words of Paul Halmos: ‘Don’t just read it; fight it! Ask your own questions, look for your own examples, discover your own proofs. Is the hypothesis necessary? Is the converse true? What happens in the classical special case? What about the degenerate cases? Where does the proof use the hypothesis?’

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*Don’t just read it; fight it!*  
*— Paul R. Halmos*