Math 444/445 **Geometry for Teachers** **Summer 2009**

SYLLABUS

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Classes: Math 444 (Jun 22–Jul 22): Monday/Wednesday/Friday 10:50-1:00, Condon 135.
Math 445 (Jul 24–Aug 21): Monday/Wednesday/Friday 10:50-1:00, Guggenheim 218.

Web site: *www.math.washington.edu/~lee/Courses/444-5-2009*
From the Math Dept. home page, **Class Web Pages → Math 444/445**

Textbooks: The main text will be the following course notes. Students need to pay for the notes in advance in the Math Department Office (PDL C-138), and the notes will be handed out each week as they are written. The price hasn't been settled yet, but it will probably be approximately $15.

- John M. Lee, *Axiomatic Geometry*, course notes for Math 444/445.

In addition, you'll need to get a copy of the following high-school math textbook, which we will use briefly in Math 444:

- Harold Jacobs, *Geometry: Seeing, Doing, Understanding*, 3rd edition, Bedford, Freeman, and Worth, 2003.

You'll also need to have access to the text of Book I of *Euclid's Elements*, translated by T. L. Heath. Here are some alternatives:

- The complete text of *Euclid's Elements* is available online, with interactive Java applets illustrating the propositions: *http://aleph0.clarku.edu/~djoyce/java/elements/toc.html*.
- All 13 books of *Euclid's Elements*, edited by Dana Densmore (Green Lion Press, 2002). This is an excellent edition, and I recommend purchasing it.
- Books 1 and 2 of *Euclid's Elements* are available in an inexpensive Dover edition. This edition is less convenient than the Green Lion one, because it's cluttered with a lot of commentary by Heath, which is not as relevant for our purposes.

Finally, you should have a reference book that explains set theory, functions, mathematical logic, and methods of mathematical proof. If you don't already own one, I recommend the following book, which is sometimes used as a textbook for Math 300:

- Peter J. Eccles, *Introduction to Mathematical Reasoning*, Cambridge, 1998.

The books by Jacobs, Euclid (Densmore ed.), and Eccles are available for purchase (new and used) in the U Bookstore, and are on reserve in the Math Research Library (PDL C-306).

Prerequisites: Grades of 2.0 or better in Math 126, 308, and 300 (formerly 310).

Exams: Math 444 Final: Wednesday, July 22.
Math 445 Final: Friday, August 21.

GENERAL DESCRIPTION

This course is designed for people who expect to be teaching geometry at the high school or middle school level, but it can be useful for many others as well.

Mathematics is the single field of human endeavor in which we are the most certain of the correctness of our knowledge. How can we be so certain? It is because mathematicians have developed a rigorous system for *proving* mathematical assertions, starting from simple assumptions and progressing by simple logical steps whose legitimacy virtually everyone can agree on. This system, together with the many mathematical insights that have been gained from it, is among the crowning intellectual achievements of humanity.

Geometry is the first branch of mathematics that humans managed to systematize and place on a rigorous footing, and it has served as a model for rigorous logical thought for more than two millennia, as well as being one of the most practically useful branches of mathematics.

The main goal of this course is to help you acquire a deep understanding of and appreciation for geometry, and learn to think about it rigorously. This is a *math course*, not a course in pedagogy—thus I won't be teaching you "how to teach geometry"; that's something you'll have to learn from education courses and hands-on practice. But in order to be a successful teacher, you need to have what the experts call "profound understanding of elementary mathematics." In this course, most of the mathematical topics we discuss will be rather elementary, but our approach will be far from elementary.

A secondary goal of this course is to help you become adept at mathematical communication. Opportunities to improve your communication skills on several levels will arise throughout the course (see below for details): speaking precisely about mathematical ideas in class; writing informally about mathematical ideas on the Geometry Blog; writing careful mathematical arguments for homework assignments; and writing polished expositions of mathematical ideas for your final portfolios.

Here are the main topics for 444/445:

- critical reading of Euclid;
- critical reading of a high-school geometry text;
- introduction to and comparison of different axiom systems for geometry;
- in-depth study of the most important results of Euclidean geometry and their proofs;
- comparison of intuitive, graphical, verbal, and axiomatic ways of understanding geometry;
- an introduction to the history and main results of non-Euclidean geometries.

REQUIREMENTS

Please note that this intensive summer course consists of two 3-credit courses (usually 20 weeks of classes) compressed into about 8 weeks of classes. You should be prepared to do an average of 12–15 hours of work every week *in addition to class time.*

Here are the specific requirements:

Classes: Although I won't keep a formal attendance record, *class attendance is required.* Many things will be discussed in class in more depth than they are covered in the reading. Sometimes there will be unannounced quizzes. If you will miss a class for a religious holiday, let me know in advance and I'll help you get the information you missed. If you must miss a class for some other unavoidable reason, it's your responsibility to find out what happened, and get your homework to me by class time (or, in case of emergency, as soon as possible thereafter).

Geometry Blog: I've set up a Math 444/445 Geometry Blog, accessible from the class website. I will try to post a blog entry as soon as possible after every class—usually, my entries will be ready by about 4:00PM, sometimes sooner. Each of my blog entries will include a brief summary of what happened that day (no substitute for attending class!), the latest reading and written assignments, and some questions for you to address in your own blog entries. Part of the requirement for this course is to post a blog entry of your own, in response to mine, before the next class. Your posts won't be graded for quality, but for full credit you must respond to at least two posts a week, and your entries must address the questions I pose in my own posts. In addition, I encourage you to bring up any questions that have been raised in your mind by the latest reading, lecture, and/or homework, and to respond (respectfully!) to questions or comments made by other students. Please don't just repeat what others have written; instead, try to contribute something new to the conversation. If you wish to write about specific homework problems, please confine your comments to general questions and suggestions about how to get started.

Reading: Most of my blog posts will include reading assignments. I expect you to read through each assignment quickly before the next class, and then to reread it carefully after it is covered in class. All reading assignments are required.

Written Homework Assignments: Most of my blog posts will also include written homework assignments, usually due at the next class meeting. Homework will not be accepted after the due date except in extraordinary circumstances and (except for emergencies) with advance permission. I strongly encourage you to work on the homework problems together with other students. However, when you write up your solutions to hand in, *you must write your own solutions in your own words.* More details about how to write up homework assignments will be given in an upcoming handout.

Quizzes and Exams: At sporadic intervals throughout the summer, I will give short quizzes in class. These will often be simply homework problems that you've already done, which I will ask you to answer in a timed setting without looking at your notes. Other times, they will be short questions that test how well you've absorbed the concepts that have been discussed recently. Not all quizzes will be announced in advance. Quizzes cannot be made up, but your lowest quiz score will be dropped, and any quiz missed for religious or medical reasons (with a doctor's note) will not count against you.

On the last day of each course (444 and 445), there will be a two-hour final exam.

Writing Portfolios: In Math 445, some written assignments will be designated as "Portfolio Assignments." You'll revise and rewrite your portfolio assignments, often with feedback from other members of the class, the TA, and/or me. After a couple of rounds of revision, you'll come up with a final version to keep in your portfolio. At the end of the quarter, you'll turn in a completed writing portfolio for a grade. If you pass Math 445 *and* receive an overall score of 70% or better on the writing aspects of the course (portfolio and blog), you will get "W-course" credit for Math 445.

GRADES: Your grade for each quarter will be based on a weighted average of the following scores:

Math 444		**Math 445**	
35%	Homework assignments	30%	Homework assignments
20%	Quizzes	15%	Quizzes
5%	Blog posts	5%	Blog posts
40%	Final exam	35%	Final exam
		15%	Writing portfolio

Individual homework and quiz scores will be recorded as percentages, and the lowest homework score and lowest quiz score will be dropped before averaging the rest.