Math 444/445 **Geometry for Teachers** **Summer 2018**

COURSE DESCRIPTION

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Classes: Math 444 (June 18-July 18): Mon/Wed/Fri 10:50-1:00, Thomson 125
Math 445 (July 20-August 17): Mon/Wed/Fri 10:50-1:00, Thomson 215.

Web site: www.math.washington.edu/~lee/Courses/444-5-2018/

Required Textbooks:

- *Axiomatic Geometry* by John M. Lee
  (If you buy the book, I'll reimburse you for my $12 share of the profits)
- 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: *aleph0.clarku.edu/~djoyce/java/elements/*.
  - –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 if you plan to be teaching geometry.
  - –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.

Prerequisites: For 444: Grades of 2.0 or better in Math 300 and 308.
For 445: Grade of 2.0 or better in Math 444.

Exams: Math 444 Final: Wednesday, July 18.
Math 445 Final: Friday, August 17.

GENERAL DESCRIPTION

This course is designed primarily 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 people 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. In many high school curricula, geometry is the only course in which students have a significant opportunity to learn the rules and techniques of logical reasoning and proofs.

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 fundamental 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 and in discussion sessions; writing informally about mathematical ideas on the class discussion board; and writing careful mathematical arguments for homework assignments.

Here are the main topics for 444/445:

- critical reading of Euclid;
- introduction to and comparison of different axiom systems for geometry;
- in-depth study of the most important results of Euclidean geometry and their proofs;
- introduction to the history and main results of non-Euclidean geometry.

Math 444 will probably cover approximately Chapters 1–9 of the textbook, and Math 445 will cover most of the rest. Although you can get credit for 444 without taking 445, I strongly discourage it—444 will mainly be occupied with laying the groundwork for 445, where most of the real meat of the course occurs.

REQUIREMENTS

Please note that this intensive summer course consists of two 3-credit courses (usually 20 weeks of classes) compressed into nine weeks. In addition to spending six and a half hours each week in class, you should be prepared to do an average of four to five hours of homework before each class. This adds up to the equivalent of a *half-time job*, so be sure to allocate your time accordingly!

Here are the specific requirements:

Classes: Although I won't keep a formal attendance record, *class attendance is required*. Much of what I talk about in class will be designed to *supplement* the reading, not repeat it. 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 or unforeseen illness, as soon as possible thereafter).

Class Website: I've set up a web page for this class (see the URL on the first page of this syllabus). On that page, I will post basic information about the course, handouts, and homework assignments. I will also be making limited use of the Canvas system to post announcements and to manage a discussion board for the class. I'll post a new homework assignment as soon as possible after every class—usually, by about 3:00PM, sometimes sooner, and I'll post a Canvas announcement when it's ready. There will also be a discussion area where anyone in the class can ask and answer questions. If you wish to write about specific homework problems, please confine your comments to general questions and suggestions about how to get started.

Reading Assignments: There will be a reading assignment for each class—in the early part of the course, this will usually be approximately one chapter from the book, but later assignments might include two chapters. You should read through each assignment quickly before class, and then read it again more carefully after we've discussed it. I really mean *read it*. This is not the kind of material that can be learned by looking at a homework problem and then leafing back through the book to find an example showing how to do that kind of problem. There might be quiz questions based on the reading.

Written Assignments: After each class, I'll post a written homework assignment, due at the beginning of the next class meeting. Homework that is turned in after the first fifteen minutes of class will get a 10% deduction, and homework turned in after class is over will not be accepted except in extraordinary circumstances and (except for emergencies) with advance permission. More details about how to write up homework assignments will be explained in the *Homework Guidelines* handout.

Collaboration: I strongly encourage you to work together on the written asignments. However, when you write up your solutions to hand in, you must *write your own solutions in your own words*. Even if you work out a solution as a group, it is not acceptable for one person to write down the solution and for others to copy it. If I receive papers from different people that include identical or near-identical answers, or answers that have been copied from a published or online source, they will be treated as instances of academic dishonesty and reported to the Dean's office.

Oral Presentations: At various times throughout the course, you will be assigned a theorem to present in class—sometimes one that is proved in the book, and sometimes one that is left as an exercise. Each student will probably be assigned two presentations during Math 444. You're welcome to discuss the proof with me or with other students, and to look up any supplementary material that might be helpful. Your presentations will be graded on both mathematical correctness and quality of exposition. More details to come.

Quizzes: At sporadic intervals throughout the summer, I will give short quizzes in class. These might be simple questions about the latest reading assignment, or homework problems that you've already done, or short questions that test how well you've absorbed the concepts that have been discussed recently. Quizzes will not be announced in advance. Quizzes cannot be made up, but your lowest quiz percentage score will be dropped, and any quiz missed due to an excused absence will not count against you.

Final Exams: On the last day of each course (444 and 445), there will be a two-hour final exam in the regular classroom at the regular meeting time.

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

15%	Oral presentations
15%	Quizzes
35%	Homework
35%	Final exam

Individual homework and quiz scores will be recorded as percentages and averaged (after dropping your lowest quiz score). I don't grade on a strict curve (which would mean that only a certain percentage of the class could earn A's, a certain percentage B's, etc.). Instead, I will start with a "default" grading scale (roughly 93% for a 4.0, 73% for a 2.0, and linearly interpolated or extrapolated from there), and adjust the scale if necessary in case the exams or homework turn out to be unusually hard or unusually easy.