Math 444 **Geometry for Teachers** **Winter 2017**

COURSE DESCRIPTION

Professor: John M. (Jack) Lee
Padelford C-546
206-543-1735
johnmlee@uw.edu

TA: Karthik Iyer
Padelford C-430
karthik2@uw.edu

Classes: Mon/Wed/Fri 12:30–1:20, Savery 156

Web site: *www.math.washington.edu/~lee/Courses/444-2017/*

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/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 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.

  The books 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.

Exams: Midterm: TBA, probably during the week of Feb 6–10
Final: Thursday, March 16, 8:30–10:20, Savery 156

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 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.

Math 444 topics: Chapters 1–8 of the textbook, and Appendices E through H.

- critical reading of Euclid
- comparison of different axiom systems for geometry
- introduction to axiomatic systems through careful study of a simplified system called *incidence geometry*
- in-depth study of *neutral geometry*, which is Euclidean geometry without any parallel postulate

Math 445 topics: The rest of the textbook.

- in-depth study of the most important results of Euclidean geometry and their proofs
- an introduction to the history and main results of non-Euclidean geometry

Note that most of the real geometric "meat" of the course will not occur until Math 445. Although it is technically possible to take 444 without taking 445, I strongly discourage it, because you won't get nearly as much from the course that way.

REQUIREMENTS

Classes: Although I won't keep a formal attendance record, *class attendance is required.* Much of what we 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 Blog: I've set up a GoPost blog for this class (linked from the class website), where I will post announcements about the class. I welcome questions or comments about any subject related to the course material, and I encourage you to offer answers to other students' questions as well. If you wish to write about specific homework problems, please confine your comments to general questions and suggestions about how to get started; please don't post complete solutions.

Reading Assignments: Along with each homework assignment, there will be a reading assignment. In the early part of the course, this will usually be approximately one chapter from the book each week, but later assignments might include two chapters. It's a good idea to read through the next chapter 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: Each week, there will be a written homework assignment, with a due date to be announced. These assignments will be posted on the class website and announced on the blog; they will *not* be announced in class. Homework that is turned in after the first ten 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 Expectations* handout.

Oral Presentations: The TA and I will be leading discussion sessions at various times throughout each week (times to be announced during the first week of class). At these sessions, you can ask for clarification or explanation about anything that has come up in class. In addition, each student will be required to present solutions to two homework problems during the quarter (one problem before the midterm, and one after the midterm). The presentations will be graded credit/no credit: If you can present a complete and correct solution to a homework problem, with however much help you need from the TA and other students, you will get credit. More details to come.

Collaboration: I strongly encourage you to work on the written asignments together with other students. And if you attend discussion sessions, you can share your solutions with other students, or listen to other students present their solutions. You might be able to find solutions to some of the problems on the Internet, but I do not recommend it. Some of those solutions are probably wrong, and in any case, by reading someone else's polished solution instead of struggling with the ideas yourself, you deprive yourself of the most important learning experience that a course like this can provide.

When you write up your solutions to the homework assignments, *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, and it is even less acceptable to copy a solution that you find on the Internet. If we receive a homework paper that contains material that has been copied, it will be treated as a case of academic dishonesty.

Quizzes: At sporadic intervals throughout the course, I'll 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 score will be dropped, and any quiz missed due to an excused absence will not count against you.

Final Exams: The final exam for 444 will cover all of the material from winter quarter. The 445 exam will cover all material from spring quarter, and although there will probably not be any questions directly about the material from 444, you'll need to have a deep understanding of the 444 material in order to succeed in 445.

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

10%	Oral presentations
10%	Quizzes
20%	Homework
30%	Midterm exam
30%	Final exam

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. 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 92% for a 4.0, 70% 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.