

**Math E-320:
Teaching Mathematics with a Historical Perspective**
Oliver Knill, Harvard Extension School, Spring 2013

Key information:

- **URL:** <http://www.math.harvard.edu/~knill/teaching/mathe320.2013/index.html>
- **Class:** Monday, Science Center 113, 5:30-7:30 PM
- **First Class:** Monday, January 28, 2013
- **Instructor:** Oliver Knill, 432 Science Center, knill@math.harvard.edu
- **Office hours:** Before and after the lecture and by appointment.
- **Text:** John Stillwell, Mathematics and its History, Third edition.



Abstract:

The process of learning and teaching mathematics has parallels in the history of mathematics. The struggle of early research mathematicians who developed and formalized a topic parallels the challenges of students and teachers embrace in the modern classroom. Students learning about the concept of limits and series undergo a similar process as the pioneers of a subject did when they developed the subject. This process goes on today, as new flavors of calculus are developed and studied. In this course we consider each week a different mathematical subject and pinpoint one or several moments when something interesting happened. We condense this into specific and concrete mathematical problems to work on in class.

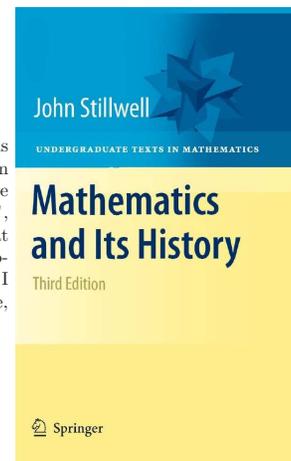
Prerequisites:

We try to keep the presentation open to a more general public. While good pre-calculus background is of advantage, an open mind is even more important. We believe that also interesting and new mathematics can be made accessible.

Methodology:

By using the "case method" methodology many different part of mathematics can be covered. The range of mathematical topics is broad. The main goal is to stimulate interest in some topic rather than cover a lot of ground. After a general overview of Mathematics in the first lecture, we will work each week with a specific branch of mathematics and see its development in a historical context. The **case method** is diametrically opposed to an **encyclopedic approach**. The advantage is that one can get more involved if a concrete example is used. As a balance, we encourage to read text which is a bit more encyclopedic. A specific story is more engaging and each "case" can serve as a crystallization point for an entire subject. In a time, when knowledge explodes fast and a plethora of possibilities are offered online, teaching requires both to be broad as well as care for details. The dilemma of combining these two can be achieved with a "short story approach" and also by mixing different teaching elements (presentation, discussion and work on problems). The case method is well established and was used especially at the Harvard business school, where "discussions focused on real-world situations" is considered a good way to prepare students. In our case, the "real word situations" are "historical highlights". Participants can adapt such models for their own teaching. Besides the material, the pedagogy will play an important role. While all of the lectures could be adapted to lectures for to high school students and some even on middle school level level, we will also discuss pedagogical and think about it. We will notice a general principle: difficulties for the pioneers developing a topic, reverberate today in the classroom when students are taught the subject.

Text:



We have used different books in the past for this course but since the lectures are independent from any text, we keep the reading light. This year, we recommend "Stillwell Mathematics and its History", ISBN 978-1-4419-6052-8. Today, the web is a great source to get more information on particular topics. For students interested in particular topics, I can show more literature. We live in a great time, where many wonderful books are available.

Grades:

The course grade is based on three parts:

1. Quizzes after each lecture 40 percent
2. A final project with details to be announced. 40 percent
3. General participation in discussion 20 percent

Day to Day Syllabus:

The lecture sequence has worked well in the last three years. We use part of the lecture to get an overview over the topic in a lecture using slides and multimedia. We work on in class on some particular problems. We always end the lecture with a short quiz. This quiz is always very closely tied to the lecture. If you have seen the lecture, the quiz should not be a problem. You can use all notes from the lecture while taking the quiz. Keep notes therefore during the presentation part.

Lecture	Topic	Presentation
January 28, 2013	Mathematics	What is mathematics?
February 4, 2013	Arithmetics	Representing Numbers
February 11, 2013	Geometry	Shapes and Symmetries
February 18, 2013	Presidents day	No class
February 25, 2013	Number theory	Primes and Diophantine Equations
March 4, 2013	Algebra	Symmetries and Games
March 11 2013	Calculus	Summation and Differences
March 17 -March 24	Spring break	
March 25 , 2013	Set theory	Sets, Infinities, Incompleteness
April 1, 2013	Probability	Chance and Processes
April 8, 2013	Topology	Polyhedra and Invariants
April 15, 2013	Analysis	Fractals and Dimension
April 22, 2013	Cryptology	Codes and Cyphers
April 29, 2013	Dynamics	Chaos and Predictability
May 6, 2013	Computer science	Artificial Intelligence
May 13-May 18, 2013	Exam period, Project	

Special dates:

Feb 18:	Presidents day
May 13-18:	Exam period
Mar 17-24:	Spring break