

E-320: Teaching Math with a Historical Perspective

Oliver Knill, Harvard Extension, Spring 2014

Key information:

- **URL:** http://www.math.harvard.edu/knill/teaching/mathe320_2014
- **Class:** One Story Str. 307, 5:30-7:30PM
- **First Class:** Mo, Jan 27, 2014
- **Instructor:** Oliver Knill, 432 Science Center, knill@math.harvard.edu
- **Office hours:** Before and after the lecture and by appointment.
- **Text:** Stillwell, Mathematics and its History



Abstract:

The process of learning mathematics correlates with the history of mathematics. The struggle of research mathematicians developing a topic is similar to the challenges we have to learn it. When learning the concept of limits and series for example we undergo a similar process as the pioneers of a subject did when they developed the subject. This continues to happen, as new flavors of calculus are developed and studied. We will consider each week a different mathematical subject and pinpoint moments of of interest. We condense this into concrete working problems.

Prerequisites:

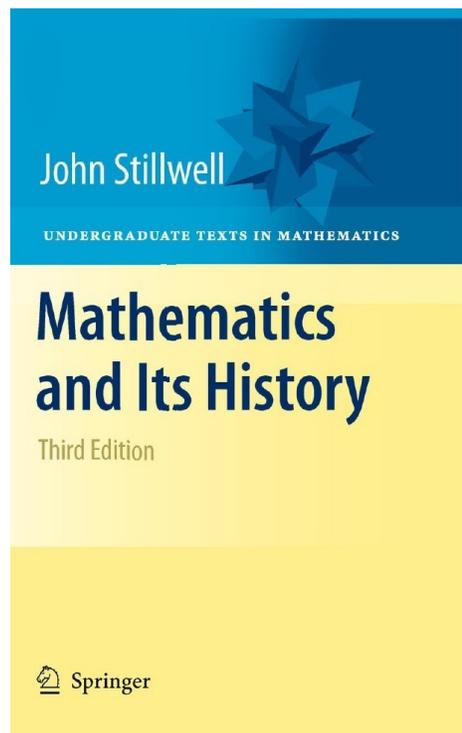
The presentation part should be generally accessible. While a pre-calculus background is of advantage, an open mind is more important. Interesting and new mathematics can be enjoyed also without vast background knowledge.

Methodology:

We use the "case method" methodology in which many different fields mathematics can be covered. The range of mathematical topics is broad. The main goal is to stimulate interest 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** can be complemented with a **encyclopedic approach** which has its value too. The advantage of the case method is that one can pick concrete examples. As a balance, we encourage to read in a book. 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 like presentation, discussion and work problems. The case method is well established like at business schools, 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, pedagogical questions will play an important role. One main theme will be a general general principle: difficulties for the pioneers developing a topic, reverberate today in the classroom when students are taught the subject.

Text:

The lectures are independent from any text, we keep the reading light. This year, we again go with "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. If you are interested in particular topics, I can provide more literature. We live in a 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: 40 percent
3. General participation in discussion or email. 20 percent

Day to Day Syllabus:

The lecture sequence has worked well in the last four 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 27, 2014	Mathematics	What is mathematics?
February 3, 2014	Arithmetic	Representing Numbers
February 10, 2014	Geometry	Shapes and Symmetries
February 17, 2014	Presidents day	No class
February 24, 2014	Number theory	Primes and Diophantine Equations
March 3, 2014	Algebra	Symmetries and Games
March 10 2014	Calculus	Summation and Differences
March 14 -22	Spring break	
March 24 , 2014	Set theory	Sets and Infinities
April 1, 2014	Probability	Chance and Processes
April 7, 2014	Topology	Polyhedra and Invariants
April 14, 2014	Analysis	Fractals and Dimension
April 21, 2014	Cryptology	Codes and Cyphers
April 28, 2014	Dynamics	Chaos and Predictability
May 6, 2014	Computer science	Artificial Intelligence
May 13-18, 2014	Exam week	10 Pioneers in Math

Special dates:

Feb 17:	Presidents day
May 13-18:	Exam period
Mar 14-22:	Spring break