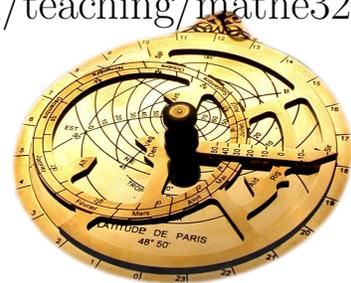


E-320: Teaching Math with a Historical Perspective

Oliver Knill, Harvard Extension, Spring 2021

Key information:

- **Website:** www.math.harvard.edu/~knill/teaching/mathe320_2021
- **Class:** Zoom, Mon 05:50 PM-07:50 PM
- **Instructor:** Oliver Knill
- **Email:** knill@math.harvard.edu



Abstract:

We take a panoramic tour over all mathematics with the goal to know all parts of it. Each week we focus on some topic in mathematics, from a historical perspective. The process of learning mathematics correlates with the history of mathematics. The struggle of research mathematicians exploring new mathematics is similar to the challenges which students experience when they learn established mathematical theories. This process continues even today, as new mathematics is developed and refined and taught. In our panoramic stroll through the landscape of all mathematics we study it from a historical perspective. The connections to other fields, to other cultures and to other epochs including our time will help us to widen the horizon and to inspire others.

Prerequisites:

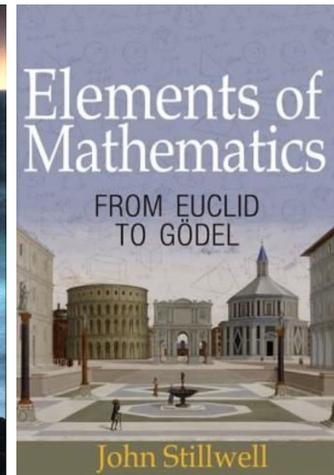
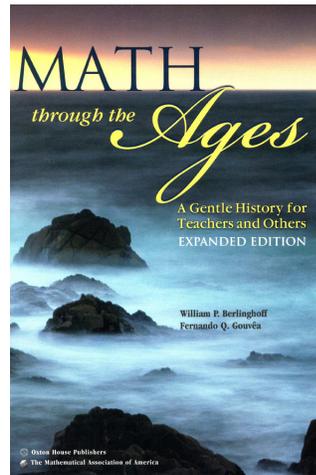
Any previous mathematics background is of advantage, but an open mind is more important. Interesting and new mathematics can be enjoyed also without a vast background knowledge. Of course, you benefit more from this course if you can connect to some known areas of mathematics.

Methodology:

The range of mathematical topics is broad. The main goal is to stimulate interest, get a global view and see connections between different fields and different areas, different times and different approaches. After a general overview of Mathematics in the first lecture, we will work in each week with a specific branch of mathematics and in particular also focus on its historical context. We mainly follow the **case method** rather than a systematic **encyclopedic approach**. More so than in other years, where the course has been taught online, we will allow also to be more selective for specific areas. We also will have some light reading on the side. Specific stories can be 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 electronically, teaching requires both to be broad as well as some care for details. The dilemma of combining these two extremes can be achieved with a "short story approach" combined by mixing different teaching elements like presentation, story telling, experimentation, discussion, problem solving and identify historical highlights. Participants can adapt such models for their own teaching. Besides the material, pedagogical questions will come up. One main theme will be a general general principle: difficulties for the pioneers developing a topic reverberate today in the classroom.

Text:

No textbook is required. Reading material is provided. For background, the book "Math through the Ages", by William Berlinghoff and Fernando Gouvea or the book of "Elements of Mathematics" by John Stillwell matches.



Project:

The project topic this spring is:

“The life and work of five extraordinary mathematicians”

The project is to write 5 short stories of the same length (about 2-3 pages) where each should introduce a mathematician in a different area and his or her work.

Course policies:

We follow the standard Harvard Extension School's policies on academic integrity. It can be accessed online at

www.extension.harvard.edu/resources-policies/student-conduct/academic-integrity

This document also describes how to use sources responsibly. In particular, the project in this course and the quiz should be written and completed by each student individually. For the homework assignment, discussions among students is encouraged.

Grades:

We expect attendance by video conference with video turned on. The course grade is based on three parts:

- Quizzes: 20 percent
- Homework: 20 percent
- Class participation: 20 percent
- The final project: 40 percent

Day to Day Syllabus:

The lecture sequence has worked well when the course was taught in the past. We use part of the lecture to get an overview over the topic in a lecture. We then discuss a particular problem in the subject. We then use part of the discussion to review the lecture and prepare for the quiz done in class.

Lecture	Topic	Presentation
January 25, 2021	0) Mathematics	What is mathematics?
February 1, 2021	1) Arithmetic	Number Systems
February 8, 2021	2) Geometry	Symmetries and Shapes
February 15, 2021	No class	Presidents day
February 22, 2021	3) Number Theory	Primes and Equations
March 1, 2021	4) Algebra	Puzzles and Structures
March 8, 2021	5) Calculus	Summations and Differences
March 15, 2021	6) Set theory	Infinities and Paradoxa
March 22, 2021	7) Probability	Chance and Processes
March 29, 2021	8) Topology	Polyhedra and Invariants
April 5, 2021	9) Analysis	Fractals and Dimension
April 12, 2021	10) Cryptology	Codes and Ciphers
April 19, 2021	11) Dynamics	Chaos and Time
April 26, 2021	12) Computer Science	Artificial Intelligence
May 3 2021	13) Project	Writing projects