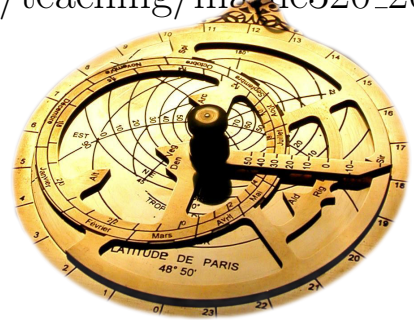


E-320: Teaching Math with a Historical Perspective

Oliver Knill, Harvard Extension, Fall 2018

Key information:

- **Website:** www.math.harvard.edu/~knill/teaching/mathe320_2018
- **Class:** On Campus, SC 104, 6PM-8PM,
First: September 10, 2018
- **Instructor:** Oliver Knill, 432 Science
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Abstract:

In this course which is now taught for the 10th time at the Harvard extension school, we take a panoramic tour over all mathematics. In each topic, we proceed historically and focus on some topics which can inspire. The process of learning mathematics correlates with the history of mathematics. The struggle of research mathematicians finding 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 this course, we take a wide panoramic stroll through the landscape of all mathematics and study it primarily from a historical perspective. The connections to other fields, to other cultures and to other epochs including current developments in mathematics will help us to widen the horizon as a teacher and to inspire the classroom.

Prerequisites:

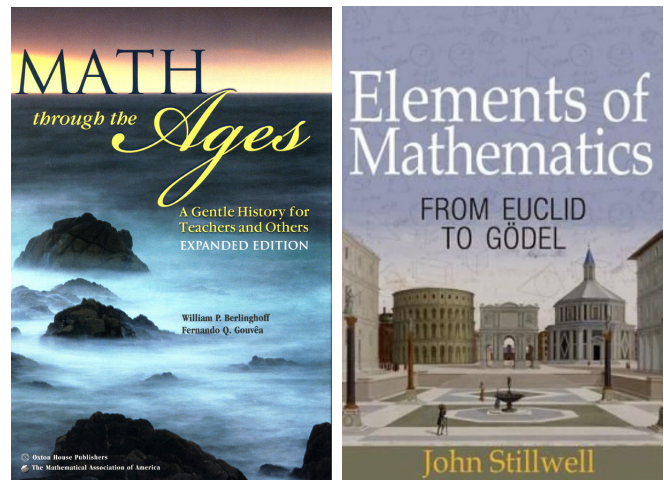
Any previous mathematics background is of advantage, but an open mind is more important. Interesting and new mathematics can be enjoyed also without vast background knowledge. Of course, you benefit more from this course if you can connect it to some known areas of mathematics.

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 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 see its historical context. We mainly follow the **case method** rather than a systematic **encyclopedic approach**. This allows us to pick concrete examples. We also will suggest some light reading on the side. 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 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, experimentation, discussion and problem solving. The case method is well established 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 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. I will suggest some reading material. We have used various books in the past. The pioneering book "Math through the Ages", by William Berlinghoff and Fernando Gouvea (2004, ISBN 978-0-99385-736-6) is great. An other more recent book is John Stillwell's book "Elements of Mathematics" has a similar approach we follow.



Project:

The project topic this fall is:

“Illustrating the 5 most important mathematical concepts”

The project is to write 5 short stories of the same length (2 pages) which explain a major idea, concept, result in the development of mathematics.

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 quizz should be written and

completed by each student individually. For the homework assignment, discussions among students is encouraged.

Grades:

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 in the last 9 times the course was taught. We use part of the lecture to get an overview over the topic in a lecture using multimedia. We discuss then some particular problems and also will conclude with a small quiz. We will use part of the discussion to review the lecture and prepare for the quiz done in class.

Lecture	Topic	Presentation
September 10, 2018	0) Mathematics	What is mathematics?
September 17 2018	1) Arithmetic	Representing Numbers
September 24, 2018	2) Geometry	Shapes and Symmetries
October 1,2018	3) Number Theory	Primes and Equations
October 8, 2018	Columbus day	No class
October 15, 2018	4) Algebra	Symmetries and Puzzles
October 22, 2018	5) Calculus	Summations and Differences
October 29, 201	6) Set theory	Infinities and Paradoxa
November 5, 2018	7) Probability	Chance and Processes
November 12, 2018	8) Topology	Polyhedra and Invariants
November 19, 2018	9) Analysis	Fractals and Dimension
November 26, 2018	10) Cryptology	Codes and Ciphers
December 3, 2018	11) Dynamics	Chaos and Time
December 10, 2018	12) Computer Science	Artificial Intelligence
December 17, 2018	Outlook	Discussing Projects