Snapshots of the history of mathematics, spring 2015

What is going on?

Give us feedback!

Some extra exercises for compensating for missing hours have been uploaded: check the "Exam" section below.

Here some of the essays written by the students of the course (published with their permission):

Zenith Purisha, Galileo Galilei
Matias Von Bell, Highlights from the History of Graph Theory
Francesca Corni, The Essence of Mathematics Lies in its Freedom
Oluwatosin Ishmeal, On Fermat Last Theorem
Clifford Gilmore, William Rowan Hamilton: Mathematician, Poet and Vandal

Some lecture slides

Most details presented and especially almost all of the mathematics at the blackboard are not shown in these slides, they just give a partial skeleton of the material.

Lecturer

Eero Saksman

Description of the course

The course is not a 'standard history of mathematics course'. Instead, it focuses on some specifically chosen themes or turning points in the development of mathematics. In addition, the topics do not aim at all to cover full areas or the complete time evolution of some historic period in mathematics. Naturally such selection also reflects the lecturer's own interests in the history of mathematics.

Examples of topics that will be presented in the lectures:

• Solving polynomial equations - fundamental theorem of algebra and prehistory of Galois theory
• Work of Emmy Noether and Sophia Germain
• History of spectral theory
• Fourier series and development of rigor in analysis in the 1800's
• Road to modern probability
• Gauss, Weil, Grothendieck, Deligne: long path to modern level of abstraction
• Along the way, life of some interesting math personalities will be described

The course is mainly aimed to master students and graduate students. During many of the lectures the main aim is to try to present some bits of the mathematics involved. Hence knowledge of basic analysis courses, probability and algebra is needed to follow many of the lectures. Level of mathematics in the lectures may vary considerably from lecture to lecture.

One can pass the course by attending most lectures, writing an essay on a given topic and giving a presentation of it in the exercise class run and supervised by Paola Elefante. Their timetable will be decided later on.

The topics for the student presentations will be decided during the first weeks of the course. Own suggestions are welcome!

Scope

6 sp.

Type

Advanced studies
Prerequisites

Some basic knowledge of analysis courses, probability and algebra are needed to follow all the lectures, see the course description above.

Lectures

Weeks 4-9 and 12-18 (with some exceptions/changes mentioned later on) Tuesday 10-12 and Wednesday 10-12 in room C123.

Occasionally the Wednesday lecture will start at 9 (it will be communicated in this webpage).

Easter Holiday 2.-8.4.

Bibliography

All written math since antiquity... but, in particular, here are some interesting sources:

- Biographies of mathematicians.
- Biographies of women in science


H. W. Lenstra Jr., *Solving the Pell Equation* (link).


H. Edwards, Galois theory. Springer.


Jason Bardi, *Calculus Wars*, High Stakes 2006

Isaac Newton, *Mathematical Principles of natural Philosophy*, (translated by Abdrew Motte, and revised by Florian Cajori, Univ. of California Press, 1934)


Registration

Did you forget to register? What to do?

Exam

The course can be passed by completing the following:

- regular attendance (at least 80% = you can skip up to 5 lectures) (see below for exceptions)
- writing an essay
- giving a presentation on the essay

The final examination (essay and presentation) can be carried out in pairs (of your choice) or on your own. The essay shall contain some mathematics and some history. As a general indication, the essay should be minimum 15 page long, 5 of which should be non-math.

If you work in pairs, the presentation is required to be 2 academic hour long (45+45 minutes), otherwise it can be either 2 or 1 academic hour long. The presentation can be held at some Friday time slot (see table below) or as replacement for some lecture (agree with Eero Saksman).

Please remember that essay and presentation must be in English language.

You can agree your chosen topic and book a time slot with Paola Elefante. The deadline to send the essay is 10.5.2015. Please send it via email in pdf format to Paola Elefante.

For the essay, you can choose any topic of your interest, but if you lack ideas, here are some suggestions:
To avoid repetitions of presentations and with lectures, please agree the choice of topic with the lecturer.

About attendance: if you really really really have need to skip more than 20% of lectures, you can cover them by doing some exercises given by the lecturer. You can find them here (in constant update: check the date of the document): extra exercises. Please agree with Eero Saksman or Paola Elefante, in case.

**Exercises**

Friday 10-12 can be used for office hours (contact Paola Elefante beforehand) or as time slots for the final presentations.

Please contact Paola Elefante to book a time slot. Remind is first come, first serve.

**Presentations calendar**

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Title</th>
<th>Day</th>
<th>Time</th>
<th>Place</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown User (<a href="mailto:axhartma@helsinki.fi">axhartma@helsinki.fi</a>) (***)</td>
<td>Leibniz and analysis notation</td>
<td>Friday 6.3</td>
<td>10-12</td>
<td>C122</td>
<td>Paola Elefante</td>
</tr>
<tr>
<td>Unknown User (<a href="mailto:samelson@helsinki.fi">samelson@helsinki.fi</a>) (1 hour)</td>
<td>A Brief History of Western Mathematical Notation</td>
<td>Friday 13.3</td>
<td>10-11</td>
<td>C122</td>
<td>Paola Elefante</td>
</tr>
<tr>
<td>Oluwatosin O Ishmeal, Clifford Gilmore</td>
<td>Fermat's last theorem</td>
<td>Tuesday 17.3</td>
<td>10-12</td>
<td>C123</td>
<td>Paola Elefante</td>
</tr>
<tr>
<td>Anne Isabel Gaudreau (§), Unknown User (<a href="mailto:sijaniel@helsinki.fi">sijaniel@helsinki.fi</a>)</td>
<td>Unexpected repercussions of knot theory</td>
<td>Friday 20.3</td>
<td>10-12</td>
<td>C122</td>
<td>Paola Elefante</td>
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<tr>
<td></td>
<td></td>
<td>Friday 27.3</td>
<td>10-12</td>
<td>C122</td>
<td>Paola Elefante</td>
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<tr>
<td>Unknown User (<a href="mailto:mavo@helsinki.fi">mavo@helsinki.fi</a>), Atte Walden</td>
<td>The history of graph theory</td>
<td>Friday 10.4</td>
<td>10-12</td>
<td>C122</td>
<td>Paola Elefante</td>
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<tr>
<td>Nidia Obscura Acosta and Fiyinfoluwa A Soyoye</td>
<td>The History of Cryptography</td>
<td>Friday 17.4</td>
<td>10-12</td>
<td>C122</td>
<td>Paola Elefante</td>
</tr>
<tr>
<td>Zenith Purisha (1 hour), Unknown User (<a href="mailto:corni@helsinki.fi">corni@helsinki.fi</a>) (1 hour)</td>
<td>The First Physicist, Galileo Galilei</td>
<td>Friday 24.4</td>
<td>10-12</td>
<td>C122</td>
<td>Paola Elefante</td>
</tr>
<tr>
<td>Unknown User (<a href="mailto:soultani@helsinki.fi">soultani@helsinki.fi</a>)</td>
<td>Bourbaki</td>
<td>Wednesday 29.4</td>
<td>9-10</td>
<td>C123</td>
<td>Paola Elefante</td>
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<tr>
<td>Janne M Junnila and Jesse Jääsaari</td>
<td>The Rising Sea (**)</td>
<td>Friday 8.5</td>
<td>10-12</td>
<td>C122</td>
<td>Paola Elefante</td>
</tr>
<tr>
<td>Yijie Jiang</td>
<td>The history of Pi</td>
<td>Wednesday 13.5</td>
<td>10-11</td>
<td>C124</td>
<td>Paola Elefante</td>
</tr>
</tbody>
</table>

(**) Clifford Gilmore - William Rowan Hamilton: Mathematician, Poet and Vandal

To mark St Patrick’s Day we will hear about the remarkable life of Ireland’s greatest mathematician, William Rowan Hamilton (1805-1865). Hamilton was a child prodigy whose contribution to physics and mathematics transformed algebra and laid the foundations for, among others, quantum mechanics and computer graphics.

He is also famous for his "eureka" moment, when he used a penknife to inscribe the quaternion formula into a bridge on Dublin's Royal Canal.

Did you miss this talk? Here are some pictures (taken by Glen).

(****) Find the slides here.
(§) Anne Isabel Gaudreau - *Unexpected repercussions of knot theory*

Knots have captured the imagination for millennia. In the 18th century, they motivated the invention of a new branch of mathematics and have since then changed people’s understanding of the world.

(§§) Francesca Corni - *The essence of mathematics lies in its freedom*

A little history about infinity, through Cantor’s main results about the discovery of different levels of infinity. During his researches Cantor found out an apparently harmless question that will have led him to mental illness. Gödel and other great mathematicians then tried to answer to the same charming problem, without success.

(°°) Janne Junnila and Jesse Jääsaari - *The Rising Sea*

In this talk we will go through the developments of algebraic geometry, starting from the analytic geometry of Descartes and Fermat and then moving in a rapid pace towards the today’s state of art. The main points are the increase of abstraction in mathematics during the 20th century and showing how the classical more concrete concepts were translated into this modern framework developed by Grothendieck et al. In the end we will also shortly discuss an application to Weil conjectures, maybe the biggest result in number theory in the 20th century along with Fermat’s last theorem.