MATH3560

HISTORY OF MATHEMATICS

Semester 1, 2015
MATH3560 — Course Outline 2015

The historical view of mathematics places emphasis on underlying ideas and themes— that often took centuries to formulate. This course will introduce selected topics in the history of mathematics, relating primarily to ancient Greek thinking, and then to developments in modern European mathematics, from the years 1600 up to the rise of combinatorics in the twentieth century. The course will provide a complement to other courses in your program, including calculus, geometry, topology, linear algebra, number theory and discrete mathematics. Many important mathematicians will figure prominently, however the historical details will be less important for us than the broad development of the mathematical ideas.

Students will be asked to combine historical reading with a short presentation and a one to two page report, and the tests and final exam will encourage clear exposition of both historical and mathematical facts and ideas. We will also have some classroom discussions in which students are encouraged to share their knowledge and opinions. Online YouTube videos will play a role in our learning, as we will use reverse teaching this year for half of the course.

Information about the course

Course Authority and Lecturer: Associate Professor Norman Wildberger
Room: RC-4108 email: n.wildberger@unsw.edu.au

Consultation: TBA but feel free to drop in if I am not busy.

Credit, Prerequisites, Exclusions: This course counts for 3 Units of Credit (3UOC).

At least 6 UOC in Second Year Mathematics is assumed knowledge for MATH3560 but we are also enrolling General Studies students with at least 2 Unit Mathematics at HSC level. There is NO higher version. Exclusions: NONE.

The times and place for the lectures are:

| Wednesday 2-4 pm | OMB G32 |

Half of the weeks will involve reverse teaching, using as a basis the lecturer’s YouTube videos (available at YouTube channel: njwildberger, and also linked to Moodle) on the History of Mathematics, and which will involve class discussion. The other weeks will be regular lectures. Students are expected to have watched the relevant YouTube video(s) each week before coming to class, and be prepared to comment on and discuss the content of these videos.

Assessment

Please read this section carefully.
Overview:

<table>
<thead>
<tr>
<th>Task</th>
<th>Due Date</th>
<th>Weighting</th>
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<tbody>
<tr>
<td>Test1</td>
<td>Wednesday Week 5</td>
<td>15%</td>
</tr>
<tr>
<td>Test2</td>
<td>Wednesday Week 11</td>
<td>15%</td>
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<tr>
<td>Historical report and participation</td>
<td>variable</td>
<td>20%</td>
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<tr>
<td>Final Exam</td>
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<td>50%</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>100%</strong></td>
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**Tests:** There will be two tests, each half an hour long, in WEEKS 5 and 11. They are a way of encouraging you to remember and summarize the material of the course, and will help consolidate your understanding. The tests will not require detailed knowledge of formulas or proofs, but rather a *general understanding* of the most important theorems and arguments, as well as their historical context.

**Historical report and participation:** Each student will give a short presentation on either a particular mathematician or a particular mathematical topic (such as an important theorem), and will be expected to submit simultaneously a one to two page report (pdf) summarizing either a mathematician’s context and achievements. Each student will be allocated a mathematician or topic in the second week of class.

The short presentation should be about 5 minutes long, with a **maximum of 7 minutes**! It must *not be read*. One 3x5 cue card is allowed, but only to summarize points. The one to two page report should outline the basic information re your mathematician or mathematical topic. Enthusiasm, humour and interest are encouraged; this is a chance to educate and also entertain your classmates!

Students will also be marked on their participation in class discussions. We will expect you to discuss videos that you have watched, and summarize their contents verbally. *So watching and summarizing videos before class, and participating in class discussions is essential!*

**Final Exam:** This will be an opportunity for you to demonstrate some of the knowledge and skills you have acquired during the course, and will test whether you have REGULARLY ATTENDED CLASS, READ THE TEXTBOOK, WATCHED THE YOUTUBE VIDEOS CAREFULLY and LISTENED TO OTHER STUDENT’S HISTORICAL REPORTS. There will be a mix of mathematical and historical questions.

**Textbook, e-learning, and YouTube videos**

**Textbook**

There is a **RECOMMENDED TEXTBOOK** for this course: John Stillwell: *Mathematics and its History* (Third edition) Springer Undergraduate Texts in Mathematics.

This book has much more in it than we will cover, but we will be following it carefully in places. It is a great resource for all mathematics students, and is available in the Uni BookStore. Some copies should be on open reserve in the library.
We will be covering Chapters 4, 7, 8, 9, 10, 22, 24, 25 in that order, generally one topic a week, with some additional lectures not from Stillwell.

Syllabus

The videos marked (*) here refer to the PlayList MATH HISTORY at YouTube user: njwildberger (more detail below). Weeks 2, 4, 9 will require students to have pre-watched YouTube videos before coming to class, while Weeks 1, 5, 7 videos will be watched in class (technology permitting!)

- Week 1: *Infinity in Greek Mathematics [Math History 4 YouTube video] [Chapter 4 of Stillwell]*
- Week 2: *Analytic Geometry and the continuum [Math History 7a, 7b YouTube videos] [Chapter 7 of Stillwell]*
- Week 3: Number systems and Stevin’s decimals [Lecture]
- Week 4: *Projective Geometry [Math History 8 YouTube video] [Chapter 8 of Stillwell]*
- Week 5: *Calculus [Math History 9 YouTube video] [Chapter 9 of Stillwell]*
- Week 6: Problems with the Calculus [Lecture]
- Week 7: *Infinite series [Math History 10 YouTube video] [Chapter 10 of Stillwell]*
- Week 8: Matrices, determinants and the birth of Linear Algebra [Lecture]
- Week 9: *Topology [Math History 17 YouTube video] [Chapter 22 of Stillwell]*
- Week 10: Sets, logic and computability [Lecture] [Chapter 24 of Stillwell]*
- Week 11: Problems with set theory [Lecture]
- Week 12: Combinatorics [Lecture] [Chapter 25 of Stillwell]

e-Learning = Moodle

Lecture notes will NOT be available online—you are expected to make your own notes from videos and lectures. However we will post links to the required YouTube videos on Moodle.

YouTube videos

We will be using reverse teaching for half of this course: using existing YouTube videos on the History of Mathematics created by the lecturer Norman Wildberger over the last few years. These videos are available (for free) at his YouTube channel Insights into Mathematics (user name: njwildberger), under the PlayList MATH HISTORY: found at http://www.youtube.com/playlist?list=PL55C7C83781CF4316
Not all these videos are directly necessary for this course—ONLY THE VIDEOS IN THE ABOVE LIST. These are the videos Math History 4,7a,7b,8,9,10 and 17. The video for each chapter is roughly an hour long (sometimes split into two smaller parts). These videos are also accessible via Moodle, which may be more convenient for students in colleges that have YouTube blocked for some reason. Please let the lecturer know if you have any difficulty in accessing these videos.

The other videos in this series may well be of interest to you, feel free to watch them, but they are not required. Assoc Prof Wildberger also has several other PlayLists, some of which might be useful and/or interesting to you; in particular courses on Linear Algebra (WILDLINALG), Rational Trigonometry (WILDTRIG), the Foundations of Mathematics (MATHFOUNDATIONS), Hyperbolic Geometry (UNIVHYPGEOM), K-6 mathematics education (ELEM MATH), Algebraic Topology (ALGTOP) and Differential Geometry (DIFFGEOM). Feel free to make comments or ask questions with any video.

Course aims

This course aims to introduce you to some important modern themes of mathematics from a historical perspective, and will introduce you to a good cross section of some of the greatest and most influential ancient Greek and European mathematicians. This will augment and unify material you may have taken, or be studying, in other courses. You will also have a chance to discuss mathematics from a historical study, and to practise your expository skills in front of your classmates. The course will be focussing on some philosophical aspects to the history of mathematics, centered on the developments of the calculus, the role of infinity, and Cantor’s theory of sets.

The class also aims at experimenting with the idea of a flipped classroom, combining online work at home with lecture discussion and involvement.

Relation to other mathematics courses

This subject will include some fundamental mathematics that overlaps with material in Calculus, Geometry, Analysis, Topology, Discrete Mathematics and Logic. So it provides a unifying historical framework for these areas, and gives you some insight into the mathematicians who created these subjects, and the problems they wrestled with at the time. Mathematics does not always proceed smoothly—often there are historical battles between opposing points of view or schools of thought. It is rewarding for a modern student of mathematics to be exposed to some of these intellectual challenges, some of which are still with us today as the role of computing grows ever stronger in modern mathematics.

Much mathematics is best learnt with an eye on the historical development, which usually begins with clearly understood concrete problems and works gradually towards a more general framework.
Student Learning Outcomes

Students taking this course will gain some insight into the history of Mathematics and the problems that motivated key developments. You will:

- understand the basic principles behind several key strands of modern mathematics, including calculus, complex functions and curves, topology, group theory and Galois theory;
- learn how to take effective written notes in a seminar setting;
- have confidence in standing up, summarizing knowledge and expressing your views;
- be able to present and communicate your ideas in writing and verbally to a group of people;
- acquire a basic outline of the recent historical development of mathematics and how this relates to modern mathematics;

Through carefully watching videos, regularly attending lectures, giving a short presentation and writing a short one page report, you will achieve these outcomes. Students will also benefit by participating in class discussions.

Relation to graduate attributes

The above outcomes are related to the development of the Science Faculty Graduate Attributes, in particular: 1. Research, inquiry and analytical thinking abilities, 4. Communication, 6. Information literacy

Teaching strategies underpinning the course

New ideas and skills are introduced and demonstrated in lectures, then students develop these skills by discussion and demonstrate their competency in tests.

Rationale for learning and teaching strategies

Effective learning is best supported by a climate of enquiry, in which students are actively engaged in the learning process. To ensure effective learning, students should participate in class as outlined below. There will be a free exchange of ideas in this class that all students are expected to engage and participate in.

Students should attend all classes, have prepared effectively for classes by reading through the relevant sections in the textbook (Stillwell), watching carefully the YouTube videos for the relevant weeks, and participating in discussions. Make sure to take good notes that summarise the lecture content.

Effective learning is achieved when students have a genuine interest in the subject and make a serious effort to master the material.

The art of logically setting out mathematics is best learned by watching an expert and paying particular attention to detail. This skill is best learned by regularly attending classes.
Course Evaluation and Development

The School of Mathematics and Statistics evaluates each course each time it is run. We carefully consider the student responses and their implications for course development. It is common practice to discuss informally with students how the course and their mastery of it are progressing.

Administrative matters

Additional Assessment

The usual rules for Additional Assessment for upper year courses in the School of Mathematics apply. See:

Students should note in particular that as well as the usual university procedures to deal with illness or misadventure, Additional Assessment is also be available to students who have participated fully in the course but whose final mark is in the range 40–49.

Students to whom these procedures might apply are recommended to also contact Norman Wildberger as soon as possible for advice.

School Rules and Regulations

Fuller details of the general rules regarding attendance, release of marks, special consideration etc are available via the School of Mathematics and Statistics Web page at http://www.maths.unsw.edu.au/students/current/policies/studentpolicy.html.

Other matters

Students should be aware of the many other policies that govern their study at university, including those on occupational health and Safety, and on students with disabilities.

Students who may need special arrangements should contact the Student Equity and Diversity Unit (although simple requests can usually be handled very easily with a quick word with the lecturer).