History of Mathematics[1]
MA 330, Sections 001 & 002, Spring 2008

1. **General Information**

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Section 001: 8:00-8:50 AM: MWF, 347 Whitehall Classroom Building
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2. **Texts**

2.1. **Required Texts:** *Journey Through Genius: The Great Theorems of Mathematics*, by William Dunham. ISBN-10: 014014739X

Math Through The Ages: A Gentle History for Teachers and Others, Expanded Edition, by William P. Berlinghoff and Fernando Q. Gouva. ISBN-10: 0883857367

A Source Book in Mathematics, by D. E. Smith. ISBN-10: 0486646904

2.2. **Recommended Reference for Writing:** *The Elements of Style*, by William Strunk and E. B. White.

3. **Course Description**

We begin with two quotes from John Stillwell.

> One of the disappointments experienced by most mathematics students is that they never get a course on mathematics. They get courses in calculus, algebra, topology, and so on, but the division of labor in teaching seems to prevent these different topics from being combined into a whole. In fact, some of the most important and natural questions are stifled because they fall on the wrong side of topic boundary lines. Algebraists do not discuss the fundamental theorem of algebra because "that's analysis" and analysts do not discuss Riemann surfaces because "that's topology," for example. Thus if students are to feel they really know mathematics by the time they graduate, there is a need to unify the subject.

Mathematics and its History
John Stillwell

> The best way to teach real mathematics, I believe, is to start deeper down, with the elementary ideas of number and space. . . . in fact, arithmetic, algebra, and geometry can never be outgrown. . . by maintaining ties between these disciplines, it is possible to present a more unified view of mathematics, yet at the same time to include more spice and variety.

Numbers and Geometry
John Stillwell

[1] I reserve the right to change or amend this syllabus at any time for any reason.

A course in the history of mathematics is a great opportunity for students of mathematics to remedy the disappointment described by Stillwell. We will think seriously about a variety of the pillars of mathematics, the truly outstanding theorems, while trying to maintain balance and dialogue among the most fundamental branches of mathematics. In this way, we will hopefully create for ourselves a cohesive vision of mathematics and establish connections between mathematics and the non-mathematical world.

Our class sessions will consist of discussions based on daily readings. The readings will be structured around *Journey Through Genius*, with additional material taken from the other course texts. There will be a variety of short assignments, from journal responses to traditional problems, and these will often be a starting point for our discussions. The readings and short assignments will be the common material we draw from. Students will also be responsible for writing one biographical paper and completing one course project. These are described in detail in a following section, and will be the work we do as individuals pursuing our own interests.

One comment that must be made regarding this course is that there are many possible paths we could take in our investigation of the pillars of mathematics. For example, how does one choose the "best" theorems? What does that even mean? What makes a theorem beautiful? Or useful? Though we will be following the path laid out by the course texts, these questions are important and a large part of our discussions should be dedicated to developing an understanding of our own mathematical aesthetic and how it differs from those of other people. Consider, for example, the following quote from Paul Erdős.

> *Beauty* and *insight* – these are words that Erdős and his colleagues use freely [in reference to mathematics] but have difficulty explaining. "It's like asking why Beethoven's Ninth Symphony is beautiful," Erdős said. "If you don't see why, someone can't tell you. I know numbers are beautiful. If they aren't beautiful, nothing is."
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> *The Man Who Loved Only Numbers:*
> *The Story of Paul Erdős and the Search for Mathematical Truth*
> Paul Hoffman

While Erdős's thoughts are satisfying in some ways, they fall short in others. There must be reasons why certain theorems are almost universally accepted as profoundly beautiful while others are considered less important. What drives our sense of mathematical value, both individually and collectively? How have those values changed over time? These are perhaps the most fundamental questions to ask in a history of math course because the mathematicians whose work we are studying were inspired by their own values, leading directly to where we are now. So, while we will be reading texts by experts in the history of mathematics, we must look at the topics they have selected with, simultaneously, the utmost respect and a sharply critical eye. The following passage from *Ways of Reading* is very relevant to this point.

For good reasons and bad, students typically define their skill by reproducing rather than questioning or revising the work of their teachers (or the work of those their teachers ask them to read). It is important to read generously and carefully and to learn to submit to projects that others have begun. But it is also important to know what you are doing – to understand where this work comes from, whose interests it serves, how and where it is kept together by will rather than desire, and what it might have to do with you. To fail to ask fundamental questions – Where am I in this? How can I make my mark? Whose interests are represented? What can I learn by reading with and against the grain? – to fail to ask these questions is to mistake skill for understanding, and it is to misunderstand the goals of a liberal education.

Ways of Reading
David Bartholomae and Anthony Petrosky

4. **On Reading**

We learned that if our students had reading problems when faced with long and complex texts, the problems lay in the way they imagined a reader – the role a reader plays, what a reader does, why a reader reads (if not simply to satisfy the requirements of a course). When, for example, our students were puzzled by what they read, they took this as a sign of failure. ("It doesn't make any sense," they would say, as though sense were supposed to be waiting on the page, ready for them the first time they read through.) And our students were haunted by the thought that they couldn't remember everything they had read... or if they did remember bits and pieces, they felt that the fragmented text they possessed was evidence that they could not do what they were supposed to do. Our students were confronting the experience of reading, in other words, but they were taking the problems of reading – problems all readers face – and concluding that there was nothing for them to do but give up...

Our students need to learn that there is something they can do once they have first read through a complicated text; successful reading is not just a matter of "getting" an essay the first time... You work on what you read, and then what you have at the end is something that is yours, something you made.

Ways of Reading
David Bartholomae and Anthony Petrosky

In this course, our central activity will be reading mathematical texts independently. This is not a task that most students are prepared for. Mathematics textbooks are generally viewed by students as databases for homework problems or supplements to lectures rather than as books to be enjoyably read. This is a consequence of the fact that textbooks are often designed and written with conflicting goals in mind: to provide students with homework problems and examples, to provide instructors with flexibility for a variety of courses, to serve students in a diverse range of majors, etc. As a result, while there are some beautiful and fascinating textbooks available, many textbooks are not pleasures to read, which is unfortunate. When a student does stumble upon a textbook that is worth reading, their prior experience often discourages them from investing the time and effort needed to benefit from a serious reading.

The texts we will be reading are not textbooks in the usual sense. They were written to be read, in detail and with joy, by interested readers. They were created for their own purpose, not in an attempt to serve the purposes of others. Because of this, the readings will be challenging; we will need to constantly refine our reading abilities. We need to be careful not to mistake these ordinary challenges for insurmountable obstacles. We also need to recognize, from the beginning, that the act of reading will not get any easier as we go along. Rather, we will become familiar with and accepting of the challenges these texts offer us. The two quotes in this section offer valuable insight regarding reading that we should keep in mind throughout the semester.

> In order to appreciate *[Finnegans] Wake's* reader-friendliness, however, one has to abandon two assumptions about the act of reading which frequently exist side-by-side (though they are, on the surface at least, contradictory). One is that reading is an act of mastery whereby the text is made to yield up all its secrets and allowed to hold nothing back; the other is that reading is a passive experience whereby the reader receives meanings unambiguously communicated by the text. The *Wake* will never be mastered... More than this, however: the *Wake* teaches us, in a most delightful way, that *no* text can be mastered, that meaning is not something solid and unchanging beneath the words, attainable once and for all. All reading, the *Wake* insists, is an endless interchange: the reader is affected by the text at the same time as the text is affected by the reader, and neither retains a secure identity upon which the other can depend.
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> "Reading Joyce," in *The Cambridge Companion to James Joyce*
> Derek Attridge

5. **Special Presentation by David Bressoud**

In conjunction with MA 330, the UK Math Club will be hosting a talk by David Bressoud, President-Elect of the Mathematical Association of America, Professor of Mathematics at Macalester College. His talk will be on Friday, March 28, at Noon in Classroom Building Room 102. *All MA 330 students are required to attend if they do not have a class conflict.* There will be an extra assignment related to the talk.

For the case of students enrolled in a course meeting at noon on Fridays, each student is responsible for telling me in advance what course they are enrolled in; I will verify their enrollment status through the faculty course roll database. For students with a class conflict, an alternate assignment will be provided.

6. **Poster Presentations**

As a part of the course project described below, students will prepare a poster presenting their project. These posters will be displayed for the class during our final exam period. The math department would like to laminate and display a selection of these posters in the hallways of Patterson Office Tower. We hope that this will add some flavor to the department and provide a better sense of community for our students as well as prominently displaying mathematics. While it is not a requirement for the course, during the semester I will ask students to donate their posters to the department for this purpose.

7. **Course Assessment**

- *Attendance and Participation*
  - You must be present and engaged in class discussion each day. I will pass around an attendance sheet each day.
  - *WARNING:* Signing another person's name on the attendance sheet will result in an automatic grade of E for the course.

- Engagement does not mean you have to talk every day, or meet some quota of comments. It means you have to listen to what other people are saying and share your thoughts from time to time. I will try to use the short assignments to facilitate participation, so be prepared for me to ask you to share your responses in class.
  - Your participation grade will be largely subjective. If you have any concerns, please come talk to me.
  - You are allowed 2 unexcused absences. Beyond that, you will lose 2% of your overall course grade for each unexcused absence.
- *Short Assignments*
  - I will assign short assignments on a regular basis. They will take a variety of forms: for example, I might request a written reflection on the reading or I might assign a traditional problem set.
  - I will regularly require typed assignments. Look at the course website for some suggestions on word processing for mathematics.
  - *WARNING:* No late work will be accepted.
- *Biographical Essay*
  - You will write one biographical essay about a notable mathematician. The biographical essay should be approximately 2000 words in length (around 6 pages with 1 inch margins, 12 point Times New Roman font, double spaced). Your biographical essay must include significant mathematical content; in other words, this is a biography about both the life and the mathematical life of the mathematician.
  - To find a mathematician to write about, look through our course texts and the relevant links on the course website.
  - You will turn in a first version of your paper for peer review; the first version must be a complete paper which you will revise substantially to create your final version.
- *Course Project*
  - You will choose a topic for and complete a major project related to the history of mathematics during the course of the semester. This will be a written project, approximately 3500 words in length (around 10.5 pages with 1 inch margins, 12 point Times New Roman font, double spaced). All projects will include significant mathematical content, though the projects will take a variety of forms: one student might write a report about one of Hilbert's problems, another might create a connected set of lesson plans for a high school class incorporating history of math, while yet another might translate papers by Euler from Latin to English for submission to The Euler Archive, providing an analysis of the mathematics involved. The only restriction is that the course project may not be a biographical paper.
  - You will turn in a first version of your project for peer review; the first version must be a complete project which you will revise substantially to create your final version.
  - You will create a poster presenting your project for display during the final exam time for the course.

8. **Course Grades**

Your total grade will be determined by your attendance and participation, short assignments, special presentation attendance and assignment, biographical essay, and project. The grading scale will be no stricter than the usual A>89.9, B>79.9, C>69.9, D>59.9, E otherwise, weighted as follows:

- Attendance and Participation: 10%
- Short Assignments: 20%
- Attendance and Assignment for Special Presentation by David Bressoud: 5%
- Biographical Essay:
  - First Version: 10%
  - Final Version: 15%
- Project:
  - First Version: 10%
  - Final Version: 20%
  - Poster: 10%

9. **Academic Integrity and Classroom Demeanor**

All students are expected to follow the academic integrity standards as explained in the University Senate Rules, particularly Chapter 6, found at:

http://www.uky.edu/USC/New/SenateRulesMain.htm

Turn off all cell phones, pagers, etc. prior to entering the classroom. ***You are not to use your cell phones, pagers, or other electronic devices during class.*** An attitude of respect for and civility towards other students in the class and the instructor is expected at all times.

10. **Classroom and Learning Accommodations**

Any student with a disability who is taking this course and needs classroom or exam accommodations should contact the Disability Resource Center, 257-2754, room 2 Alumni Gym, jkarnes@uky.edu.

11. **Tentative Schedule**

Abbreviations:
JTG = Journey Through Genius
MTA = Math Through the Ages
SBM = A Source Book in Mathematics
The *Extra Fun* readings listed below are not required for class, but you should investigate them for some extra fun!

Jan 9: Syllabus Review
Jan 11: JTG: Preface

Jan 14: JTG: Ch 1, pgs 1–17
Extending the remarks on page 10 of JTG, familiarize yourself with a proof that $\sqrt{2}$ is irrational that does not use results about decimal expansions. (Wikipedia is one possible source.)

Jan 16: JTG: Ch 1, pgs 17–26
Extra Fun: Relating to JTG, page 24, read the selection by Hermite on pages 99–106 in SBM proving that e is transcendental.
Jan 18: MTA: Sketches 1 and 2

Jan 21: JTG: Ch 2, pgs 27–37
MTA: Sketch 14
Jan 23: JTG: Ch 2, pgs 37–47
Jan 25: LaTeX presentation

Jan 28: JTG: Ch 2, 48–53
MTA: Sketch 12
Jan 30: JTG: Ch 2, pgs 53–60
MTA: Sketch 19
Extra Fun: Read pages 351–388 in SBM, the original works of Saccheri, Lobachevsky, and Bolyai.
Feb 1: JTG: Ch 3, pgs 61–68
Extra Fun: Read pages 348–350 in SBM, containing comments by Gauss on the construction of regular polygons.

Feb 4: JTG: Ch 3, pgs 68–75
Extending the remarks on page 69 of JTG, familiarize yourself with a proof that the Euclidean algorithm works. (Wikipedia is one possible source.)
Feb 6: JTG: Ch 3, pgs 75–83
Extra Fun: Read pages 127–148 in SBM, the work of Chebyshev related to the Prime Number Theorem[2].
Feb 8: MTA: Sketch 15
Topic for Biographical Paper due

Feb 11: JTG: Ch 4, pgs 84–99
Feb 13: JTG: Ch 4, pgs 106-112
MTA: Sketch 7
Feb 15: JTG: Ch 4, pgs 99–105

Feb 18: JTG: Ch 5, pgs 113–118
Feb 20: JTG: Ch 5, pgs 118–132
Feb 22: MTA: Sketches 5 and 10

Feb 25: Peer Edit Session: First Version of Biographical Paper
Feb 27: JTG: Ch 6, pgs 133–142
MTA: Sketch 11

[2] The Prime Number Theorem states that the number of primes less than a given number n is approximately $\frac{n}{\log(n)}$, where log is the natural log, not log base 10, and this approximation gets better and better as n goes to infinity.

Feb 29: JTG: Ch 6, pgs 142–154
SBM: Pages 203–206, Cardan's original paper.

Mar 3: MTA: Sketch 17
Extra Fun: Read pages 55–66, 201–202, 207–212, 261–267, and 440–454 in SBM. These are papers by Wallis, Wessel, Cardan, Ferrari, Abel, and De Moive related to solving polynomial equations and understanding complex numbers.
Mar 5: No Reading
Mar 7: Final Version of Biographical Paper Due

Spring Vacation: March 10-14

Mar 17: No Class, accounting for talk by D. Bressoud on Mar 28.
Mar 19: JTG: Ch 7, pgs 155–165
MTA: Sketches 8, 13
Mar 21: JTG: Ch 7, pgs 165–174
SBM: Pages 219–228, Wallis's exposition of Newton's binomial theorem and Newton's original letter to Leibnitz

Mar 24: JTG: Ch 7, pgs 174–183
Topic for Course Project Due
Mar 26: JTG: Ch 8, pgs 183–199
Mar 28: Special Presentation by David Bressoud at Noon in CB 102!!!
Regular Assignment: JTG: Ch 8, pgs 199–206
Extra Fun: Read pages 644–655 in SBM, Bernoulli's writing on the Brachistochrone problem

Mar 31: JTG: Ch 9, pgs 207–212
Apr 2: JTG: Ch 9, pgs 212–218
Apr 4: JTG: Ch 9, pgs 218–222

Apr 7: Peer Edit Session: First Version of Course Project
Apr 9: JTG: Ch 10, pgs 223–229
Apr 11: JTG: Ch 10, pgs 229–235
Extra Fun: Read pages 91–94 in SBM, Euler's proof that every number can be written as a sum of four squares.

Apr 14: JTG: Ch 10, pgs 235–244
Following up on JTG page 239, familiarize yourself with a detailed statement of the Fundamental Theorem of Algebra. (Wikipedia is one possible source.)
Extra Fun: Read pages 292–306 in SBM, Gauss's writings on the Fundamental Theorem of Algebra.
Apr 16: No Reading
Apr 18: Final Version of Course Project Due

Apr 21: JTG: Ch 11, pgs 245–259

Apr 23: JTG: Ch 11, pgs 259–266
Apr 25: No Reading

Finals: Course Project Poster Session.
Section 001 (8AM): Thursday, May 1, 10:30-12:30
Section 002 (1PM): Wednesday, April 30, 1-3PM