18.S097 Cultural History of Mathematics

Spring 2014

Frans Floris, *Arithmetic*, 1556

Class website: http://stellar.mit.edu/S/course/18/sp14/18.S097/

Dr. Slava Gerovitch
Office E18-420
slava@mit.edu

Wednesdays 2-4
6 units (2-0-4)
Room E18-466A

What was the connection between geometric proof and court rhetoric in Ancient Greece? Who were the most active users of mathematics in the Middle Ages? Why was mathematics viewed as a spiritual exercise during the Scientific Revolution? Why did leading experimentalists believe that mathematical language was exclusive and restrictive? Which mathematical theory best expressed the rational spirit of the Enlightenment? Where did the romantic image of a lone genius come from? Did computers change the way mathematicians work in the late twentieth century? Do mathematicians think differently if they live in different cultures?

Combining lectures and discussions, this class will explore how mathematics was practiced in various historical contexts: Greek antiquity, the Middle Ages, the Scientific Revolution, the Age of Enlightenment, the Romantic era, Victorian culture, and the tumultuous twentieth century. The students will read and discuss short articles by professional historians. The readings link mathematical innovations with contemporary developments in politics, literature, philosophy, and theology. This class presents an opportunity to gain deep cultural understanding of influential mathematical concepts and methods of reasoning.

Discussions

Each week's readings must be read prior to recitation section. Active participation in the discussions is expected.

Weekly Reading Response

A short reading response (1 page; roughly 300 words) must be submitted via the Stellar class site by 9 am every Wednesday. PDF format is preferred, but DOC and TXT are also allowed. A few tentative questions will be provided to stimulate your thoughts, but you are encouraged to raise your own questions.

Strategies for writing a good reading response:

* avoid generalities, be specific;
* define your personal stance towards issues raised in the readings;
* focus on the points where you disagree, or where you can push the argument further;
* cite examples from your personal experience or from other literature;
* ask provocative questions, even if you do not know the answers.

Your reading response will be made accessible online to other students in the class after the deadline. It may be part of discussion in class.

All the responses must be submitted to complete the course.

By the instructor's permission, graduate students may submit a 10-page final paper instead of the weekly responses.

Grading

Final grades will be based on:
Attendance (20%)
Participation in discussions (40%)
Weekly writing or Final paper (40%)

Readings

All required readings are available on the Stellar class site. The main recommended textbook is on reserve at MIT libraries:

Ronald Calinger, *A Contextual History of Mathematics to Euler* (Upper Saddle River, NJ: Prentice Hall, 1999).

Primary sources (original writings by mathematicians) are not required, but if you wish to consult them, a collection of primary sources is also put on reserve:

Ronald Calinger, ed., *Classics of Mathematics* (Englewood Cliffs, NJ: Prentice Hall, 1994).

Topics and readings

02/05 (1) Introduction

02/12 (2) Greek Mathematics and the Idea of Proof

G.E.R. Lloyd, Chapter 3, "The conception and practice of proof," and Chapter 4, "A test case: China and Greece, comparisons and contrasts," in *Demystifying Mentalities* (Cambridge, UK: Cambridge University Press, 1990), pp. 73-97, 105-134.

Recommended:

Calinger, *A Contextual History of Mathematics*, chapters 3, 4, 8.

Raviel Netz, *The Shaping of Deduction in Greek Mathematics: a Study in Cognitive History* (Cambridge, UK: Cambridge University Press, 1999).

02/19 (3) Medieval Mathematics: Theology and Commerce

Mark Thakkar, "Mathematics in Fourteenth-Century Theology," in *The Oxford Handbook of the History of Mathematics*, eds. Eleanor Robson and Jacqueline Stedall (Oxford, UK: Oxford University Press, 2009), pp. 619-638.

Joel Kaye, *Economy and Nature in the Fourteenth Century: Money, Market Exchange, and the Emergence of Scientific Thought* (Cambridge, UK: Cambridge University Press, 2004), pp. 200-220.

Recommended:

Calinger, *A Contextual History of Mathematics*, chapter 12.

02/26 (4) Early Modern Mathematics as a Voyage of Exploration

Amir R. Alexander, "Exploration Mathematics: The Rhetoric of Discovery and the Rise of Infinitesimal Methods," *Configurations*, vol. 9, no. 1 (Winter 2001): 1-36.

Recommended:

Calinger, *A Contextual History of Mathematics*, chapter 14.

Amir R. Alexander, *Geometrical Landscapes: The Voyages of Discovery and the Transformation of Mathematical Practice* (Stanford, CA: Stanford University Press, 2002).

03/05 (5) Mathematics and Theology: Views of the Infinite

Joseph W. Dauben, "Georg Cantor and Pope Leo XIII: Mathematics, Theology, and the Infinite," *Journal of the History of Ideas*, vol. 38, no. 1. (1977): 85-108.

Loren R. Graham and Jean-Michel Kantor, "A Comparison of Two Cultural Approaches to Mathematics: France and Russia, 1890-1930," *Isis* 97 (2006): 56-74.

Recommended:

Joseph W. Dauben, *Georg Cantor: His Mathematics and Philosophy of the Infinite* (Princeton, NJ: Princeton University Press, 1990).

Loren R. Graham and Jean-Michel Kantor, *Naming Infinity: A True Story of Religious Mysticism and Mathematical Creativity* (Cambridge, MA: Belknap Press, 2009).

03/12 (6) Massively Collaborative Math?

Alma Steingart, "A group theory of group theory: Collaborative mathematics and the 'uninvention' of a 1000-page proof," *Social Studies of Science* 42, no. 2 (April 2012): 185-213.

Michael J. Barany, " '[B]ut this is blog maths and we're free to make up conventions as we go along': Polymath1 and the Modalities of 'Massively Collaborative Mathematics'," WikiSym '10 Proceedings of the 6th International Symposium on Wikis and Open Collaboration, Article No. 10, ACM New York, NY, 2010.

Recommended:

Gowers, Timothy, and Michael Nielsen, "Massively collaborative mathematics," *Nature* 461, no. 7266 (15 October 2009): 879–881.

Gowers, Tim. "Is massively collaborative mathematics possible?" Gowers Weblog (with 196 responses) <http://gowers.wordpress.com/2009/01/27/is-massively-collaborative-mathematics-possible/>.

Julie Rehmeyer, "Massively Collaborative Mathematics," SIAM News (April 1, 2010) <http://www.siam.org/news/news.php?id=1731>.

03/19 (7) Doing Mathematics on/with/by a Computer

Donald MacKenzie, "Slaying the Kraken: The Sociohistory of a Mathematical Proof," *Social Studies of Science* 29, no. 1 (February 1990): 7-60.

Recommended:

Donald MacKenzie, *Mechanizing Proof: Computing, Risk, and Trust* (Cambridge, MA: MIT Press, 2001).

Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge, MA: MIT Press, 2002).

04/02 (8) Mathematics as Cultivation of Virtue in the Scientific Revolution

Matthew L. Jones, "Descartes's Geometry as Spiritual Exercise," *Critical Inquiry*, vol. 27, no. 4 (Summer 2001): 40-71.

Recommended:

Calinger, *A Contextual History of Mathematics*, chapter 15.

Matthew L. Jones, *The Good Life in the Scientific Revolution: Descartes, Pascal, Leibniz, and the Cultivation of Virtue* (Chicago: University of Chicago Press, 2006).

04/09 (9) The Scientific Revolution: The Mathematization of Nature?

Steven Shapin, "Certainty and Civility: Mathematics and Boyle's Experimental Conversation," chapter 7 in *A Social History of Truth* (Chicago: University of Chicago Press, 1994), pp. 310-354.

Recommended:

Calinger, *A Contextual History of Mathematics*, chapters 16 and 17.

Peter Dear, *Discipline and Experience: The Mathematical Way in the Scientific Revolution* (Chicago, IL: University of Chicago Press, 1995).

04/16 (10) Mathematics as Rational Calculation in the Enlightenment

Lorraine Daston, "Enlightenment Calculations," *Critical Inquiry* 21 (Autumn 1994): 182-202.

Lorraine Daston, "Fitting Numbers to the World: The Case of Probability Theory," in *History and Philosophy of Modern Mathematics*, eds. William Aspray and Philip Kitcher (Minneapolis, MN: University of Minnesota Press, 1988), pp. 221-237.

Recommended:

Lorraine Daston, *Classical Probability in the Enlightenment* (Princeton, NJ: Princeton University Press, 1995).

04/23 (11) Romantic Mathematics: Beauty, Rigor, and the Genius

Amir R. Alexander, "Tragic Mathematics: Romantic Narratives and the Refounding of Mathematics in the Early Nineteenth Century," *Isis* 97 (2006): 714-726.

Judith V. Grabiner, "Who Gave You the Epsilon? Cauchy and the Origins of Rigorous Calculus," *The American Mathematical Monthly* 90 (1983): 185-194.

Recommended:

Amir Alexander, *Duel at Dawn: Heroes, Martyrs, and the Rise of Modern Mathematics* (Cambridge, MA: Harvard University Press, 2010).

Judith Grabiner, *The Origins of Cauchy's Rigorous Calculus* (New York: Dover, 2005).

04/30 (12) Oral and Written Cultures of Education and Research

Andrew Warwick, "A Mathematical World on Paper: Written Examinations in Early 19th Century Cambridge," *Studies in the History and Philosophy of Modern Physics*, vol. 29, no. 3 (1998): 295-319.

David E. Rowe, "Making Mathematics in an Oral Culture: Göttingen in the Era of Klein and Hilbert," *Science in Context* 17 (2004): 85-129.

Recommended:

David E. Rowe, “Klein, Hilbert, and the Göttingen Mathematical Tradition,” *Osiris*, 2nd series, 5 (1989): 186-213.

Andrew Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics* (Chicago: University of Chicago Press, 2003).

05/07 (13) Mathematics and the Arts: The Rise of Modernism

Jeremy Gray, “Modernism in Mathematics,” in *The Oxford Handbook of the History of Mathematics*, eds. Eleanor Robson and Jacqueline Stedall (Oxford, UK: Oxford University Press, 2009), pp. 663-683.

Recommended:

Jeremy J. Gray, *Plato’s Ghost: The Modernist Transformation of Mathematics* (Princeton, NJ: Princeton University Press, 2008).

Leo Corry, “How Useful is the Term ‘Modernism’ for Understanding the History of Early Twentieth-Century Mathematics?” in *Modernism in the Sciences, ca. 1900-1940*, eds. Moritz Epple and Falk Mueller (Berlin, Akademie, forthcoming). <http://www.tau.ac.il/~corry/publications/articles/Math-Modernism.html>

Linda Dalrymple Henderson, *The Fourth Dimension and Non-Euclidean Geometry in Modern Art* (Princeton, N.J.: Princeton University Press, 1983).

Joan L. Richards, *Mathematical Visions: The Pursuit of Geometry in Victorian England* (Boston: Academic Press, 1988).

05/14 (14) Mathematics as a “Cultural Connector”: The Case of Nicolas Bourbaki

David Aubin, “The Withering Immortality of Nicolas Bourbaki: A Cultural Connection at the Confluence of Mathematics, Structuralism, and the Oulipo in France,” *Science in Context*, vol. 10, no. 2 (1997): 297-342.

Peter Galison, "Structure of Crystal, Bucket of Dust," in *Circles Disturbed: The Interplay of Mathematics and Narrative*, ed. by Apostolos Doxiadis and Barry Mazur (Princeton University Press, 2012), pp. 52-78.

Recommended:

Leo Corry, “Nicolas Bourbaki: Theory of Structures,” chapter 7 in *Modern Algebra and the Rise of Mathematical Structures* (Basel: Birkhäuser, 1996). <http://www.tau.ac.il/~corry/publications/articles/pdf/bourbaki-structures.pdf>

Liliane Beaulieu, “Bourbaki’s Art of Memory,” *Osiris*, 2nd series, 14 (1999): 219-251.