Math 7h | Professor: Padraic Bartlett

Syllabus for Math 7h

Weeks 1-10 | *UCSB 2014*

Basic Course Information

- Professor: Padraic Bartlett
- Class time/location: Tuesday, Girvetz 2129, 5-6:15pm.
- Office hours/location: Tuesday, 2-3pm, South Hall 6516. Additionally, I have office hours from 1-2pm Tuesday and 1-3pm Thursday for my other three classes; you are welcome to attend these office hours instead if they work better for you, though students from those classes "have priority" during these time slots.
- Reading/response due dates: The Tuesday after the relevant talk is given, before the start of class.
- Email: padraic@math.ucsb.edu.
- Course webpage: http://math.ucsb.edu/~padraic/math7h_w2014/math7h_w2014.html, or Gauchospace.

Course Description

Here's a fun game for you to play out in the real world: ask people what they think research mathematicians do. You'll get some pretty interesting answers, usually ranging from "count things **really** quickly" to "yell at college students about factoring polynomials."

Now, ask yourselves the same question: what do you think research mathematicians do? After all, if you're in this class you might be thinking about being a mathematician. What answers come to mind?

If you're like most first- or second-year students, you might be drawing a blank here. Thus far in your mathematical career, pretty much all of the people that you've known to be mathematicians have been teachers. Furthermore, most of the mathematics you've studied has been pretty well hammered out since the 17th century or earlier; unless you've been lucky enough to live near a math circle or spend a lot of time reading Wikipedia articles, you may have not encountered a mathematical topic that's been discovered in recent memory. So: what do research mathematicians do? What is research in mathematics like? This class is designed to answer these questions.

Over the next year, we're going to look at topics from pretty much every area of mathematical research we can get to, discuss currently open problems in mathematics, and essentially create a "preview" of what your future mathematics classes may look like. There is no required background for this course, beyond being currently enrolled in one of the

university's calculus sequences; any background material that we need will be covered in lecture or homework in this class.

Also, it's going to be fun!

Course Evaluation

Roughly speaking, this class consists of three parts:

- On Tuesdays, you come to class and learn about some mathematical subject via some sort of interactive talk.
- Then, you go home and look on Gauchospace, where the original research paper or section of a graduate-level textbook that the talk was drawn from is posted.
- You read this paper before the next class.
- Then, you log onto Gauchospace and write a response to the reading of some sort: i.e. write a question about something you saw in the paper, or something you thought was cool, or answer someone else's question, or mention something that seems related! Length should be at least a paragraph, and content must be nontrivial (i.e. any response should demonstrate that you actually read part of the paper and thought about it some, instead of just being some generic "yeah it was a paper that certainly contained words.")

With this in mind, this is how your grade will be determined in Math 7H:

- **Attendance** (50%.) There will be either nine or ten classes (depending on some wrinkles with travel plans.) Attendance will be taken at the start of each class. Show up!
- **Readings** (50%). There will be nine or ten papers. Read them (or some of them; I don't expect everyone to be able to read the entirety of most papers) before the next class. Once you do, go to the forums on Gauchospace and write something about what you read: either a question, or something you thought was neat, or an answer to someone else's question. If you do this, you get credit here! Responses must be made before the next class to get credit.

If you attend $(n-2)/n$ classes and respond on Gauchospace to $(n-2)/n$ readings, you will get an A; other combinations that total to $2n-4$ "things" will also get A's. Lower performances in the class will receive proportionally lower marks, but seriously, just do the work. It'll be fun, I swear.

Course Textbook

Doesn't exist.

Course Timeline

There isn't one. I have a large stack of lectures prepared for this course; however, I want to adjust the class as it progresses to follow what **you** are interested in! Accordingly, the topics for this sequence will shift to match the interests of the students in the course over time. This means that if there's anything you remember from a random Wikipedia article you were interested in, or from a math talk you saw once, tell me about it! There are very few limits to the mathematical concepts we can work on in this class.

That said, some topics we may discuss include:

- Cardinality: i.e. the "size" of infinity.
- The Collatz conjecture.
- Cryptography.
- The four-color theorem.
- The prisoner's dilemma.
- Combinatorial game theory.
- Electrical circuits and random walks.
- The unit distance graph problem.
- Dynamical systems and chaos theory.
- The surreal number system.
- Pen-and-paper constructions.
- The mathematics of origami.
- Stirling's approximation.
- Asymptotic series.
- Barker sequences and ECC.
- The art gallery theorem.
- The axiom of choice.
- Latin squares.
- Ramsey theory.
- Sorting algorithms.
- P versus NP.
- Generating functions.
- Graph theory (many, many subtopics.)
- Knot theory.