2017-09-06

Information

Misc class information

- **18.100B**
- Prof: David Jerison
  - 2-272
- Office hours
  - Tuesday 3:00PM - 4:00PM
  - Friday 3:00PM - 4:00PM
- Important that you read all that is assigned
- PSETs due on Wednesdays

Homework policies

- Collaboration is encouraged
  - But no copying
    - Any observed copying will result in a zero
  - If you didn't collaborate, write "no consultation"
- Allowed one automatic extension without penalty
  - No excuse needed
  - All other late work is graded for half-credit

Textbook

- Called "Baby Rudin"
  - Has some problems
    - It's efficient and doesn't hold your hand
    - Unclear as to what is the **important** ideas
      - Things hidden in excercises are important
    - No graphics
    - Generally very difficult to read

Overview of Class

- Goals
  1. Learn foundations of calculus, series, and differential equations
  2. Learn to read and write "rigorous" math
- Continuation classes
  - 18.101 Analysis and Manifolds
  - 18.102 Introduction to Functional Analysis
  - 18.103
  - 18.112
  - 18.901
- Number theory makes heavy use of analysis

And So it Begins

What is e?

- $e = \lim n \to \infty \left(1 + \frac{1}{n}\right)^n$
- $e = \sum_{n=0}^{\infty} \frac{1}{n!}$
- ln was first created, but $log_1 0$ was used because it could make calculation books simpler

Forier series

- When Forier series were developed, it raised questions about the nature of real numbers
- $\sum_{n=1}^{\infty} \frac{sin(nx)}{n} = \frac{\pi}{2} - x$
- MIT researcher looked at $\sum_{n=1}^{\infty} a_n(w) \frac{sin(nx)}{n}$
  - Where $a_n(w)$ are called **Gaussian random variables**
    - Meant to represent Brownian motion

Key question

- *How do we determine the distance between two functions?*
  - Maybe $d(f, g) = |f(x) - g(x)|$
- Actually, our notion of distance can affect problems
  - For some problems, $d = \int_0^{\pi}$

Back to our question: What are real numbers?

- **Field** = a set with addition and multiplication defined
  - Also must set some axioms
    - Must be closed under addition
    - Must satisfy commutative addition
    - Must satisfy associative addition
    - Must havce a zero element that completes identity
    - Must satisfy the existence of an additive inverse
    - Must satisfy associated multiplicative axioms
    - Must satisfy distributive property
  - Different from vector spaces
- **Ordered set**
  -
- **Ordered field**