CS1001

Lecture 19

Overview

- Midterm
- OOP Wrap-up
- Functions, Hilbert's Hotel

Goals

- Learn foundations of modern functions/etc

Assignments

- Brookshear: Ch 5.5, Ch 6.3/6.4, Ch 7 (especially 7.7) (Read)
- Read linked documents on these slides (slides will be posted in courseworks)

Midterm

- Expected Mean was 70. Actual Mean was ~67
- All grades are B- or higher (good work)
  - A/A- is >= 81
  - B to B+ is 55 to 81
  - B- is < 55

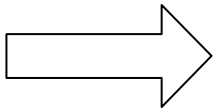
Grade Distribution

- 4 Homeworks: 28%
- Tech project: 16%
- Final Paper: 16%
- Midterm: 17%
- Final: 23%

Sets

- Functions are really just maps from a set of things to another set of things
  - For Example, f(x) = 2x establishes the discrete map (1 =>2, 2=>4, 3=>6 …) Since f(1) = 2, f(2) = 4, f(3) = 6
- Most functions we work with are *continuous* and work over the real numbers

Propositional Logic

- Information definition: a **<u>proposition</u>** is a statement of **fact**
  - "It is raining" (english)  Raining
- Connectives: operators on propositions
  - And, or, not, implies, if and only if

$$\wedge, \vee, \neg, \rightarrow, \leftrightarrow$$

Theories

- A **Theory** in propositional logic is a set of constants, functions, relations and axioms.
- Example: (theory of ordered integers)
  - Constants: non-negative integers
  - Function: +, Relation: <
  - Axioms: $\neg(x < x)$

    $0 < x \rightarrow y < x + y$

    $(x < y) \rightarrow \neg(y < x)$

Why?

- Why do computer scientists care?
- Because theories are *specifications* of a collection of structures
- To reason about code correctness
- To enable code transformations
  - Must preserve invariants

Key Idea

- Sets and mappings define a function
- Functions (along with axioms and relations) form theories
- Theories are the foundation of logic
- Our entire system of logic is built on the axioms of arithmetic (+, -, etc)

Sets

- A finite set holds some number of things.
- An infinite set holds a *concept*, not a number. It holds an infinite number of things.
- Are all infinite sets equal in size? No! (Cantor)

Hilbert's Hotel

- http://www.salon.com/comics/lay/2002/09/10/lay/
- Is the set of Real Numbers equal to the size of the set of Integers? In other words are there more integers than real numbers? What about fractions? Are there more Rational (fractional) numbers than integers?