CSC236 fall 2012

Theory of computation

That's me!

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BA4270 (behind elevators)

good

Course web page 416-978-5899

really bad!

Using Introduction to the Theory of Computation

Outline

Introduction

Chaper 1, Simple induction

Notes

Why reason about computing?

guess & check
old, really fast.

infinitely many
strings

- It's more than just hacking
- Testing isn't enough
- You might get to like it (?!*)

weird.

How to reason about computing

math is messy
many drafts
polished over time.

- It's messy...

- It's art...

proof is literature
no Nobel required —
this year.

How to do well at this course

www.cdf.toronto.edu/~heap/236/F12/

- Read the course information sheet as a two-way promise
- Question, answer, record, synthesize
- Collaborate with respect

see course info

What should you already know?

148 → loops
148 → recursion

- $\boxed{\text{Chapter 0}}$ material from *Introduction to Theory of Computation*
- CSC165 material, especially the mathematical prerequisites (Chapter 1.5), proof techniques (Chapter 4), and the introduction to big-Oh (Chapter 5).
- But you can *relax* the structure

What'll you know by December?

- Understand, and use, several flavours of induction
  simple, complete, structural, well-ordering.
- Complexity and correctness of programs — both recursive and iterative
- Formal languages, regular languages, regular expressions grep.
  finite state machine

Domino fates foretold — simple induction thm

what could go wrong?

DOMINO DOMINO DOMINO DOMINO DOMINO DOMINO DOMINO DOMINO DOMINO DOMINO DOMINO DOMINO

falling transfers →

fall. blocking wall

$$[P(0) \wedge (\forall n \in \mathbb{N}, P(n) \Rightarrow P(n+1))] \Longrightarrow \forall n \in \mathbb{N}, P(n)$$

all fall down.

If the initial case works,
and each case that works implies its successor works,
then all cases work

$P(n)$: A

~~Every~~ set with n elements has exactly 2^n subsets

Use: $[\, P(0) \wedge (\forall n \in \mathbb{N}, P(n) \Rightarrow P(n+1))\,] \Longrightarrow \forall n \in \mathbb{N}, P(n)$

$P(0)$ $\quad \{\} \longrightarrow \{\}$ — $2^0 = 1$

Scratch work:

Every set with n elements has exactly 2^n subsets...

Use: $[\,P(0) \wedge (\forall n \in \mathbb{N}, P(n) \Rightarrow P(n+1))\,] \Longrightarrow \forall n \in \mathbb{N}, P(n)$

Every set with n elements has exactly 2^n subsets...

Use: $[\,P(0) \ \wedge \ (\forall n \in \mathbb{N}, P(n) \Rightarrow P(n+1))\,] \Longrightarrow \forall n \in \mathbb{N}, P(n)$

For every $n \in \mathbb{N}$, $12^n - 1$ is a multiple of 11

Use: $[\,P(0) \;\wedge\; (\forall n \in \mathbb{N}, P(n) \Rightarrow P(n+1))\,] \Longrightarrow \forall n \in \mathbb{N}, P(n)$

Scratch work: How to connect n to $n+1$?

For every $n \in \mathbb{N}$, $12^n - 1$ is a multiple of 11

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Notes