Welcome to the Stanford Automata Theory Course

Why Study Automata? What the Course is About

Why Study Automata?

- A survey of Stanford grads 5 years out asked which of their courses did they use in their job.
- Basics like intro-programming took the top spots, of course.
- But among optional courses, CS154 stood remarkably high.
 - 3X the score for AI, for example.

How Could That Be?

Regular expressions are used in many systems.

- E.g., UNIX a.*b.
- E.g., DTD's describe XML tags with a RE format like person (name, addr, child*).

 Finite automata model protocols, electronic circuits.

How? – (2)

 Context-free grammars are used to describe the syntax of essentially every programming language.

 Not to forget their important role in describing natural languages.

And DTD's taken as a whole, are really CFG's.

How? – (3)

 When developing solutions to real problems, we often confront the limitations of what software can do.

- Undecidable things no program whatever can do it.
- Intractable things there are programs, but no fast programs.

Automata theory gives you the tools.

Other Good Stuff

 We'll learn how to deal formally with discrete systems.

 Proofs: You never really prove a program correct, but you need to be thinking of why a tricky technique really works.

 We'll gain experience with abstract models and constructions.

Models layered software architectures.

Automata Theory – Gateway Drug

This theory has attracted people of a mathematical bent to CS, to the betterment of all.

- Ken Thompson before UNIX was working on compiling regular expressions.
- Jim Gray thesis was automata theory before he got into database systems and made fundamental contributions there.

Course Outline

Regular Languages and their descriptors:

- Finite automata, nondeterministic finite automata, regular expressions.
- Algorithms to decide questions about regular languages, e.g., is it empty?
- Closure properties of regular languages.

Course Outline – (2)

Context-free languages and their descriptors:

- Context-free grammars, pushdown automata.
- Decision and closure properties.

Course Outline – (3)

 Recursive and recursively enumerable languages.

- Turing machines, decidability of problems.
- The limit of what can be computed.
- Intractable problems.
 - Problems that (appear to) require exponential time.
 - NP-completeness and beyond.

Text (Not Required)

 Hopcroft, Motwani, Ullman, Automata Theory, Languages, and Computation 3rd Edition.

 Course covers essentially the entire book.