

Lecture 2: Modeling Computers



cs302: Theory of Computation
University of Virginia
Computer Science

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Menu

- Modeling Computers
- Course Organization
- Finite Automata

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What can computers do?

What is a "computer"?

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How should we model a Computer?

Colossus (1944)

Cray-1 (1976)

Apollo Guidance Computer (1969)

Introducing The IBM 5100 Portable Computer

Productivity on your desk. When you need it. When you need it.

IBM 5100 (1975)

Turing invented his model in 1936. What "computer" was he modeling?

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"Computers" before WWII



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Mechanical Computing

Handwritten calculations showing long division and multiplication, illustrating mechanical computing.

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Modeling Pencil and Paper

How long should the tape be?

"Computing is normally done by writing certain symbols on paper. We may suppose this paper is divided into squares like a child's arithmetic book."
 Alan Turing, *On computable numbers, with an application to the Entscheidungsproblem*, 1936

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Modeling Brains

•Rules for steps
 •Remember a little

"For the present I shall only say that the justification lies in the fact that the human memory is necessarily limited."
 Alan Turing

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Turing's Model

Start → A

A → B: Input: 0, Write: 1, Move: →

B → A: Input: 0, Write: 1, Move: ←

A → B: Input: 1, Write: 1, Move: ←

B → H: Input: 1, Write: 1, Move: Halt

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What makes a good model?

Ptolemy

Copernicus

Newton

$$F = GM_1M_2 / R^2$$

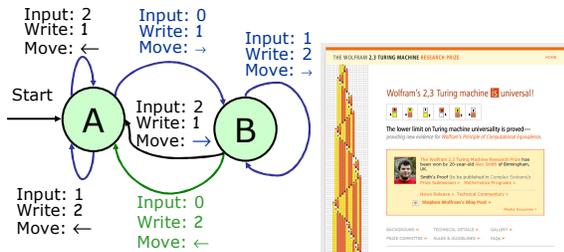
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Questions about Computing Model

- How well does it match "real" computers?
 - Can it do everything they can do?
 - Can they do everything it can do?
- Does it help us understand and reason about computing?
 - What problems can computers solve?
 - How long will it take?

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Universal Turing Machine



Course Organization

Assignments

- Reading: mostly from Sipser, some additional readings later
- Problem Sets (6 – first is due in 1 week)
- Exams (2 + final)
- Extra credit:
 - Challenge Problems
 - Communication Efforts

Help Available

- David Evans
 - Office hours (Olsson 236A):
Mondays, 2-3pm
 - Coffee Hours (Wilsdorf):
Wednesdays, 9:30-10:30am
 - Other times: open office door, or send email to arrange
- Assistants: Suzanne Collier, Qi Mi, Joe Talbott, Wuttisak Trongsirawat
 - Problem-Solving Sessions (Olsson 226D)
 - Mondays 5:30-6:30pm, Wednesdays 6-7pm

First coffee hours and problem-solving session tomorrow

Honor Code

- **Please don't cheat!**
 - If you're not sure if what you are about to do is cheating, ask first
- On most problem sets: "Gilligan's Island" collaboration policy
 - Encourages discussion in groups, but ensures you understand everything yourself
 - Don't use *found* solutions
- On most exams: work alone, one page of notes allowed

Charge

- Remember to submit registration survey
- PS1 is posted on course website: due 1 week (- 73 minutes) from now
- Coffee hours tomorrow (9:30am)
- Problem-solving session tomorrow (6pm)