Foundations of Computing

Introduction

Arkady Yerukhimovich

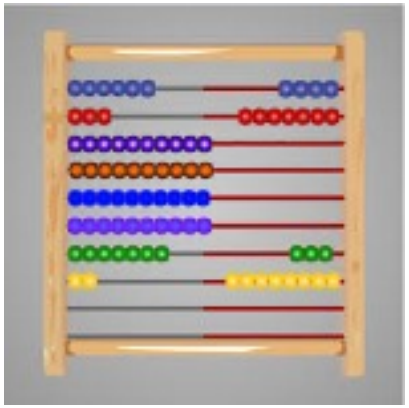
January 14, 2025

Course Information

- Course Title: CSCI 3313 – Foundations of Computation
- Professor: Arkady Yerukhimovich
- Lectures: 11:10 - 12:25 on Tuesdays and Thursdays in SEH 1300, 1400, 1450
- Labs: Wednesday 10-11:15 or 11:15-12:30 in SEH 1300, 1400, 1450
- Webpage: `https://gw-cs3313.github.io/`
- We will also use Blackboard, Gradescope, and Piazza

Outline

What is a computer?



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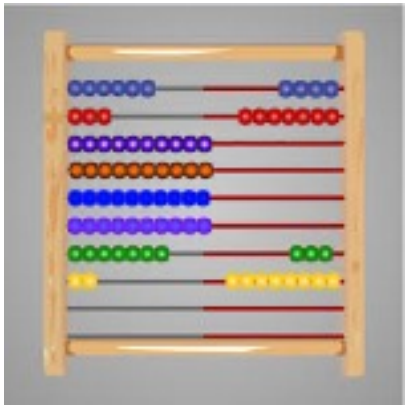

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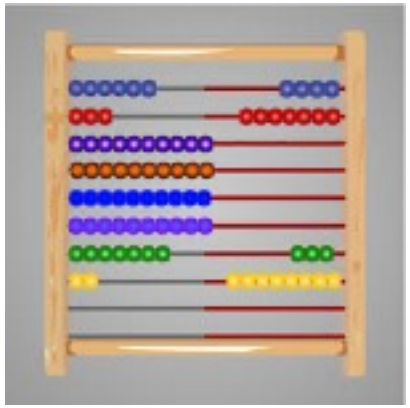

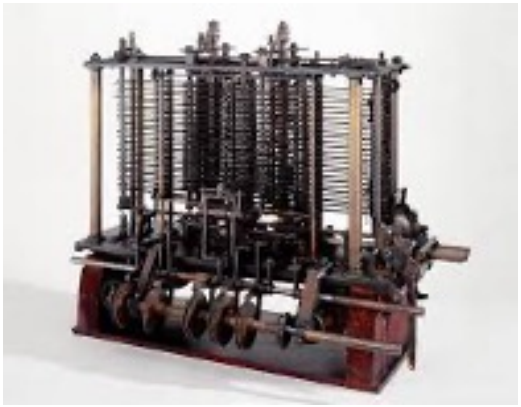

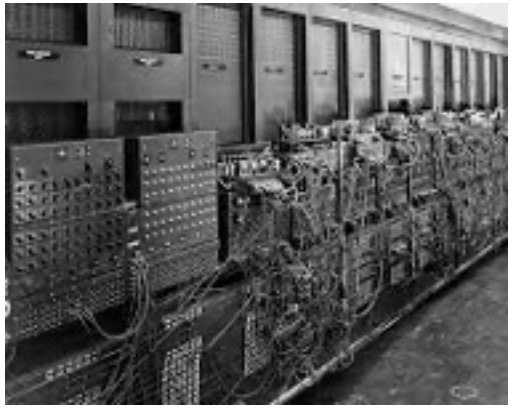

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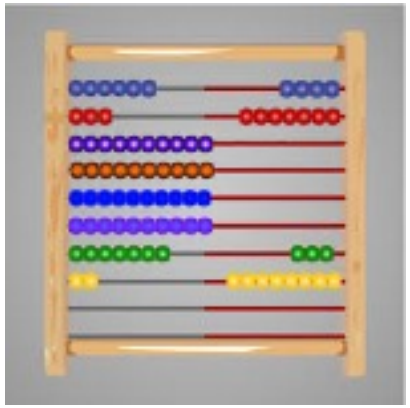

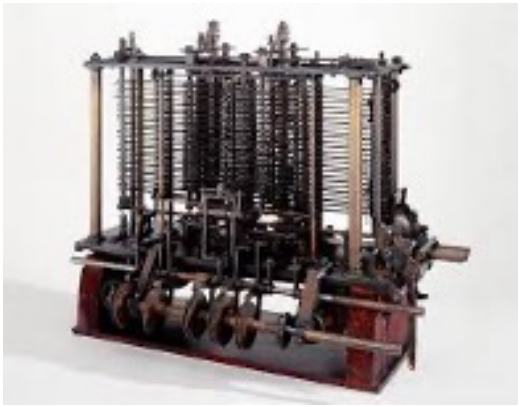

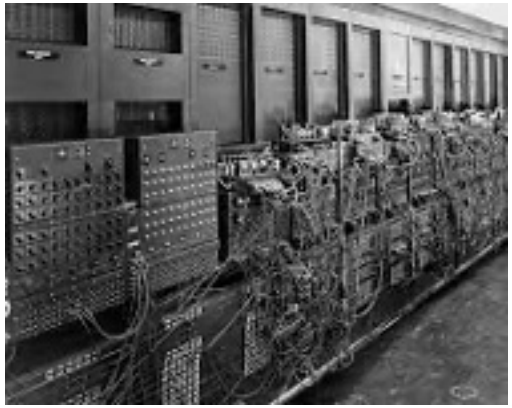

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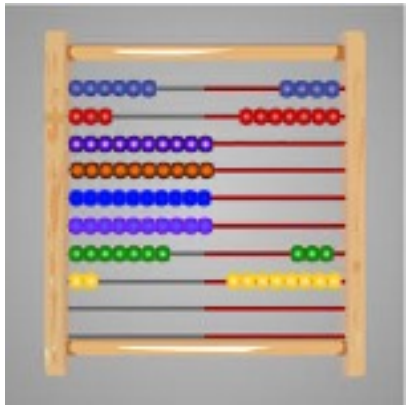

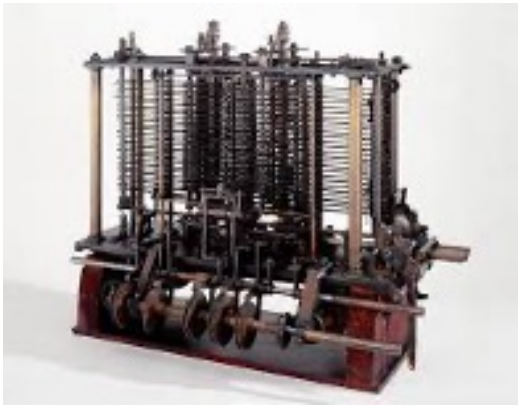

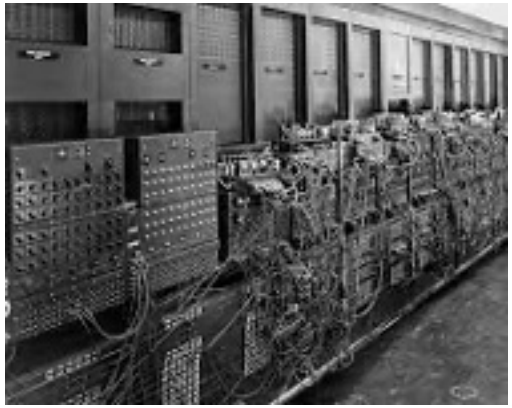

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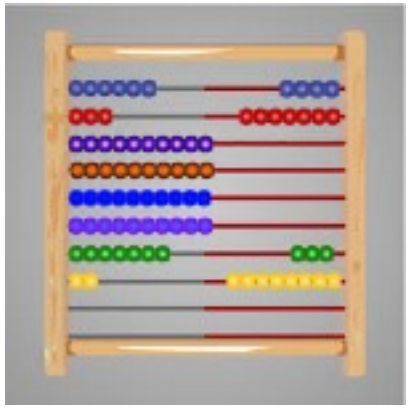

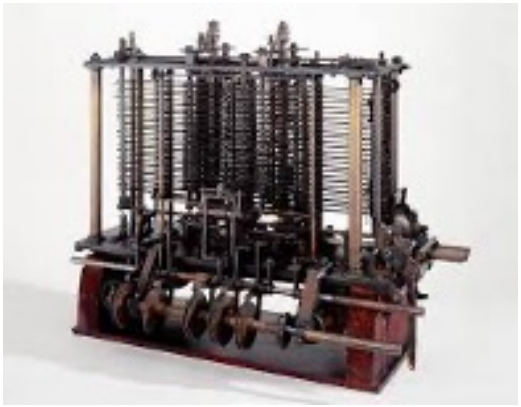

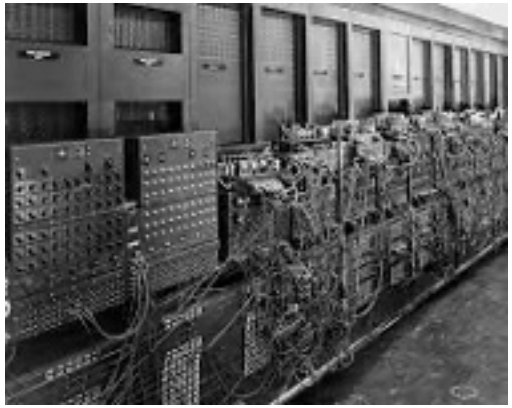

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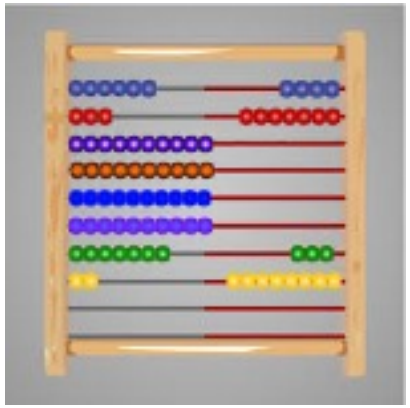

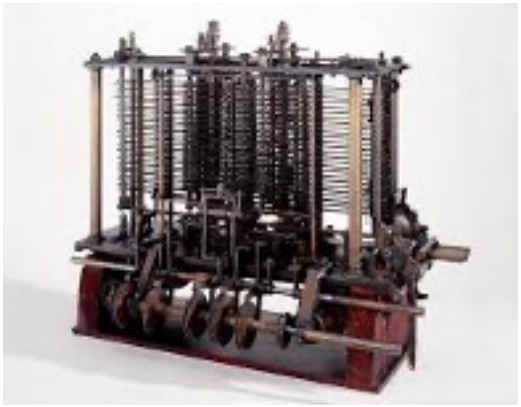

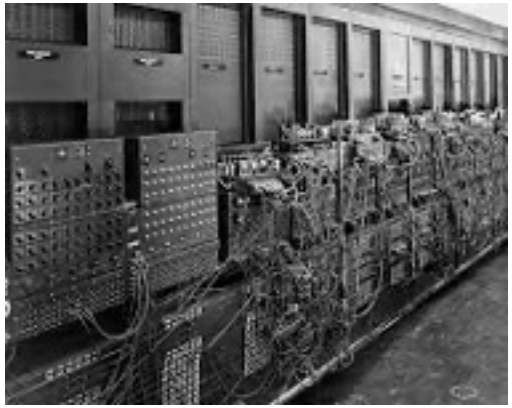

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- Arithmetic
- Basic logical operations
- Play Tron
- Algebra and calculus
- TikTok
- Destroy humanity

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Course objective

We will aim to study what a "computer" is so that we can study what it can and cannot do

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- Will give you an understanding of WHY some problems are harder than others
- Will teach you to reason about computation

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- This class will involve a good deal of math!
  - Logic, proofs, discrete math
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- My main goal is to help you build intuition
  - It is easy to get lost in notation and details
  - But, if you understand the intuition of why something is true (or false), this gets MUCH easier

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- Theoretical foundations of Computer Science
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  - Build intuition about power of respective models
- Instead of asking HOW to solve a problem, we ask
  - WHAT problems can be solved?
  - WHY are some problems harder than others?
  - Learn "fundamental properties" of computation

Course Learning Objectives

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  - Apply mathematical reasoning to assert properties of the machines
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- Understand definition of efficient computation and what can be solved efficiently
  - Reason about basic complexity classes

Course Schedule – Topics

- Part 1: Automata and Languages (weeks 1-6)
  - Finite Automata – same as Finite State Machines in Hardware!
  - Pushdown Automata – adding simple "memory" to finite state machines
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- Part 3: Complexity Theory (weeks 11-14)
  - Time complexity and P vs. NP
  - Poly-time reductions and NP-completeness
  - Interactive proofs

Outline

Instruction team

- Instructor: Arkady Yerukhimovich
- Grad TAs:
  - Suvasree Biswas
  - Jie Hou
- Undergrad TAs:
  - Freya Rosenstein
  - Ozzy Simpson
- Laboratory Assistants (LAs):
  - Laura Anker

Course Materials

- Lectures: Tuesday/Thursday – 11:10-12:25
- Labs: Wednesday – 10-11:15 or 11:15-12:30

- Course webpage
  - will have links to syllabus, lecture notes, online resources
  - `http://gw-cs3313.github.io`

- Blackboard will be used for:
  - Synchronous online lectures
  - Lecture recordings

- GradeScope will be used for:
  - Homework submissions
  - Reporting grades

- Piazza – for discussions and general questions

Lectures

Accessing Lectures:

- In person

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- In person
- Zoom: Zoom information on Blackboard

Important:

- Zoom option is ONLY for students who have a legitimate reason not to attend class in person.
- Let me know before using Zoom to attend lecture.
- Labs will only be in person.

Textbooks / Software

- Textbook:
  - "Introduction to the Theory of Computation" 3rd edition (earlier versions will work too) by Michael Sipser
- Alternate textbooks:
  - "Introduction to Formal Languages and Automata", 6th edition by Peter Linz (earlier editions will work too), JB Learning
  - "Introduction to Theoretical Computer Science" by Boaz Barak
- Online notes and resources
- JFLAP – simulator for automata
  - You can install it locally on your laptop
  - Check the tutorial video on the course webpage
  - This will be optional, but useful

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  - To encourage you to ask and answer questions
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- Do NOT wait until the last minute to ask for clarifications
  - The instructors and TAs do NOT plan on spending their weekend checking Piazza!

Outline

Grading

- Exam(s): 50%
  - 3 exams
  - Approximately weeks 6, 10, and Finals week
  - Lowest score exam will count for 10%, others for 20% each
- Homework - 30% – lowest score will be dropped
- Participation, quizzes, and in-class (lab) exercises - 20%
- Grades curved (and scaled as percentage of highest score in class)

Homework

- Homework will come out (approximately) every week
- Homework is due (in Gradescope) by 5:00PM on Friday

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- For all homework grading questions contact the professor via email
  - Do not post to piazza

In-class Quizzes, Exercises, and Participation

In Class Exercises:

- You will learn through in-class activities and exercises (lecture+lab)
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Excused Absences

If you are sick or cannot participate in a given lecture, please email me.

Outline

Sharing Online Course Content

- Recordings of lectures MUST NOT be shared outside of class. These are only for students registered in the class.
- Slides may be downloaded and shared.

In Class Behavior

- Treat others with respect. We have students coming from diverse backgrounds, and I want everyone to feel welcome.
- Encourage others by asking questions and helping each other
- Do not disparage anybody

Important

Everyone will enjoy the class more if we treat each other with respect.

Enjoy the Class