

Foundations of Computing

Introduction

Arkady Yerukhimovich

January 16, 2024

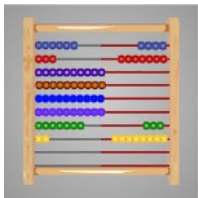
Course Information

- 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

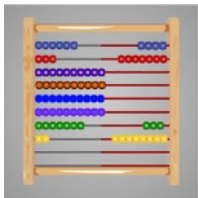
Outline

- 1 What this course is about
- 2 Course Logistics
- 3 Expectations and Grading
- 4 Important Policies

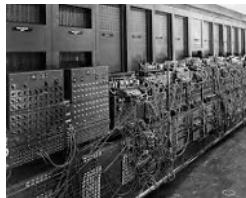
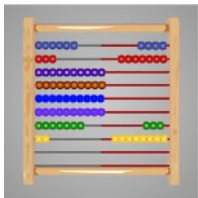
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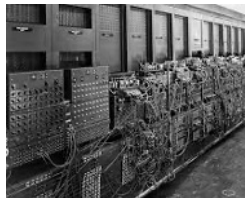
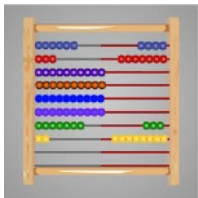
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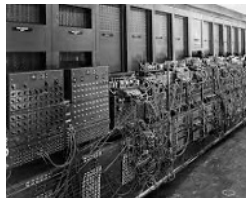
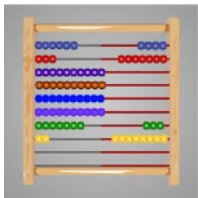
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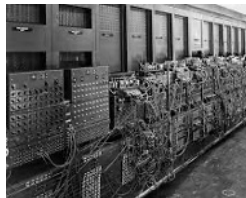
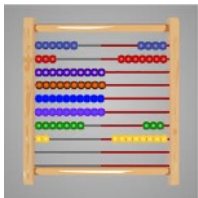
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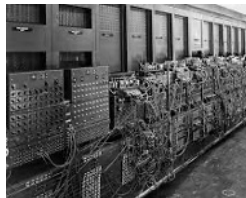
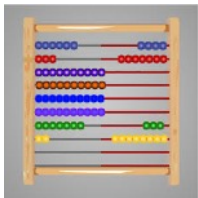
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What can a computer do?

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

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Course objective

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

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 - Regular expressions
 - Context-free grammars
 - Etc.

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- Will give you an understanding of WHY some problems are harder than others

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- This class will involve a good deal of math!
 - Logic, proofs, discrete math
 - No linear algebra or calculus!

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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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 - What is a “computer”?
 - What can/can't a computer compute?
 - How do we reason about the power of computation?

CS 3313: What is it about?

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 - Mathematical models of computation
 - Proofs of properties of these models
 - Build intuition about power of respective models

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- 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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 - How to determine if a problem is solvable on a computer
- 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
 - Languages recognized by these machines

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 - What is computable? What is not computable?
 - Reductions between problems

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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

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- 4 Important Policies

- Instructor: Arkady Yerukhimovich
- Grad TAs:
 - Suvasree Biswas
- Undergrad TAs:
 - Clare Jenney
 - Ozzy Simpson
 - Ethan Cohen
- Laboratory Assistants (LAs):
 - Abdulrahman Alsaleh

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: you've used this before...

Accessing Lectures:

- 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.

- Textbook:
 - “Introduction to the Theory of Computation” 3rd edition (earlier versions will work too) by Michael Sipser, CEngage publishers
- 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

- The purpose of this:
 - to encourage you to ask and answer questions
 - Be very careful not to border on plagiarism!
 - Don't post your HW solution to the world!!
- Signup instructions posted on Blackboard
- Do not expect instant response or substitute Piazza for office hours!
 - Piazza is not manned 24 hours/7 days a week
 - Sometimes an answer may take more than 24 hours!
- Posting on piazza, not the same as telling instructor things
 - E.g. : I'm going to miss the exam! I need to attend class virtually!
 - Use email for this
- Do NOT wait until the last minute to ask for clarifications. . .
 - The instructors and TAs do NOT plan on spending their weekend checking Piazza!

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- 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 (on Blackboard) by 5:00PM on Friday
- 10 point bonus for HW submitted by 5:00PM on Wednesday
- NO LATE HOMEWORK ACCEPTED
 - In VERY special cases, this may be allowed – email the professor
- 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 in many classes (lecture+lab)
 - Make sure you attend lecture and lab
 - Let instruction team know if you need to miss for some reason
- In-class exercises are due by end of class/day

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Discussion:

- We **STRONGLY** encourage questions during lecture, labs, and on Piazza
- Participating in discussion is part of your grade

Excused Absences

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

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Sharing Online Course Content

- Recordings of lectures **MUST NOT** be shared outside of class. These are only for students registered in the class.
- Slides and recordings made by the professor 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