



THEORY OF COMPUTATION

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SPRING 2021

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WHY STUDY THEORY OF COMPUTATION?

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

OBJECTIVES

- Introduce concepts in automata theory and theory of computation
- Identify different formal language classes and their relationships
- Design grammars and recognizers for different formal languages
- Prove or disprove theorems in automata theory using its properties
- Determine the decidability and intractability of computational problems

COURSE ORGANIZATION

- Very broadly, the course will contain three parts:
 - Part I) Regular languages
 - Part II) Context-free languages
 - Part III) Turing machines & decidability

WHY FINITE AUTOMATA AND REGULAR EXPRESSIONS?

- Regular expressions (REs) are used in many systems.
- E.g., UNIX, Linux, OS X,... $a \cdot b$.
- Finite automata model protocols, electronic circuits.
- Theory is used in model-checking.

WHY CONTEXT-FREE GRAMMARS?

- Context-free grammars (CFGs) are used to describe the syntax of essentially every modern programming language.
- Every modern compiler uses CFG concepts to parse programs

WHY TURING MACHINES?

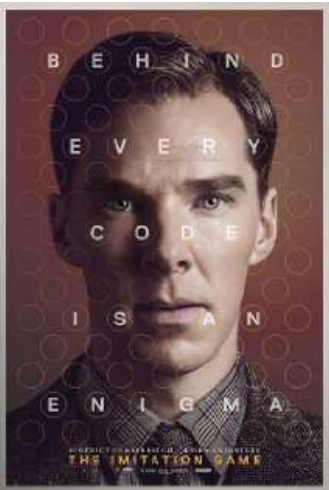
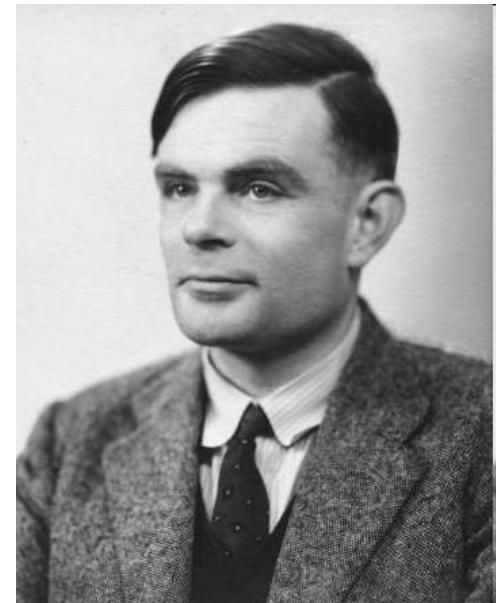
- When developing solutions to real problems, we often confront the limitations of what software can do.
- Undecidable things – no program can do it 100% of the time with 100% accuracy.
- Intractable things – there are programs, but no fast programs.

EXAMPLE – HALTING PROBLEM

Can you write a program which takes another program P as input and tell whether P will terminate or not?

ALAN TURING (1912-1954)

- Father of Modern Computer Science
- English mathematician
- Studied abstract machines called **Turing machines** even before computers existed
- Heard of the Turing test?



REQUIRED TEXTBOOK

- Introduction to Automata Theory, Languages and Computation
 - By J.E. Hopcroft, R. Motwani, J.D. Ullman
 - 3rd Edition
 - Addison Wesley/Pearson

EVALUATION PLAN

Sl. No.	Mode of Assessment	Marks
1	Mid Exam	25%
2	End Semester Exam	35%
3	Assignments	30%
4	Class Participation (Surprise Quiz)	10%

REFERENCES

- <http://www.eecs.wsu.edu/~ananth/CptS317>
- <https://nptel.ac.in/courses/106/106/106106049/#>
- <http://www.cs.virginia.edu/~robins/cs3102/>