

Theory of Computation Syllabus

Arjun Chandrasekhar

About Me

- ▶ Caltech → UCSD → **Pitt**
- ▶ I teach both CS and SCI courses
- ▶ Teaching interests: **theory & algorithms**, computer programming, probability & statistics
- ▶ Research interests: biological distributed algorithms
- ▶ At the end of class you can learn more about me through a 10 minute AMA

About me

I came to college wanting to be a software engineer



About Me

- ▶ This class changed my life
- ▶ I want it to change yours
- ▶ I want this to be your favorite CS class
- ▶ I want this to be the best theory of computation course out there
- ▶ I want this to make you (re)consider the merits of pursuing a career in theory

Course Website and syllabus

- ▶ Here is the course website: <https://www.arjun-chandrasekhar-teaching.com/courses/Pitt/CS1502/home>
- ▶ Contains all course info, lecture slides, lecture notes, assignments
- ▶ Please read the syllabus thoroughly
 - ▶ There is a syllabus quiz for you to complete on Canvas

Grading Scheme

- ▶ In-class participation: 10%
- ▶ Programming assignments: 10%
- ▶ Written assignments 50%
- ▶ Midterm Exam: 20%
- ▶ Final Exam: 20%
- ▶ Extra Credit: TBD

Getting Help

- ▶ Ask questions in class
- ▶ Flood my email: arjunc@pitt.edu
- ▶ Chat with each other on [Discord](#)
- ▶ Student hours
 - ▶ Monday-Thursday from 12:30-2:30pm in Sennott Square 6305
 - ▶ **Or by appointment**

Lecture speed

- ▶ Please let me know if I am going too fast
- ▶ **Please let me know if I am going too fast**
- ▶ Please let me know if I am going too fast
- ▶ Please let me know if I am going too fast
- ▶ Please let me know if I am going too fast
- ▶ **Please let me know if I am going too fast**

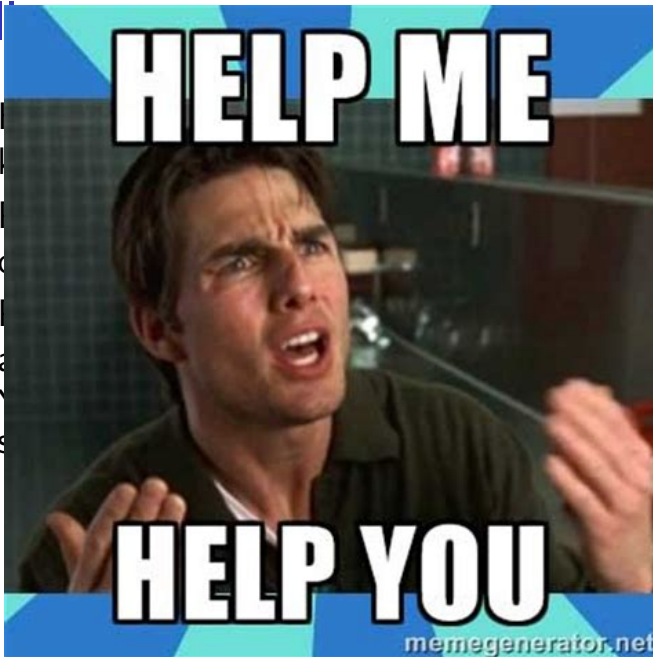
I kindly ask you to avoid saying...

- ▶ “I’m just not smart enough to do theory”
 - ▶ Yes you are!
- ▶ “This may be a stupid question, but...”
 - ▶ There are NO stupid questions!

Miscellaneous

- ▶ Hate speech, bullying, and harassment of any kind will not be tolerated
- ▶ Please correct me if I mispronounce your name or misgender you
- ▶ Please let me know ASAP if you need special accommodations for quizzes and exams
- ▶ You do not need to ask me for permission to skip class for any reason
 - ▶ If my teaching style is not working for you, I welcome respectful, constructive criticism!

Miscel



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Course overview

What exactly is “Theory of Computation”?

- ▶ What *is* a computer?
- ▶ What can we do with different types of computers?
 - ▶ What *can't* be done with certain computers?
 - ▶ What can't be done with *any* computers?
- ▶ Are certain problems strictly harder than others?

Course overview

- ▶ We will study different “models of computation” (also called abstract computing devices).
- ▶ You have already seen a model of computation – the random access memory (or RAM), which is an abstraction for today’s computers.
- ▶ For each, we will ask “how powerful is this model?”
 - ▶ Put another way: “what can and can’t we compute with this model?”

Why should I care about this class?

- ▶ You need it to graduate
- ▶ The kind of thinking you will do in this class will help you be a better programmer
- ▶ You might discover untapped passion for the theoretical side of computer science.
- ▶ **All of the models of computation that we will study have applications**

Applications of Deterministic Finite Automata (DFAs)

- ▶ Lexical analysis in a compiler¹
- ▶ Software for modeling or verifying systems of all types that have a finite number of states. e.g., communication protocols, elevator controls²
- ▶ Embedded software³
- ▶ HTML Buttons

¹Louden 1997.

²Campbell and Stiles 2007.

³Adamski et al. 2005.

Applications of Regular Expressions

- ▶ Software for scanning large bodies of text for occurrences of words, phrases, or other patterns⁴
- ▶ Natural language processing⁵
- ▶ Syntax highlighting

⁴Abou-Assaleh and Ai 2004.

⁵Martin and Jurafsky 2009.

Applications of Turing machines

- ▶ (Literally) every programming language ever created
- ▶ Computability theory helped defeat the Nazi U-boats⁶
 - ▶ It may help us defeat the Nazi tiki torches
- ▶ DNA computing⁷
- ▶ Magic: the gathering⁸

⁶Rosser 1982.

⁷Winfrey 2004.

⁸Churchill et al. 2019.

Strategies for Success

This class is all about two things: **definitions** and **techniques**

- ▶ Precise definitions are the foundation of this course. To learn, you must understand *exactly* what different terms mean, to be able to formulate *precise* questions and answers
- ▶ This class is about applying techniques to solve problems and prove results. When you learn how to solve a problem, do not focus on the verbatim solution; focus on the technique.