Automata, Formal Languages, and Computability

COMP 481/581

Time and Place

Registration URL:

Tuesday, Thursday: 9:25AM – 10:40AM

Sewall Hall 305

Canvas Web Page

https://canvas.rice.edu/courses/59401

Instructor

Professor

Ron Goldman

rng@rice.edu

Office Hours: Tuesday After Class
Or by Appointment

Labbie

TBA

Text and Syllabus

Text

- *Automata, Computability, and Complexity: Theory and Applications* -- Elaine Rich

Syllabus

- Chapters: 5-14, 17-21, 23, 25-28
- May Skip Some Sections
- Will Begin in Chapter 5 -- Finite State Machines
- Pace $\approx$ 5-15 Pages/Lecture

Topics

I. Finite State Automata and Regular Languages
   - Chapter 5-10 $\approx$ 7 Lectures

II. Push Down Automata and Context Free Languages
   - Chapter 11-14 $\approx$ 7 Lectures

III. Turing Machines and Undecidability
   - Chapters 17-26 $\approx$ 7 Lectures

IV. Complexity Theory
   - Chapters 27, 28 $\approx$ 7 Lectures

Prerequisites

1. Chapter 2
   - Languages and Strings

2. Appendix A.1 – A.5
   - Sets, Logic, Relations, Functions, Closures

3. Appendix A.6.5
   - Mathematical Induction

SKIM THESE CHAPTERS BEFORE THURSDAY'S LECTURE

BIG QUESTIONS

What is Computation?

- What Different Models can we Use for Computation?
- What Problems can be Solved by Each of these Models?

What are the Limits of Computation?

- What Problems Cannot Be Solved **in Principle** by Computation?
- What Problems Cannot Be Solved **in Practice** by Computation?

Models of Computation

Finite State Automata

- States Only -- No External Memory (Read Only)
- Examples -- Vending Machines

Push Down Automata

- External Memory = Stack -- Unbounded External Memory
  Limited Access
- Programming Languages -- Recursion

Turing Machine

- Tape = Unbounded External Memory, Arbitrary Access
- Arbitrary Computations – Universal Turing Machines

Limits of Computation

Decidability Theory

- Problems that Cannot Be Solved in Principle By Computation
- Decidable, Semi-Decidable, Not Semi-Decidable Problems
- Halting Problem

Complexity Theory

- Problems that Cannot Be Solved in Practice by Computation
- P vs. NP
- SAT and Hamiltonian Cycles

Lectures

- Posted on course web page BEFORE each class
- Questions about Lectures and Text should be directed to Professor Goldman

Homework

Weekly

- Due each Thursday at START of Lecture
- 5 Exercises per Week from Textbook (Rich)

Grading

- 30% of Final Grade ≈ 3% per Week
- Must Work Alone, NOT in Study Groups (Honor System)
- Googling for Solutions is NOT Allowed
- Use of ChatGPT or Other AI is NOT Allowed
- Can Seek Help Only from Labbie

Help from Labbie

Questions

- What did you try?
- Where did you get stuck?

Answers

- How to get started
- How to continue

Rules for Handing in Homework

Exercises

- One Problem per Page
- Type or Dark Ink -- Pencil Forbidden
- Write Large

VIOLATORS WILL RECEIVE ZERO CREDIT

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Second Chance on Homework

- Redo Problems for Additional Half Credit
- Due One Week After Return
- Hints from Labbie

Standard for Grading the Homework

Formal Proofs as in the **Textbook**

Lectures are often only high level **explanations**
Lectures do not always contain complete proofs

Exams

Quantity

- 2 Exams
- Each Exam = 30% of Final Grade
- More than Half (Probably ALL) the Questions are Exercises from the Text and from the Homework

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Format

- Probably Timed Take Home
- Open Book and Open Lecture Notes
- Must Work Alone (Honor System)

Grading

Exams

- 2 Exams -- Each Exam is 30% of Final Grade

Homework

- Weekly Assignment = 30% of Final Grade ≈ 3% per Week

Class Participation

- 10% of Final Grade

Late Policy

Slip Days

- Each Student gets 5 Slip Days during the Semester.
- If you are ill or have another reasonable excuse, you do NOT need to take a Slip Day.
- Slip Days may be used ONLY for Weekly Exercises and for Attendance, NOT for Exams.
- Once your 5 Slip Days are used up, any work you hand in late will receive ZERO Credit.

How to Study

1. Read the Text BEFORE Each Lecture
2. Solve Problems, Solve Problems, Solve Problems
3. Do Unassigned Exercises in the Text Every Week
   -- Do NOT Wait Till Exam Week -- Too Many Problems
   -- Do NOT Attempt All the Exercises -- Too Many
4. Spend Time ≈ 10 Hours/Week
   -- 2.5 Hours ≈ Lecture
   -- 2.5 Hours ≈ Reading the Text
   -- 5 Hours ≈ Exercises

How to Get Help

Lectures and Text

- Professor Goldman -- Office Hours

Homework

- Labbie -- Office Hours
- Do NOT spend more than 1 hour on any problem – Get help
- Get help from the Labbie when you need help – do not be shy

Honors Code Violations on Homework and Exams

- Copying Solutions (from current or previous students)
- Googling Solutions
- Using ChatGPT or Other AI
- Handing in Solutions not Entirely Your Own
  (but help from the Labbie on the homework is permitted)

Disabilities

If you have a documented disability that may affect academic performance, you should:

1. Make sure this documentation is on file with Disability Resource Center (Allen Center, Room 111 / adarice@rice.edu / x5841) to determine the accommodations you need.
2. Meet with me online to discuss your accommodation needs.

Title IX

Rice University cares about your wellbeing and safety.

Rice encourages any student who has experienced an incident of harassment, pregnancy discrimination, gender discrimination, or relationship, sexual, or other forms interpersonal violence to seek support through The SAFE Office. Students should be aware when seeking support on campus that most employees, including myself, as the instructor are required by Title IX to disclose all incidents of non-consensual interpersonal behaviors to Title IX professionals on campus who can act to support that student and meet their needs. For more information, please visit:

safe.rice.eduLinks to an external site

or email titleixsupport@rice.edu.