Course Syllabus: CS 150: The Theory of Automata and Formal Languages
Spring, 2025

Course Description: The course introduces some fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton, and Turing machine. Not only do they form basic models of computation, they are also the foundation of many branches of computer science, *e.g.* compilers, software engineering, concurrent systems, etc. The properties of these models will be studied and various rigorous techniques for analyzing and comparing them will be discussed, by using both formalism and examples.

Course format: The course consists of two 80-minute lectures in Watkins 1000 on TR at 2:00-3:20pm and one 50-minute discussion session per week. The lectures are only offered in-person this quarter, but recordings of similar lectures from the past can be made available on Canvas/Yuja upon request. The discussion sessions start in the first full week of the quarter (*i.e.*, the week of March 31). Each discussion session will be led by a TA and used primarily to enforce concepts and techniques learned in class.

Prerequisite: CS 10C and CS/MATH 111. The students are expected to have a strong background in the fundamentals of discrete mathematics (symbolic logic, set, induction, number theory, summation, series, combinatorics, graph, recursion, basic proof techniques, etc.), algorithms and data structures. Some knowledge of programming languages, programming, and computer architecture will be helpful.

Instructor: Tao Jiang, WCH 336, phone: 827-2991, email: `jiangATcs.ucr.edu`. Office Hours: TR 4:00-5:00pm. Zoom sessions can be made available upon special requests and the meeting ID is 886 998 0294.

Teaching Assistants: The TA office hours are held on M 2-3pm (LC), W 10-11am (MS) and F 3-4pm (MRM) in WCH 136/110 (for LC and MRM) or MRB 2133 (for MS).

Dis021	W 7-7:50pm	WCH 142	Md Rayhanul Masud	mmasu012ATucr
Dis022	F 12-12:50pm	MSE 003	Michael Strobel	mstro016ATucr
Dis023	W 2:00-2:50pm	MSE 103	Lisa Chen	lchen314ATucr

UCR Academic Resources Center (ARC): 156 Skye Hall. See `www.arc.ucr.edu`.

Textbook: J. Hopcroft, R. Motwani, and J. Ullman. *Introduction to Automata Theory, Languages, and Computation*, 3rd edition, 2007, Pearson/Addison-Wesley. Available for purchase/rent via the Internet (2nd edition okay too). It can be borrowed for short periods from `https://www.hathitrust.org` (with UCR NetID) and `https://archive.org/account/signup`. Relevant chapters are also available on eLearn/Canvas.

Lecture Notes: Copies of slides used in lectures are available on the class homepage `www.cs.ucr.edu/~jiang/150-homepage.html` in the PDF format.

Reference Books (on reserve at the Science Library):
(1) P. Linz and S. Ridger. *Introduction to Formal Languages and Automata*, 7th edition, 2022 (earlier editions okay), Jones and Barlett.
(2) C. Allison. *Foundations of Computing: An Accessible Introduction to Formal Languages*, 2021, Fresh Sources, Inc.
(3) A. Maheshwari and M. Smid. *Introduction to Theory of Computation*, 2019, `https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf`

Grading:

5 homework assignments (all paper and pencil) — 25%
Midterm I (40 minutes in class, Thursday May 1) — 10%
Midterm II (full class, Thursday, May 22) — 20%
Final examination (June 10, 3:00 - 5:50pm) — 45%

Reading assignment: You are expected to review, before and after each class, the material to be covered in the class. A reference to the chapters of the text and major reference books that will be covered in lectures can be found in the *tentative timetable* below.

Assignment Policy:

1. All assignments will be posted on the class homepage `www.cs.ucr.edu/~jiang/150-homepage.html`, and submitted on Gradescope.
2. You have roughly one and half weeks for each homework assignment.
3. Make sure to always include your full name, ID, *discussion section number*, and the assignment number on the first page.
4. Write legibly. What cannot be read will not be graded.
5. No late assignments will be accepted.

Academic dishonesty: Many students find it helpful to consult their peers while doing assignments. This practice is legitimate and to be expected. However, it is not acceptable practice to pool thoughts and produce common answers. To avoid this situation, it is suggested that students not write anything down during such talks, but keep mental notes for later development of their own. Major occurrences of academic dishonesty, such as the submission of work that is not the student's own, will be dealt with according to UCR's policies on academic dishonesty that can be found at webpage `http://conduct.ucr.edu/policies/academicintegrity.html`. Students who allow their files or assignments to be copied are as guilty of academic dishonesty as those who copy and will be treated accordingly. Each student is responsible for taking reasonable precautions to ensure that his/her work is not available for unauthorized use.

Copying solutions from the Internet/AI or books or any other sources without explicit citations is prohibited!

Table 1: Tentative Timetable

Week of	Topic	Chapters of		
		[HMU]	[Linz]	[MS]
Mar 31	basic concepts of finite automata and languages	1,2	1,2	1,2
	deterministic finite automaton, nondeterminism	2	2	2
Apr 7$*$	equivalence between DFAs, NFAs and ϵ-NFAs	2,3	2,3	2
	regular expression			
Apr 14$*$	equivalence between regular expression and FA	3	3	2
	algebraic laws for regular expressions	3	3	
Apr 21	pumping lemma and applications	4	4	2
	properties of regular languages	4	4	
Apr 28$*$	equivalence and minimization of DFAs	4	2	
	Midterm I on May 1			
May 5$*$	context-free grammars and languages	5	5	3
	parsing (or derivation) and parse trees	5	5	3
May 12	ambiguity of grammars and languages	5	5	
	pushdown automaton (PDA) and various forms	6	7	3
May 19$*$	equivalence between CFG and PDA	6	7	3
	Midterm II on May 22			
May 26	Chmosky normal form of CFG	7	6	3
	pumping lemma for CFLs and closure properties	7	8	3
June 2	more properties of CFLs	7	8	3
	Turing machines and (un)decidability	8	9,12	4

Legend: $*$ denotes the handing out of homeworks.

Class Mailing List: Please subscribe to the class mailing at `https://fenris.cs.ucr.edu/mailman/listinfo/cs150` or via the class homepage ASAP, and remember to confirm your subscription!