CS 154-03: Formal Languages and Computability Syllabus

San José State University, Spring 2021

Instructor Information

Instructor	Email	Zoom Office Hours
Yan Chen	yan.chen01@sjsu.edu	TR 14:45 – 15:45 or By Appointment

General Information

TR 12:00 – 13:15 @ https://sjsu.zoom.us/s/86968435343

Catalog Description

Finite automata, context-free languages, Turing machines, computability.

Prerequisite(s)

MATH 42 or MATH 42X and CS 46B (with a grade of "C-" or better in each); Allowed Declared Majors: Computer Science, Applied and Computational Mathematics, or Software Engineering, or instructor consent. Permission codes will be provided to the requesters who fulfill the prerequisites based on the priorities stated in University Policy F17-4 (https://www.sjsu.edu/senate/docs/F17-4.pdf).

Course Format

Online Synchronous Mode: live lectures will be conducted at the set times/days via Zoom. Also, those lecture sessions will be recorded and posted on Canvas (https://sjsu.instructure.com/courses/1416858, which is also for all other class activities). Office hours will also be held via Zoom (https://sjsu.zoom.us/j/87347407637).

Course Learning Outcomes (CLO)

Upon successful completion of this course, students would be able to:

- Understand the high-level building blocks of computer science.
- Analyze and design deterministic and non-deterministic machines for various formal languages.
- Describe regular languages in terms of regular expressions and vice versa.
- Analyze and design pushdown automata for some formal languages.
- Analyze and design Turing machines for some formal languages.
- Describe the properties of various automata and formal languages.
- Construct different type of grammars (regular, context-free, etc.) for some formal languages.
- Use the pumping lemma to prove that some formal languages are not regular.
- Describe decidability and classify problems as decidable or undecidable.
- Describe computability and complexity of problems.
- Categorize languages based on their complexities.
- Be familiar with some open questions in computer science.

Course Materials

There is no required text for this course other than all the materials (lecture notes, homework, etc.) on Canvas. You are responsible for regularly checking the Canvas course page for any updates, including its messaging system.

Further Readings

- Peter Linz, "An Introduction to Formal Languages and Automata," 5th edition, Jones & Bartlett Learning, ISBN-13: 978-1449615529
- The references at the end of each lecture note.

Course Requirements and Assignments

There will be weekly assignments (optional), a midterm (optional) and a final (mandatory). No high-level programming is required in this course.

Weekly Assignments

Assignments will be posted on Canvas every week, locked by passwords that are ONLY given in the lectures. They are optional, but points earned in those assignments will be extra points adding to the final score. See "Grading Information" for more details.

There will be two types of assignments (either one of below each week):

- Timed quizzes that are closed-all-materials. You can start the quiz any time before due, but must finish it in one sitting, within the time limit. They are cumulative with more focus on the material learned during that week.
- Design problems that are open notes with no time limit before due but more complex than those appear in timed quizzes.

Midterm

The midterm will be held in class (see tentative schedule on page 5). It will be posted on Canvas as a timed quiz, with more questions but less time per problem than normal assignments. No Zoom meeting on the midterm day, but you need to finish the exam during the required time frame. Exceptions may ONLY be given in cases of a verifiable emergency or for those who live in a different time zone where the exam time would be in the midnight or early morning. You can view the midterm as a checkpoint and a practice for the final.

Although weekly assignments and midterm are optional, they are highly recommended to practice what you learned in class and to enhance your score. University Policy S16-9 (http://www.sjsu.edu/senate/docs/S16-9.pdf) states that:

> *"Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practice. Other course structures will have equivalent workload expectations as described in the syllabus."*

Final Examination

The final will be in the same format as the midterm and is cumulative. The date and time are fixed (Friday, May 21, 9:45 - 12:00 Pacific Time). Exceptions may ONLY be given in cases of a verifiable emergency or for those who live in a different time zone where the exam time would be in the midnight or early morning.

It can be substituted/averaged with a final project; more details will be given in-class.

Final Exam is mandatory as University policy S17-1 (http://www.sjsu.edu/senate/docs/S17-1.pdf) states:

> *"Faculty members are required to have a culminating activity for their courses, which can include a final examination, a final research paper or project, a final creative work or performance, a final portfolio of work, or other appropriate assignment."*

Grading Information

There will be 125 points available (at least), including extra credits from optional exercises/activities, as shown in the following table. More details will be given in class.

	Points	Details
Final Exam	100.00	Can be substituted/averaged with final project
(Optional) Midterm	2.00	2 pts if grade over 50% (all-or-nothing)
(Optional) Assignments	21.00	14 assignments total, 1.5 pts each
(Optional) Others	2.00+	Other class activities, such as reading assignments, discussions, etc.
Total	**125.00+**	Mandatory (100) + Optional (25+)

Grading scale

Grade	Points	Grade	Points	Grade	Points
A	Above 93.00	**B minus**	80.00 to 82.99	**D plus**	66.00 to 69.99
A minus	90.00 to 92.99	**C plus**	76.00 to 79.99	**D**	63.00 to 65.99
B plus	86.00 to 89.99	**C**	73.00 to 75.99	**D minus**	60.00 to 62.99
B	83.00 to 85,99	**C minus**	70.00 to 72.09	**F**	Below 59.99

- A+ will be given for those who receive over 95% for assignments, midterm, AND the final exam. If more than 1% of students meet these criteria, the top 1% of students will be given an A+.
- Grade near the borderlines will be rounded up depending upon your level and quality of class participation (in-class and in the Discussions on Canvas).
- The grade might be curved ONLY if the final grades of the class at the end of the semester are not normal.

Class Protocol

- Do NOT share any course material publicly (on Canvas, GitHub, etc.) without permission, including but not limited to lecture notes, lecture videos, passwords, homework/exam solutions, and class meeting links.
- No late homework questions (within 24 hours before due, excluding follow-ups) via email.
- For all homework and exams, only use the notations mentioned in the class. Wrong/different notation(s) will be considered as wrong answer(s).
- You must be dressed for zoom sessions. You may wear pajamas and sweats if you want but wear a shirt.
- Instances of academic dishonesty will not be tolerated. Your own commitment to learning, as evidenced by your enrollment at San José State University and the University's Academic Integrity Policy (https://www.sjsu.edu/senate/docs/F15-7.pdf), require you to be honest in all your academic course work. Cheating or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a reduction in final course grade (for assignments, 2/3 letter grade off every time except the first time; for the final, one letter grade off) and administrative sanctions by the University.

Important Dates

Date	Description
Jan. 28, Thursday	First Day of instruction (for this class)
Feb. 8, Monday	Last day to drop without a W grade
Feb. 15, Friday	Last day to add classes via MySJSU
Feb. 15, Friday	Last day to submit credit/no-credit option request
Mar. 14, Sunday	Daylight saving time starts (at 2:00 AM Pacific Time)
Apr. 22, Thursday	Last day to late drop/withdraw
May 13, Thursday	Last day of instruction (for this class)
May 16, Sunday	All class activities except for the final due (for this class)
May 21, Friday	Final examination (for this class) 9:45 - 12:00 Pacific Time
May 29, Saturday	Grades viewable on MySJSU

Visit https://www.sjsu.edu/classes/calendar/2020-2021.php for the Academic Calendar.

University Policies

Per University Policy S16-9 available at http://www.sjsu.edu/senate/docs/S16-9.pdf, relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on Syllabus Information web page available at http://www.sjsu.edu/gup/syllabusinfo. Viewing these policies and resources is highly recommended.

Course Schedule

This is a tentative schedule and is subject to change (except for the final exam) but with fair notice.

Lesson	Date	Topics
0	Thur., Jan. 28	Syllabus
1	Tue., Feb. 2	Mathematical Preliminaries (part 1)
2	Thur., Feb. 4	Mathematical Preliminaries (part 2)
3	Tue., Feb. 9	Formal Languages (part 1)
4	Thur., Feb. 11	Formal Languages (part 2)
5	Tue., Feb. 16	Deterministic Finite Automata (part 1)
6	Thur., Feb. 18	Deterministic Finite Automata (part 2)
7	Tue., Feb. 23	Deterministic Finite Automata (part 3)
8	Thur., Feb. 25	Nondeterministic Finite Automata (part 1)
9	Tue., Mar. 2	Nondeterministic Finite Automata (part 2)
10	Thur., Mar. 4	Nondeterministic Finite Automata (part 3)
11	Tue., Mar. 9	Regular Languages
12	Thur., Mar. 11	Non-Regular Languages
/	Tue., Mar. 16	**Midterm**
13	Thur., Mar. 18	Pushdown Automata (part 1)
14	Tue., Mar. 23	Pushdown Automata (part 2)
15	Thur., Mar. 25	Pushdown Automata (part 3)
/	**Tue., Mar. 30**	**Spring Break, no class (enjoy the holiday!)**
/	**Thur., Apr. 1**	**Spring Break, no class (enjoy the holiday!)**
16	Tue., Apr. 6	Turing Machines (part 1)
17	Thur., Apr. 8	Turing Machines (part 2)
18	Tue., Apr. 13	Other Models of Turing Machines (part 1)
19	Thur., Apr. 15	Other Models of Turing Machines (part 2)
20	Tue., Apr. 20	Regular Expressions (part 1)
21	Thur., Apr. 22	Regular Expressions (part 2)
22	Tue., Apr. 27	Grammars (part 1)
23	Thur., Apr. 29	Grammars (part 2)
24	Tue., May 4	Grammars (part 3)
25	Thur., May 5	Introduction to Computability
26	Tue., May 11	Introduction to Complexity
27	Thur., May 13	Final Review
Final	**Fri., May 21**	**9:45 – 12:00 Pacific Time**