

**San José State University**  
**Department of Computer Science**  
**CS154, Formal Languages and Computability, Sections 1 and 2**  
**Fall Semester, 2015**

**Course and Contact Information**

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<b>Office Hours:</b>	Monday and Wednesday: 9:00-11:00
<b>Class Days/Time:</b>	MW 12:00 – 1:15 Section 1 MW 01:30 – 2:45 Section 2
<b>Classroom:</b>	SCI 311 Section 1 SCI 311 Section 2
<b>Prerequisites:</b>	Math 42 and CS 46B (with a grade of "C-" or better in each) or instructor consent.

**Piazza page:** <https://piazza.com/sjsu/fall2015/cs154/home>

**Course Description**

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

**Learning Outcomes**

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

1. SLO1. Write a grammar for a language described otherwise.
2. SLO2. Construct deterministic and non-deterministic machines for various languages.
3. SLO3. Describe a language in terms of a regular expression.
4. SLO4. Find a regular expression for a language described by a finite automaton and conversely.
5. SLO5. Construct a deterministic finite automaton from a non-deterministic one.
6. SLO6. Minimize a deterministic automaton.
7. SLO7. Be able to use a pumping lemma to show that some languages are not regular and/or not context-free
8. SLO8. Use closure properties to simplify proofs of non-regularity of languages.
9. SLO9. Be able to construct a pushdown automaton accepting a given language.
10. SLO10. Construct a Turing machine accepting some simple languages.

10. SLO11. State in precise mathematical terms what is meant by undecidability of the Halting Problem, and be able to show the undecidability of simple extensions of the Halting Problem, using the reduction technique.

### Course Learning Outcomes (CLO)

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

1. CLO1. Construct and use regular expressions and finite automata.
2. CLO2. Construct and use context-free grammars and pushdown automata.
3. CLO3. Construct and use simple Turing machines.
4. CLO4. Describe the properties of various automata and languages.
5. CLO5. Use pumping lemmas to show non-membership in a language category.
6. CLO6. Turn a non-deterministic finite automaton into a deterministic one.
7. CLO7. Minimize a deterministic finite automaton.
8. CLO8. Describe closure properties of languages, and state minimization of automata.
9. CLO9. Describe decidability and classify basic problems as decidable or not.

### Required Texts/Readings

#### Textbook

*J. Hopcroft, R. Motwani, and J. Ullman, Automata Theory, Languages, and Computation, 3<sup>rd</sup> Edition, Addison Wesley, Boston, MA, 2007. ISBN 0-321-45536-3*

### Course Requirements

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in [University Policy S12-3](http://www.sjsu.edu/senate/docs/S12-3.pdf) at <http://www.sjsu.edu/senate/docs/S12-3.pdf>.

NOTE that [University policy F69-24](http://www.sjsu.edu/senate/docs/F69-24.pdf) at <http://www.sjsu.edu/senate/docs/F69-24.pdf> states that “Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading.”

### Grading Policy

Grades will be based on

- Homework and quizzes (30%)
- Midterm exams (2) (40%)
- Final exam (30%) (comprehensive)

Much of the homework will use an online system called Gradiance. There will also be some programs to write. Several short quizzes will be given during the semester based on the assigned homework problems.

The exams are closed book and notes. Formula sheets will be allowed. There will be no make-up exams.

My grading system allows some flexibility, but is not curved and generally follows the categories 85-100% = A, 75-85 = B, 60-75 = C, 50-60 = D, < 50 = F. Extra credit may be given on exams and assignments, but individual assignments for extra credit are never given. Partial credit is given, so show your work on all assignments and exams.

Note that “All students have the right, within a reasonable time, to know their academic scores, to review their grade-dependent work, and to be provided with explanations for the determination of their course grades.” See [University Policy F13-1](http://www.sjsu.edu/senate/docs/F13-1.pdf) at <http://www.sjsu.edu/senate/docs/F13-1.pdf> for more details.

## University Policies

### General Expectations, Rights and Responsibilities of the Student

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU’s policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arises. See [University Policy S90–5](http://www.sjsu.edu/senate/docs/S90-5.pdf) at <http://www.sjsu.edu/senate/docs/S90-5.pdf>. More detailed information on a variety of related topics is available in the [SJSU catalog](http://info.sjsu.edu/web-dbggen/narr/catalog/rec-12234.12506.html), at <http://info.sjsu.edu/web-dbggen/narr/catalog/rec-12234.12506.html>. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not serve to address the issue, it is recommended that the student contact the Department Chair as a next step.

### Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester’s [Catalog Policies](http://info.sjsu.edu/static/catalog/policies.html) section at <http://info.sjsu.edu/static/catalog/policies.html>. Add/drop deadlines can be found on the current academic year calendars document on the [Academic Calendars webpage](http://www.sjsu.edu/provost/services/academic_calendars/) at [http://www.sjsu.edu/provost/services/academic\\_calendars/](http://www.sjsu.edu/provost/services/academic_calendars/). The [Late Drop Policy](http://www.sjsu.edu/aars/policies/latedrops/policy/) is available at <http://www.sjsu.edu/aars/policies/latedrops/policy/>. Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the [Advising Hub](http://www.sjsu.edu/advising/) at <http://www.sjsu.edu/advising/>.

### Consent for Recording of Class and Public Sharing of Instructor Material

[University Policy S12-7](http://www.sjsu.edu/senate/docs/S12-7.pdf), <http://www.sjsu.edu/senate/docs/S12-7.pdf>, requires students to obtain instructor’s permission to record the course and the following items to be included in the syllabus:

- “Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor’s permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material.”
  - It is suggested that the greensheet include the instructor’s process for granting permission, whether in writing or orally and whether for the whole semester or on a class by class basis.
  - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- “Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent.”

### Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The [University Academic Integrity Policy S07-2](http://www.sjsu.edu/senate/docs/S07-2.pdf) at <http://www.sjsu.edu/senate/docs/S07-2.pdf> requires you to be

honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The [Student Conduct and Ethical Development website](http://www.sjsu.edu/studentconduct/) is available at <http://www.sjsu.edu/studentconduct/>.

### **Campus Policy in Compliance with the American Disabilities Act**

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. [Presidential Directive 97-03](http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf) at

[http://www.sjsu.edu/president/docs/directives/PD\\_1997-03.pdf](http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf) requires that students with disabilities requesting accommodations must register with the [Accessible Education Center](http://www.sjsu.edu/aec) (AEC) at <http://www.sjsu.edu/aec> to establish a record of their disability.

## CS154 Formal Languages and Computability, Fall 2015, Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines	HMU	Due
1	8/24/2015	Intro, green sheet, definitions		
1	8/26/2015	Finite automata, regular sets	2.2	
2	8/31/2015	Nondeterminism	2.3	Prob. Set 0
2	9/2/2015	Converting NFA to DFA	2.3	
3	9/7/2015	Labor Day Holiday		
3	9/9/2015	$\epsilon$ - transitions, closure, pattern matching	2.4, 2.5	Prob. Set 1
4	9/14/2015	Regular expressions	3.1	
4	9/16/2015	Re- equivalent to FA	3.2	
5	9/21/2015	Pumping lemma	4.1	Prob. Set 2
5	9/23/2015	Closure properties, homomorphisms	4.2	
6	9/28/2015	Decision problems	4.3	
6	9/30/2015	State minimization	4.4	
7	10/5/2015	Review		Prob. Set 3
7	10/7/2015	Midterm exam		
8	10/12/2015	Exam results, begin CFL	5.1	
8	10/14/2015	Parsing	5.2, 5.3	
9	10/19/2015	PDA, NPDA	6.1, 6.2	
9	10/21/2015	CFL equivalent to PDA	6.3	Prob. Set 4
10	10/26/2015	Parentheses and CNF	7.1	
10	10/28/2015	CFL pumping lemma	7.2	
11	11/2/2015	CKY algorithm, CFL properties	7.4	Prob. Set 5
11	11/4/2015	Turing machines	8.1, 8.2	
12	11/9/2015	Exam 2 (by gradience; no class)		
12	11/11/2015	Veteran's Day Holiday		
13	11/16/2015	Universal TM, halting	8.6	
13	11/18/2015	Diagonalization, reduction	9.1	Prob. Set 6
14	11/23/2015	Recursive and re languages	9.2	
14	11/25/2015	Undecidable problems	9.3	
15	11/30/2015	Rice's Theorem	9.3	
15	12/2/2015	Undecidable CFL properties	9.5	Prob. Set 7
16	12/7/2015	Review		

<b>Week</b>	<b>Date</b>	<b>Topics, Readings, Assignments, Deadlines</b>	<b>HMU</b>	<b>Due</b>
Final Exam	12/10/2015	Venue and Time Final Exam for Section 1      9:45- 12:00 Final Exam for Section 2      12:15- 14:30		