CS 154 (Sections 3, 4): Formal Languages and Computability, Fall 2016

David Scot Taylor
212 MacQuarrie Hall
Associate Professor
Dept. of Computer Science
San Jose State University
Phone: (408) 924-5124 (email works better)
Email: david.taylor "at" sjsu.edu

My office hours for Fall 2016

- Tuesday, 9:00-11:00
- Other times available, set up an appointment by email.

Class Meetings:

- Section 3: DH 450, Mon/Wed 10:30-11:45
- Section 4: DH 450, Mon/Wed noon-1:15

Course Website

The course website can be found at http://www.cs.sjsu.edu/faculty/taylor/term/fall16/CS154/. This site contains a link to this greensheet, a schedule of classes thus far, and a (soon to exist) tentative schedule of future class topics, along with other information and announcements.

Course Goal and Description

Goal: To introduce students to the basic concepts of theoretical computer science, and to show them that many of the origins of these questions came from some very practical considerations.

Topics covered will include context-free grammars, finite automata, minimization, regular expressions, Kleene's Theorem, pumping lemmas, closure properties, nonequivalence of deterministic and non-deterministic PDA's, Turing machines and decidable and undecidable problems.

Prerequisite Courses

You must show me that your prerequisite courses have been satisfied. **If you do not show me by Wednesday, August 31 (the second week of classes, the last class meeting before drop date), you may be dropped from the course.** Further, I will not give out any add codes without first seeing prerequisite proof. You should show me grades for CS46B and Math42, or their equivalents on a San Jose departmental course equivalence form. You must have a C- or better in each course. Prerequisite courses and what they covered:
CS46A: Iteration and recursion (you don't need to bring proof of this one)
CS46B: Stacks and queues, lists, dynamic arrays, binary search trees. Iteration over collections.

Hashing. Seaching, elementary sorting. Big-O notation. Standard collection classes.
Math42: Sets, logic, proofs, induction, combinatorics, probability, and equivalence classes.

Textbooks

The required text is by Sipser, we will basically cover parts 0, 1, and 2.
Introduction to the Theory of Computation, 3nd Edition
Michael Sipser
ISBN-10: 113318779X
ISBN-13: 978-1133187790
Cengage Learning, 2012.

You can find errata (bug reports) for the book at http://www-math.mit.edu/~sipser/book.html.

The textbook tries to give an intuition about the naturally confusing topics. I am sorry it is so dang expensive, especially because most students will not use it outside of the classroom. It does also contain material appropriate for a graduate course, such as CS254 at SJSU.

Course Objectives

- To teach students how to construct and use regular expressions and finite automata.
- To teach students how to construct and use context-free grammars and pushdown automata.
- To teach students how to construct and use simple Turing machines.
- To introduce students to the properties of various automata and languages.
- To teach students how to use pumping lemmas to show non-membership in a language category.
- To teach students how to turn a non-deterministic finite automaton into a deterministic one.
- To teach students how to minimize a deterministic finite automaton.
- To acquaint students with closure properties of languages, and state minimization of automata.

Student Learning Outcomes

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

- Write a grammar for a language described otherwise. Construct deterministic and non-deterministic machines for various languages.
- Describe a language in terms of a regular expression.
- Find a regular expression for a language described by a finite automaton and conversely. Construct a deterministic finite automaton from a non-deterministic one.
- Minimize a deterministic automaton.
- Be able to use a pumping lemma to show that some languages are not regular and/or not context-free
- Use closure properties to simplify proofs of non-regularity of languages.
- Be able to construct a pushdown automaton accepting a given language.
- Construct a Turing machine accepting some simple languages.
- State in precise mathematical terms what is meant by undecidablity of the Halting Problem, and be able to show the undecidability of simple extensions of the Halting Problem, using the reduction technique.

Workload

The following will be regularly assigned for time outside of class:

- Video lectures
- Readings from textbook or handouts
- Homework problems (written) will be regularly assigned

During the introduction of new material, homework is our chance to learn by making mistakes. **None of the above items will count towards your course grade**, but it is expected that you will make an effort to do homework for the sake of learning the material.

Class Participation

Class partiticipation and feedback are very important to keep the course interesting. *If I am covering material too slowly or quickly, or if I am not clearly explaining things, you must let me know.* I prefer an interactive learning environment. If you disagree with something I say, speak up. Argue with me in front of the class. It will make the class better, and right or wrong, constructive interaction will not not hurt your grade. If you are correct, clearly my mistake should be corrected. If you are incorrect, probably I have not explained something clearly anyway, and at least half of the class is confused by it. Point it out right then and there. In cases of exceptional participation that seem to benefit the class as a whole, I reserve the right to improve a student's grade by up to 1/3 grade.

University Policies

University Policies: Office of Graduate and Undergraduate Programs maintains university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc.

You may find all syllabus related University Policies and resources information listed on GUPâ€™s Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/

Grading

Tests: There will be two in-class tests during the semester, that will test "rote" knowledge. You will be given a template for each exam a week in advance. Based on the number of questions you answer correctly, after these exams, you will have a semester grade from F to B-. This grade will be a lower-bound on your course grade.

Final:

- For Section 3, the final exam will be Wednesday, December 14, at 9:45-12:00
- For Section 4, the final exam will be Friday, December 16, at 9:45-12:00

Your final exam will be a mixture of rote and advanced questions. You will be given some sample to see what advanced questions might look like, but you will **not** get a template for the exam. It will be graded on a curve, from F to A+.

Course grade: Your course grade will be the maximum of your grade from the end of semester exams, and your final exam.

Recording Lectures or Sharing Course Materials

You can make audio recordings of class for your own personal use, but they should not be reproduced or distributed. If, for some reason, you want video, please come discuss it with me.

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 solutionswithout instructor consent.

Drop Date

Note that for this semester, the last day to drop without consequence is ***Tuesday, September 6***, and the last day to add is ***Tuesday, September 13***. After these dates it becomes very difficult to drop or add a class, so be sure you are where you want to be before these dates arrive!

Class Schedule

The following table gives a general idea of what pace we will go in the book. We may not cover all parts of all chapters.

Approximate Date **Subject to change**	Topics Covered
August 24	Introductions, Administrivia, Warm Up, Chapter 0
August 29	Exercise on Finite Automata
August 31	Finish Chapter 0
September 7	Chapter 1
September 12	
September 14	
September 19	
September 21	Chapter 2 Introduction
September 26	Review for Exam 1
September 28	Exam 1
October 3	Exam 1 Returned and more
October 5	Chapter 2
October 10	
October 12	
October 17	
October 19	Chapter 3
October 24	
October 26	

October 31	Chapter 4
November 2	
November 7	
November 9	Chapter 5 Introduction
November 14	Review for Exam 2
November 16	Exam 2
November 21	Return Exams?
November 28	Chapter 5
November 30	
December 5	Chapter 6 (part)
December 7	
December 12	Questions?