Theory of Automata

Summer 2017

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Office Hours for CS 4170/6170:

T/Th 4pm – 4:45pm

Or appointment by email

**Catalog Description:** Alphabets, strings and languages; Chomsky hierarchy and language classes; regular languages, finite automata, regular expressions and operators; context-free languages, grammars, pushdown automata; context-sensitive languages; Turing machines and decidability (4 units).

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

1. Apply proof techniques and theorems in language design to a wide range of problems.
2. Design and construct nondeterministic finite state automata, deterministic finite state automata, and regular expressions, and convert between these three models of regular languages.
3. Design and construct context-free grammars and pushdown automata, and convert between these two models of context-free languages.
4. Construct effective and efficient Turing machines to solve a variety of decision problems, and appreciate the power and effectiveness of this model and its role as the foundation for Complexity Theory.
5. Prove when decision problems cannot be solved by computer, thereby developing an appreciation of Language Theory as the keystone of Computer Science.

**Meeting:** Tuesday and Thursday from 2:00pm – 3:50pm in North Science 206.

**Required Text:** *Introduction to the Theory of Computation* (Third Edition), by Michael Sipser.

**Prerequisites:** Math 2101 Elements of Linear Algebra, Math 2150 Discrete Structures, and Math 3204 Calculus III.

**Blackboard:** All course materials will be posted to Blackboard (when possible). No paper copies will be distributed during class.

**Assignments:** Problem sets will be assigned each class meeting except the lecture before the midterm (July 27th) and the last day of class (August 24). All homework must be submitted *at the start of lecture* on the due date listed on the assignment. ***No late homework will be accepted or any reason.***A randomly selected subset of problems will be graded for each assignment. You will receive solutions to *all* problems in lecture.

All homework papers must be securely fastened (not by paper clip), and must clearly indicate each student’s name, course, and assignment number *on each page*. Problems must be in proper order!

Students are allowed (*and actively encouraged*) to form study groups of at most 3 people, and to submit collective assignments as a team. The study groups cannot have mixed graduate (CS6170) and undergraduate students (CS4170), and have to remain the same through the entire quarter.

**Midterm:** There will be a midterm examination on Thursday, July 27th, 2017. No homework will be due during the week of this exam.

**Final:** There will be a cumulative final exam on Tuesday, August 29, 2017 in North Science 206. **No exam may be taken before or after the scheduled time for any reason.** All exams will remain with the instructor.

**Academic Dishonesty:** By enrolling in this class, the student agrees to uphold the standards of academic integrity described in the catalog at <http://www.csueastbay.edu/ecat/current/i-120grading.html#section12>.

Although collaborate study and dialogue are encouraged, students are expected to author solutions entirely on their own. **Any evidence** of cheating will be pursued to the fullest extent of university policy.

**Grading:** 20% assignments, 40% midterm, and 40% final. Extra credit project might be assigned. Grades will not be adjusted in any way - so an 89.9% is still a B+. No incomplete grades will be given. The grading scale is as follows:

A 92.5%

A- 90.0%

B+ 87.5%

B 82.5%

B- 80.0%

C+ 77.5%

C 72.5%

C- 70.0%

D+ 67.5%

D 60.0%

F lower than 60%

**Courtesies:**

* No eating in class.
* Deactivate all devices.
* No recordings without permission.
* Please keep e-mail and phone messages brief.
* If you think an error has been made in grading, resubmit the assignment with a brief note explaining the problem. No discussion with me is necessary!
* Do not ask for special treatment. The rules for this course apply to everyone equally.

**Other Issues:**

* Information on what to do in an emergency situation (earthquake, electrical outage, fire,

extreme heat, severe storm, hazardous materials, terrorist attack) may be found at:

<http://www.aba.csueastbay.edu/EHS/emergency_mgnt.htm>. Please be familiar with these procedures. Information on this page is updated as required. Please review the information on a regular basis.

* If you have a documented disability and wish to discuss academic accommodations, or if

you would need assistance in the event of an emergency evacuation, please contact me as

soon as possible. Students with disabilities needing accommodation should speak with Accessibility Services.

**Schedule of Topics:**

Complexity and Computability

Automata

Mathematical Notations and Terminology

Language Theory

Regular Languages

Finite Automata

Nondeterminism

Regular Expressions

Nonregular Languages

The Pumping Lemma for Regular Languages

Context-Free Languages

Context-Free Grammars

Chomsky Normal Form

Pushdown Automata

Non-Context-Free Languages

The Pumping Lemma for Context-Free Languages

Turing Machines  
The Church-Turing Thesis

Turing-Completeness

Decidability

Decidable Problems from Automata Theory

The Halting Problem

Undecidability

Reducibility