California State University Stanislaus
Department of Computer Science
Syllabus

Instructor: Dr. Xuejun Liang

My Office: DBH 282
Office Hours: MWF 10:00 a.m. - 11:00 a.m.
ZOOM Meeting ID: 4438930033, Phone: (209) 667-3169, Email: xliang@csustan.edu

Class Information:

Classroom: DBH 164 / Online
Class Days & Times: TuTh 9:30 a.m. - 10:45 a.m.
Class Website: https://www.cs.csustan.edu/~xliang/Courses3/CS4410-26S
Class Canvas: Use your class Canvas account to submit homework assignments
Class Modality: Hybrid Online - Synchronous. In-person class meetings will be on campus at the room, day, and time listed. Online class meetings will be at the day and time listed. Students must be available at the class times listed in the Class Schedule and must attend in person on days indicated as such by the instructor. Students do not have the option to choose in-person or virtual, nor opt for asynchronous participation.

Catalog Description:

CS4410 Automata, Computability, and Formal Language. (3 units) Pre-requisites: CS 3100 and MATH 2300. Finite state concepts; sequential machines and state minimization; Chomsky grammar; algorithms on grammars; computability and Turing machines; non-computable functions.

Textbook:

An Introduction to Formal Languages and Automata, Sixth Edition, by Peter Linz, Jones & Bartlett Learning, 2017, ISBN: 978-1-284-07724-7.

JFLAP:

JFLAP is a package of graphical tools which can be used as an aid in learning the basic concepts of Formal Languages and Automata Theory.

Course Outcomes

Students who successfully complete the course should be able to
1. Define the three basic concepts in the theory of computation: automaton, formal language, and grammar and perform related operations.
2. Construct a finite state machine (DFA and NFA) and the equivalent regular expression and regular grammar, transform an arbitrary NFA to an equivalent DFA, and apply the pumping lemma to show that a language is not regular.
3. Construct pushdown automata and the equivalent context-free grammars, construct derivation trees for strings generated by a context-free grammar, show that a given context-free grammar is ambiguous, rewrite a grammar to remove ambiguity, simplify context-free grammars, transform a context-free grammar into an equivalent grammar in Chomsky normal form, and apply the pumping lemma to show that a language is not context-free.

4. Construct a Turing machine to accept a specific language or to compute a simple function, and state Turing's thesis and discuss the circumstantial evidence supporting it.
5. Describe the structure and components of the Chomsky hierarchy.
6. Understand limits of algorithmic computations and have a basic understanding of the complexity classes P and NP, and concepts of intractability and NP-completeness.

Course Outline* (Major Topics and Weekly Schedule)

Date	Topics Covered
Week 1: 01/27, 01/29	Class introduction and syllabus. Introduction to the theory of computation: Mathematical preliminaries and notations.
Week 2: 02/03, 02/05	Introduction to the theory of computation: Three Basic Concepts: Languages, Grammars, Automata. Some applications. Deterministic Finite Accepters (DFA): Deterministic Accepters and Transition Graphs, Languages and DFAs, and Regular Language.
Week 3: 02/10, 02/12	Nondeterministic Finite Accepters, Equivalence of Deterministic and Nondeterministic Finite Accepters
Week 4: 02/17, 02/19	Regular expressions, Connection Between Regular Expressions and Regular Languages
Week 5: 02/24, 02/26	Regular Grammars Test #1 (Chapter 1, 2, and 3)
Week 6: 03/03, 03/05	Closure Properties of Regular Languages, Elementary Questions about Regular Languages
Week 7: 03/10, 03/12	Identifying Nonregular Languages using pumping Lemma Context-free languages and Context-free grammar.
Week 8: 03/17, 03/19	Grammar simplification methods: Substitution Rule, Remove λ-productions, unit-productions, and useless productions
Week 9: 03/24, 03/26	Two Normal forms: Chomsky and Greibach. Nondeterministic Pushdown Automata and Context-Free Languages
Week 10: 04/02	Deterministic Pushdown Automata Test #2 (Chapter 4, 5, 6, and 7)
	Spring break
Week 11: 04/14, 04/16	Properties of Context-Free Languages: Two Pumping Lemmas and Closure of Context-Free Languages
Week 12: 04/21, 04/23	Standard Turing machines, Linear Bounded Automata, universal Turing Machine.
Week 13: 04/28,04/30	Other Models of Turing machines A hierarchy of formal languages and automata.
Week 14: 05/05, 05/07	Introduction to computability: The limits of algorithms Introduction to complexity theory
Week 15: 05/12, 05/14	Test #3 (Chapter 8, 9, 10, 11, 12, 14) Review for the Final
Week 16: 05/21	Final Examination Schedule https://www.csustan.edu/class-schedule/finals-schedule

*It is subject to change.

Grading Scale

Grading scale will be assigned on a standard scale as below.

A	B	C	D	F
90-100	75-89	60-74	45-59	<45

Clustering grades may cause the grading scale to be lowered (to your benefit), but it will not be raised.

Evaluation:

The overall course grade will be the weighted sum of the points in the following categories:

Attendance	Homework	Tests	Final Exam
10%	20%	40%	30%

Other Polices:

1. I will accept the late homework assignments for maximum three days (including holidays) with the point deduction 20% per day.
2. There will be no makeup tests except in a verified emergency with immediate notification.

Academic Honesty:

The work you do for this course will be your own, unless otherwise specified. You are not to submit other people's or AI generated work and represent it as your own. I consider academic honesty to be at the core of the University's activities in education and research. Academic honesty is always expected in this course.

Accommodation for Students with Disabilities

Students with disabilities seeking academic accommodation must first register with the Disability Resource Services (DRS) program, located in MSR 210, ph. (209) 667-3159. Students are encouraged to talk with the instructor regarding their accommodation needs after registering with DRS.

Students Support Services

Services Director can be accessed via the link: [Student Services | California State University Stanislaus (csustan.edu)](csustan.edu)