California State University Stanislaus
Department of Computer Science
Syllabus

Instructor: Dr. Xuejun Liang

My Office: DBH 282
Office Hours: TuTh 11:00 a.m.-11:59 a.m. & W 2:00 p.m. - 3:00 p.m.
ZOOM Meeting ID: 4438930033, Phone: (209) 667-3169, Email: xliang@csustan.edu

Class Information

Classroom: DBH 164
Class Date & Time: TuTh 2:00 p.m. - 3:15 p.m.
Class Website: https://www.cs.csustan.edu/~xliang/Courses2/CS4440-24F
Class Canvas: Use your class Canvas account to submit homework assignments
Class Modality: In-Person. Student attendance is required

Catalog Description

CS4440 Theory of Algorithms. (3 Hours) Pre-requisites: CS 3100 and MATH 2300. Students will learn fundamentals and various techniques of designing and analyzing computer algorithms. Topics include examples of computational problems, efficiency and correctness of algorithms, limitations of algorithm power, and fundamental techniques of algorithm designs such as brute force, divide-and-conquer, decrease-and-conquer, transform-and-conquer, dynamic programming, greedy, iterative improvement, and approximation algorithm design strategies.

Textbook:

A. Levitin, "Introduction to the Design & Analysis of Algorithms," 3rd Edition, Addison-Wesley, 2012, ISBN: 0132316811

Reference Books:

Jon Kleinberg and Eva Tardos, "Algorithm Design", Addison Wesley, 2006, ISBN: 9780321295354

Course Outcomes

Students who successfully complete the course should be able to

1. Analyze the time complexity of recursive and non-recursive algorithms with respect to the asymptotic order of growth.
2. Design and analyze algorithms to solve problems using brute-force and decrease-and-conquer techniques.
3. Design and analyze algorithms to solve problems using divide-and-conquer and transform-and-conquer techniques.
4. Understand space and time trade-offs of algorithm efficiency as well as design and analyze algorithms to solve problems using hashing and dynamic programming techniques.
5. Understand concept of suboptimal and satisfactory algorithms as well as design and analyze algorithms to solve problems using greedy and iterative improvement techniques.

6. Discuss lower bound arguments, decision tree, and NP-complete problem as well as design and analyze polynomial-time heuristics to approximate solutions for NP-complete problems.

Course Outline* (Major Topics and Weekly Schedule)

Date	Topics Covered	Sections
Week 1: 08/22	Course syllabus. Introduction of the course. Analysis framework; Asymptotic notations	1.1-3 2.1-2
Week 2: 08/27, 08/29	Mathematical analysis of nonrecursive algorithms Mathematical analysis of recursive algorithms	2.3-5 App.B
Week 3: 09/03, 09/05	Brute-force algorithms: Selection Sort, Sequential Search Exhaustive search: Traveling-Salesman, Knapsack Problem	3.1-2 3.4
Week 4: 09/10, 09/12	Depth-first search and breadth-first search Decrease-by-one: insertion sort, topological sorting	3.5 4.1-2
Week 5: 09/17, 09/19	Binary search and other decrease-by-a-constant factor algorithms Variable-size-decrease algorithms	4.4 4.5
Week 6: 09/24, 09/26	Divide-and-conquer: mergesort, quicksort Other divide-and-conquer examples	5.1-2 5.4
Week 7: 10/01, 10/03	Test #1 (Chapter 1 to 5) Instance simplification: presorting, Gaussian elimination, balanced search trees	6.1-3
Week 8: 10/08, 10/10	Representation change: heaps and heapsort, Horner's rule and binary exponentiation, and Problem reduction	6.4-6
Week 9: 10/15, 10/17	Space-time trade-offs: sort by counting, string matching, hashing, Btrees	7.1-4
Week 10: 10/22, 10/24	Dynamic programming algorithms: Three basic examples, Knapsack Problem, Optimal Binary Search Trees	8.1-3
Week 11: 10/29, 11/31	Dynamic programming algorithms: Warshall's, Floyd's Greedy algorithms: Prim's, Kruskal's, Dijkstra's,	8.4 9.1-3
Week 12: 11/05, 11/07	Iterative improvement algorithms: Linear Programming, Maximum Flow Problem, Bipartite Graphs	10.1-3
Week 13: 11/12, 11/14	Iterative improvement algorithms: Stable Marriage Problem Test #2 (Chapter 6 to 10)	10.4
Week 14: 11/19, 11/21	Lower-bound arguments, Decision trees, P, NP, and NP-complete problems	11.1-3
	Thanksgiving Break	
Week 15: 12/03, 12/05	Backtracking, Branch-and-bound, Approximation algorithms for NP-hard problems	12.1-3
Week 16: 12/10	Review for the Final Exam	
Week 17: 12/12 2:00-4:00 p.m.	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. Clustering of grades may cause the grading scale to be lowered (to your benefit), but it will not be raised.

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

Evaluation:

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

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

Other Polices:

1. I will accept the homework assignments late 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.

Accommodations for Students with Disabilities

Students with disabilities seeking academic accommodations 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)