Contact Information

Instructor: Peter McGlaughlin

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Office: Duncan Hall 282

Office Hours
12-13:30 Tu/Th
Duncan Hall 282

Course Information

Class location: Clark Building 111
Class times: Tu/Th 13:30-14:45

Course Description and Requisites

Algorithm design techniques: dynamic programming, greedy algorithms, Euclidean and extended Euclidean algorithms, Discrete and Fast Fourier transforms. Analysis of algorithms, intractable problems and NP-completeness. Additional topics selected from: selection algorithms and adversary arguments, approximation algorithms, parallel algorithms, and randomized algorithms.

Prerequisite: CS 146 (with a grade of "C-" or better); Allowed Majors: Computer Science, Data Science, Applied and Computational Mathematics or Software Engineering; or instructor consent.

Letter Graded

Classroom Protocols
Do NOT share any course material publicly (on Canvas, GitHub, etc.) without permission, including but not limited to lecture notes, lecture videos, passwords, homework/exam solutions, and class meeting links.

Program Information

Diversity Statement - At SJSU, it is important to create a safe learning environment where we can explore, learn, and grow together. We strive to build a diverse, equitable, inclusive culture that values, encourages, and supports students from all backgrounds and experiences.

Course Goals

To develop an in-depth understanding of algorithm design techniques and the analysis of algorithms, and to present a substantial introduction to computational complexity and NP-completeness.

Specific Course Objectives:

- To explore details of using dynamic programming to design algorithms in a variety of areas.
- To determine when a greedy algorithm design strategy is appropriate and to effectively use such a strategy.
- To expose students to classical algorithms of higher complexity than they see in CS 146, such as Strassen’s Matrix Multiplication, number theoretic algorithms (the Extended Euclidean Algorithm), a max-flow algorithm, and the FFT and some ways to implement it.
- To develop a thorough understanding of the complexity classes P and NP, including exposure to a proof of NP-Hardness from fundamentals.
- To expose students to analysis of algorithms which are at a greater level of difficulty than in CS 146.
- To introduce students to some more complex areas of algorithms, as selected by the instructor.

Course Learning Outcomes (CLOs)

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

1. Use dynamic programming effectively.
2. Design a greedy algorithm when appropriate, including a proof of its correctness.
3. Follow and use fairly complex graph theoretic algorithms such as a max-flow algorithm.
4. Design simple geometric algorithms involving scanning or divide-and-conquer techniques.
5. Simulate the Euclidean and extended Euclidean classical number-theoretic algorithms.
6. Simulate Strassen’s Algorithm for Matrix Multiplication when given pseudocode for it.
7. Explain the Discrete Fourier Transform and simulate the Fast Fourier Transform (FFT) algorithm for computing it when given pseudocode for it.
8. Understand the definition of the complexity classes P and NP and be able to recognize some examples of each.

Course Materials
Course Requirements and Assignments

The following may be assigned:

- Reading Assignments or Handouts
- In Class Discussions, Activities, and Exercises
- Midterm Exams: there will be two exams during the semester.
- Final Exam: The final exam will be comprehensive for the semester.

Technology Intensive, Hybrid, and Online Courses

All students are required to have access to a wireless laptop (running OSX, Windows, or some version of UNIX), upon which you can install required software. Technology used will include Canvas, programming in Java, and an IDE (Integrated Development Environment).

MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on Canvas Learning Management System course login website. You are responsible for regularly checking with the messaging system through MySJSU on Spartan App Portal (or other communication system as indicated by the instructor) to learn of any updates.

Workload Expectations

University Policy S16-9 (http://www.sjsu.edu/senate/docs/S16-9.pdf) states that:

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.
Grading Information

Course weightings will be as follows:

0% Weekly Exercises - There will be about 3 ungraded problems assigned each week. These problems are a chance to check your understanding of and ability to apply important concepts from lecture. About 50% of the questions on exams will come from these problems or minor variations on them.

25% Homework Assignments - There will be 5 to 6 homework assignments throughout the semester. The lowest score will be dropped. Homeworks will be more challenging than weekly exercises and will teach you new techniques. You will have 2 weeks to complete an assignment, and may work in groups of up to 3 students. One submission per group. More details on assignments can be found on Canvas.

20% Midterm Exams - tentative dates February 27, and April 16 (in class).

35% Final Exam - Friday May 17, 12:15-14:30

Your course grade will be determined by your final weighted average:

A plus = 97% or higher
A = 93% up to 97%
A minus = 90% to 93%
B plus = 87% to 90%
B = 83% to 87%
B minus = 80% to 83%
C plus = 77% to 80%
C = 73% to 77%
C minus = 70% to 73%
D plus = 67% to 70%
D = 63% to 67%
D minus = 60% to 63%
F = 0% to 60%

Boundary cases count as the higher of the two grades.
Final grades may be curved. Any curve will only benefit students. Details can be found on canvas. I also reserve the right to increase your final grade by 1/3 of a letter grade for class participation.

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 S20-2 for more details.

University Policies

Per University Policy S16-9 (PDF), relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on the Syllabus Information web page. Make sure to visit this page to review and be aware of these university policies and resources.

Course Schedule

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<th>Topic</th>
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<td>Introduction</td>
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<td>Week 2</td>
<td>Dynamic Programming</td>
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<tr>
<td>Week 3</td>
<td>Dynamic Programming</td>
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<td>Week 4</td>
<td>Greedy Algorithms</td>
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<td>Week 5</td>
<td>Greedy, Midterm 1 Review</td>
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<td>Week 6</td>
<td>Midterm 1, Start Divide and Conquer</td>
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<td>Week 7</td>
<td>Divide and Conquer</td>
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<td>Week 8</td>
<td>Computational Geometry</td>
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<td>Week 10</td>
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<td>Week 11</td>
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<td>Week 13</td>
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<td>Week 14</td>
<td>Finish NP, Start Randomized Algorithms</td>
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<td>Week 15</td>
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<td>Week 16</td>
<td>Wrap up, Final Review</td>
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