SJSU SAN JOSÉ STATE UNIVERSITY

College of Science · Computer Science

# Data Structures and Algorithms Section 02

## CS 146

Spring 2024 3 Unit(s) 01/24/2024 to 05/13/2024 Modified 01/24/2024

## Contact Information

### Instructor: Professor Nada Attar

**Email:** nada.attar@sjsu.edu

#### Office Hours

Monday, Wednesday
10:30 AM to 11:30 AM, Zoom

Zoom Link: https://sjsu.zoom.us/j/88958853045?pwd=K0pGWW1wQzJuUzhRTlVzcW8vVmFMQT09 (https://www.google.com/url?q=https://sjsu.zoom.us/j/88958853045?pwd%3DK0pGWW1wQzJuUzhRTlVzcW8vVmFMQT09&sa=D&source=calendar&ust=1706140927209854&usg=AOvVaw2SHmz_3xZlXTJ2W0J6CCZM)

## Course Information

### Lecture

Mondays and Wednesdays
12:00 PM to 1:15 AM, MH225

## Course Description and Requisites

Implementations of advanced tree structures, priority queues, heaps, directed and undirected graphs. Advanced searching and sorting techniques (radix sort, heapsort, mergesort, and quicksort). Design and analysis of data structures and algorithms. Divide-and-conquer, greedy, and dynamic programming algorithm design techniques.

Prerequisite(s): MATH 30, MATH 42, CS 46B, and [(CS 48 or CS 49J) if CS 46B was not in Java], each with a grade of "C-" or better; Computer Science, Applied and Computational Math, Forensic Science: Digital Evidence, Software Engineering, Data Science majors only; or instructor consent.

Letter Graded

# Classroom Protocols

The lectures will be as an in-person mode. Regular class attendance is highly recommended and strongly encouraged. This section has online office hours. Please have your camera on during office hours. Do not publicly share or upload material for this course such as exam questions, lecture notes, or solutions without my consent.

Students are not allowed to share any of the materials of the course without the instructor's consent.

Grade disputes are allowed within one week of posted grades.

# 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

1. To ensure that students are familiar with ways to implement elementary data structures and their associated algorithms.
2. To introduce students to the implementation of more complex data structures and their associated algorithms.
3. To acquaint students with advanced sorting techniques.
4. To teach students how to determine the time complexity of algorithms.
5. To introduce students to algorithm design techniques.

# Course Learning Outcomes (CLOs)

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

1. Understand the implementation of lists, stacks, queues, search trees, heaps, union-find ADT, and graphs and be able to use these data structures in programs they design
2. Prove basic properties of trees and graphs
3. Perform breadth-first search and depth-first search on directed as well as undirected graphs
4. Use advanced sorting techniques (heapsort, mergesort, quicksort)
5. Determine the running time of an algorithm in terms of asymptotic notation
6. Solve recurrence relations representing the running time of an algorithm designed using a divide-and-conquer strategy
7. Understand the basic concept of NP-completeness and realize that they may not be able to efficiently solve all problems they encounter in their careers

8. Understand algorithms designed using greedy, divide-and-conquer, and dynamic programming techniques

# Course Materials

## Introduction to Algorithms

**Author:** Cormen, Leiserson, Rivest, and Stein
**Publisher:** MIT Press, 2009
**Edition:** 3rd Edition
**ISBN:** ISBN-10: 0262033844ISBN-13: 978-0262033848

You can find errata (bug reports) for the book http://www.cs.dartmouth.edu/~thc/clrs-bugs/bugs-3e.php,for whichever printing of the book you get

# Course Requirements and Assignments

SJSU classes are designed such that in order to be successful, it is expected that students will spend

a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3at http://www.sjsu.edu/senate/docs/S12-3.pdf.

Homework assignments will be individual, regularly assigned, will include written problem assignments, and perhaps some online exercises. The homework is a tool for you to learn the material and prepare you for the exams.

Late Submission:

- 0-6hr -> no penalty
- +6hr -> 50% penalty
- +12hr -> 100% penalty

# Grading Information

## Criteria

Your grade for the course will be based on the following components:

| Type | Weight | Topic | Notes |
|---|---|---|---|
| Midterm Exam | 15% | | |
| Assignments | 30% | | |

| Type | Weight | Topic | Notes |
|---|---|---|---|
| Quizzes | 30 | | |
| Final Exam | 25% | | |

Breakdown

# University Policies

Per University Policy S16-9 (PDF) (http://www.sjsu.edu/senate/docs/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 (https://www.sjsu.edu/curriculum/courses/syllabus-info.php) web page. Make sure to visit this page to review and be aware of these university policies and resources.

# Course Schedule

| When | Topic | Notes |
|---|---|---|
| Week 1<br>01/24/2024<br>12:00 PM - 1:15 AM | Introduction: syllabus, Course mechanic & Logistics; Review Data Structures (lists, stacks, queues, trees) | |
| Week 2<br>01/29/2024<br>12:00 PM - 1:15 AM | Basic algorithms, Insertion sort ; Growth of functions- O, Ω, Θ, o, ω | |
| Week 2<br>01/31/2024<br>12:00 PM - 1:15 AM | Divide and Conquer technique: Merge Sort, other examples | |
| Week 3<br>02/05/2024<br>12:00 PM - 1:15 AM | Solving recurrences | |
| Week 3<br>02/07/2024<br>12:00 PM - 1:15 AM | Online Materials | |

| When | Topic | Notes |
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| Week 4<br>02/12/2024<br>12:00 PM - 1:15 AM | Master Theorem | |
| Week 4<br>02/14/2024<br>12:00 PM - 1:15 AM | Heapsort, Priority Queues | |
| Week 5<br>02/19/2024<br>12:00 PM - 1:15 AM | Sorting in linear time | |
| Week 5<br>02/21/2024<br>12:00 PM - 1:15 AM | Counting sort, Radix Sort | |
| Week 6<br>02/26/2024<br>12:00 PM - 1:15 AM | Hash Tables | |
| Week 6<br>02/28/2024<br>12:00 PM - 1:15 AM | Hash Tables | |
| Week 7<br>03/04/2024<br>12:00 PM - 1:15 AM | Quicksort | |
| Week 7<br>03/06/2024<br>12:00 PM - 1:15 AM | Binary Search Trees | |
| Week 8<br>03/11/2024<br>12:00 PM - 1:15 AM | Red-Black trees | |

| When | Topic | Notes |
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| Week 8<br>03/13/2024<br>12:00 PM - 1:15 AM | Red-Black trees | |
| Week 9<br>03/18/2024<br>12:00 PM - 1:15 AM | 2-3 Trees | |
| Week 9<br>03/20/2024<br>12:00 PM - 1:15 AM | Dynamic Programming | |
| Week 10<br>03/25/2024<br>12:00 PM - 1:15 AM | Review | |
| Week 10<br>03/27/2024<br>12:00 PM - 1:15 AM | Midterm Exam | |
| Week 11<br>04/01/2024<br>12:00 PM - 1:15 AM | Cesar Chavez Day (Observed) - Campus Closed (CC) | |
| Week 11<br>04/03/2024<br>12:00 PM - 1:15 AM | Spring Break | |
| Week 12<br>04/08/2024<br>12:00 PM - 1:15 AM | Review + Midterm Exam Solutions | |
| Week 12<br>04/10/2024<br>12:00 PM - 1:15 AM | No Class (Reading Materials) | |

| When | Topic | Notes |
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| Week 13<br>04/15/2024<br>12:00 PM - 1:15 AM | Dynamic Programming | |
| Week 13<br>04/17/2024<br>12:00 PM - 1:15 AM | Elementary Graph Algorithms, Undirected graph | |
| Week 14<br>04/22/2024<br>12:00 PM - 1:15 AM | BFS, DFS | |
| Week 14<br>04/24/2024<br>12:00 PM - 1:15 AM | Directed graph, Topological Sort | |
| Week 15<br>04/29/2024<br>12:00 PM - 1:15 AM | Strongly connected components | |
| Week 15<br>05/01/2024<br>12:00 PM - 1:15 AM | Minimum Spanning Tree – Prim's and Kruskal's Algorithm | |
| Week 16<br>05/06/2024<br>12:00 PM - 1:15 AM | Single Source Shortest Paths: Dijkstra's Algorithm | |
| Week 16<br>05/08/2024<br>12:00 PM - 1:15 AM | NP-complete problems | |
| Week 17<br>05/13/2024<br>12:00 PM - 1:15 AM | NP-complete problems | |

| When | Topic | Notes |
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| 05/17/2024<br>9:45 AM - 12:00 PM | Final Exam | |