

CS 151 - Data Structures

Spring 2023

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An introduction to the fundamental data structures of computer science: linked lists, stacks, queues, trees (BSTs, heaps, AVLs and other self-balancing BSTs), hash tables, sets (Union-Find), graphs and their accompanying algorithms. Principles of algorithmic analysis and object reasoning and design will be introduced using mathematical techniques for the notions of both complexity and correctness. More practical issues, such as memory management, searching, sorting and hashing, will also be covered.

Textbook

Required: Data Structures and Algorithms by Goodrich, Tamassia and Goldwasser

Prerequisites

One of the following courses is required with a grade of 2.0 or better (or permission of the instructor).

1. CS B110
2. CS B113
3. CS H105

Schedule of Topics

This schedule is *tentative*. Programming assignments are due **electronically**. Students should expect **at least 10 hours of work each week**.

Week 1. Introduction, Java Review

- Reading: Chapters 1
- ArrayLists

Week 2. Object-oriented programming (OO design and inheritance)

- Reading: Chapters 2
- A2: ArrayLists and Inheritance

Week 3. Linked Lists

- Reading: Chapters 3
- A3: linked lists

Week 4. Algorithm Analysis

- Reading: Chapter 4

Week 5. Stacks and Queues

- Reading: Chapters 6

- A4: Stacks and Queues
- Week 6. List and Iterator, Binary Search
- Reading: Chapter 7 and 5
 - A5: Binary Search
- Week 7. Midterm
- Review
 - Midterm in class
- Week 8. Spring break
- Week 9. Binary Trees and Binary Search Trees
- Reading: Chapter 8
 - A6: linked BST, unbalanced
- Week 10. Priority Queues and Binary Heaps
- Reading: Chapter 9
 - A7: array-based binary heap
- Week 11. Maps and Hash Tables
- Reading: Chapter 10
 - A8: deduplication via open-addressing and double hashing
- Week 12. Sorting and Selection
- Reading: Chapter 12
 - A8: deduplication via quick sort
- Week 13. Sorted maps, Skiplists, Sets and Union-Find. Balanced Search trees, AVL trees.
- Reading: Chapter 10 and 11
 - A9: AVL tree or Quad-tree
- Week 14. Balanced search trees: splay trees, (2, 4) trees, red-black trees
- Reading: Chapter 11
- Week 15. Graphs and review
- Reading Chapter 14
- Week 16. Final exam week - the final exam will be self-scheduled through the registrar's office.

Total grade breakdown

Grades will be awarded based on the number of points earned and according to the percentage breakdowns shown.

Labs	5%
Assignments	35%
Final project	10%
Midterm	20%
Final exam	30%

Late work policy

All extensions must be requested **at least 24 hours in advance** of the deadline. Extensions will be granted based on individual circumstances. Work handed in late without a previously granted extension may not be accepted.

Rules and Pet Peeves

- **Be on time.** This includes class, lab, office hours, and appointments.
- **Attend all classes and labs.**
- **Expect 24 hours before an email response** or longer on a weekend. I often respond MUCH faster than this, but you should NOT expect it. This means that waiting until the last minute to start your work is a very bad idea.

Attendance and Participation

Attendance at, and active participation in, all class sessions is expected of all students. Participation will be taken into account in awarding of final grades for students who are “on the edge” between two grades. For example, a student with a B+/A- average and a strong attendance and participation record would receive an A-, while a student with a weak record would receive a B+.

Collaboration

It is your responsibility to understand and follow the collaboration policy in this class. The goal of the policy is to encourage collaboration while ensuring that you and your classmates really engage in earning how to solve the challenging problems you’ll see in this course. If you are ever uncertain if collaboration or certain sources are allowed, you should ask the professor.

You are encouraged to discuss the lecture material and the labs and assignments with other students, subject to the following restriction: the only “product” of your discussion should be your memory/understanding of it - you may not write up solutions together, or exchange written work or computer files. The group project is the only exception to this - in this case, these collaboration rules apply to students outside of your group and you may freely work closely with students within your group. Collaboration is not allowed on examinations or quizzes.

You should not use outside sources to copy code (the internet, other textbooks, students not in this class, etc.). In general, code should not be copied without permission from the author. If permission is given, code should be cited at the location it is used with a comment. If your solution is inspired by any outside resources (I understand that sometimes it is hard to not see things), you **MUST** cite.

Learning Accommodations

Students requesting accommodations in this course because of the impact of disability are encouraged to meet with me privately early in the semester with a verification letter. Students not yet approved to receive accommodations should also contact Deb Alder, Coordinator of Accessibility Services, at 610-526-7351 in Guild Hall, as soon as possible, to verify their eligibility for reasonable accommodations. Early contact will help avoid unnecessary inconvenience and delays.