Computer Science 210: Data Structures

Introduction

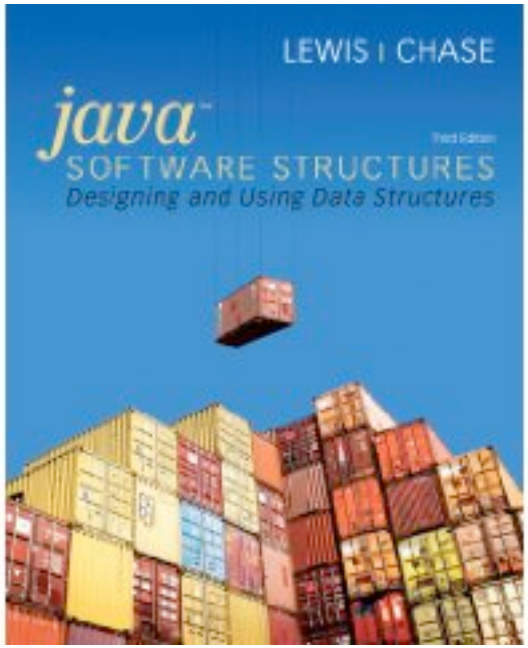
Welcome to Data Structures!

- Data structures are fundamental building blocks of algorithms and programs

- Csci 210 is a study of data structures
  - abstract data structures
  - design
  - analysis
  - implementation
  - use
- Prerequisites:
  - csci 101 (at Bowdoin or in high-school)
  - In other words
    - beginner knowledge of programming (in Java)
    - enjoy programming and problem solving
    - have a desire to learn more of it

Logistics

- Instructor: Laura Toma
  - office: Searles 219
  - Office hours:
    - T, Th 2-4pm
    - quick questions any time I am in the office
- TA: Yuna Oh
  - office hours: TBA
- Textbook:
  - Lewis & Chase
  - online: Sedgewick & Wayne, Programming in Java
- Website:
  - http://www.bowdoin.edu/~ltoma/teaching/cs210/fall09/
  - class not maintained on Blackboard



Course outline

- Week 1: Searching and sorting.
- Week 2: Analysis of algorithms.
- Week 3: Object-oriented (OO) concepts.
- Week 4: Stacks and queues.
- Week 5: Linked lists.
- Week 6,7: Recursion.
- -------- Exam 1
- Week 8: Searching and backtracking. Breadth- and depth-first search
- Week 9: Trees and search trees.
- Week 10: Balanced binary search trees.
- Week 11: Priority queues.
- Week 12: Maps and hash tables.
- Week 13, 14: Networks.
- -------- Exam 2

Pong

Breakout

Sudoku

Boggle

Tetris

Terrains

...

Work and grading policy

- Class work:
  - weekly homeworks and lab assignments (approx. 50%)
  - 2 exams (approx. 50%)
  - readings, class participation, in-class assignments
- The class is programming-intensive
- Lab assignments are not meant to be finished during lab time. You have one week to complete them.
  - Handing in: hard copy + email
  - on hard copy sign that you have followed class honor code
- Lab work: team of <= 2 people
- Late policy: 25% per day
  - Why? it is absolutely essential that you do not fall behind
  - failure to turn in a lab ==> fail the class

Honor code

- Students are expected to follow the Bowdoin Computer Use Policy and the Academic Honor Code.
- You are encouraged to discuss ideas and techniques broadly with other class members, but not specifics of assigned problems except as part of group projects.
- Discussions should be limited to questions that can be asked and answered without using any written medium (e.g. pencil and paper or email).
- This means that at no time should a student read any code written by another student unless they are part of the same group.
- Sharing of code or intermediate designs is expressly prohibited.
- The same rules apply once you have finished the course: sharing your code with other students will be considered a violation of Bowdoin's honor code.
- Violation of this policy is grounds for me to initiate an action that would be filed with the Dean's office and would come before the J Board.
- If you have any questions about this policy, PLEASE do not hesitate to contact me. This will be a zero-tolerance policy.
- Don’t leave lab for the last night!
- Just submit what you have, even if not working.

More about the class

- The class is about designing, analyzing, implementing and using fundamental data structures.

- 101
  - you learnt how to use the basic constructs in Java. Put it differently, you learnt how to use a hammer and saw.
  - focus was on learning the tools available when writing a program
    - syntax, conditionals, loops, arrays, etc

- 210
  - Knowing how to use a hammer and saw does not mean you can build a house. In 210 you'll learn how to build a house.
  - you'll learn more tools, and most importantly you'll learn to put them together to create a large program
  - and...you'll learn to LEARN

More about the class

- It is occasionally programming intensive
- However ... is NOT about programming
  - but about programming methodology
    - design + analysis + programming + debugging
- Programming language: Java. Why?
  - makes graphics and web applications easy
  - available on all platforms
  - new language, in fashion
- Most of the class will be independent of Java
  - maybe next semester ...Python?
  - You'll learn to distinguish between Java questions (check the Java doc pages to answer), and language-independent questions
- Java graphics NOT the core of the class
  - Java graphics will be used to improve the interface of your programs
  - Usually the graphical part will be given, you'll need to write the "core"

Labs

- Attendance is mandatory
- The labs are not meant to be finished during lab time
  - Labs due one week after they are assigned; they are part of your homework
- Labs are not all equal
  - in general, progressively harder
  - at the beginning: lots of info guiding you towards the solution
- The labs are not always connected to the topic studied in class that week
  - the focus is on solving a problem
- The labs are often harder than they look. You'll spend a lot of time understanding what the task is. It is a good idea to read the lab beforehand, so that you can ask many questions during lab time.
- Labs are challenging and fun. They are the most important learning tool
  - you will learn in class
  - you will REALLY learn while working out the labs
  - times the process will seem painful, and occasionally you will find a lab unfair.
- However, at the end of the class you'll find that you've learned a lot.

Expectations

- TOGETHER
  - During class time we'll talk about data structures concepts, we'll analyze various options and we'll work out the implementation details for some of these options
  - Often during class-time we'll program together as a group
  - Occasionally there'll be in-class assignments and team work

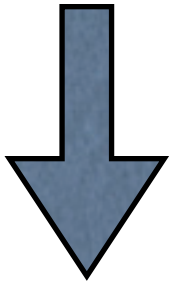
- YOU
  - you'll learn to think like a computer scientist
  - you'll learn to find out what it takes to get a task accomplished
  - you'll start your lab in a timely manner
  - The bulk of your effort will be to get the lab assignments to work
  - You need to develop your code so that it can be debugged!!
    - flowchart, develop incrementally, debug, test

Scenario

- You develop all classes at once. Nothing works! HELP!!!
  - if code has too many errors, their combinations are infinite ==> impossible to debug
  - Moral: structure your code so that you implement one feature at a time, you debug it and test it, and then move on.
- You get stuck in Java graphics (GUI) before solving the actual problem.
  - Why don't the buttons show?
  - Moral: Solve the core of the problem first, with a simple interface. If you have time at the end you can make your GUI more fancy.

More Expectations

- Problem: various backgrounds
  - 101 A vs. 101B
  - 101 vs. highschool
  - highschool 1 vs. highschool 2



- Willingness to work in a group environment
- Patience with material that is not new and when class is slow
  - participate
  - share with others
- Ask plenty of questions when something is unclear
- Goal: we want to work as a class

Class Outcomes

- You will learn the fundamental data structures:
  - lists, vectors stacks, queues, priority queues, trees, hash tables and maps
- Design: you will learn to model and come up with a solution to a problem
  - modularity, data abstraction, building blocks
- Analysis: you will learn to analyze the efficiency of your solution
  - you will learn to use efficiency considerations to decide the choice of data structures
- Program development: you will learn the importance of each step in getting a program to work: design, debug, test
  - Practice of programming:
    - Simplicity
    - clarity
    - generality
- You'll learn to find out what it takes to get a task accomplished

This being said...

- Yes, 210 will be challenging
- But, most of the people who take 210
  - like it
  - say it is one of the most fun classes they took
  - continue with Computer Science
    - 210 is the pre-requisite for all other classes
  - If you like 210, you should think about majoring or minoring in computer science

- You are all here because you liked 101
- Welcome, and hope you'll stay!

The major in Computer Science

1 entry-level class

101
Introduction to CS

210
Data Structures

5 core classes

cs 231
Algorithms

cs 270
Artificial
Intelligence

cs 289
Theory of
Computation

Math 200
Introduction to
mathematical
reasoning

3 electives

320
Robotics

340
Spatial Da
Structures

350
GIS

355
Cognitive
Architecture

360
Computer
and Netwo
Security

375
Optimization
and Uncertain

380
Computer G

260
Software Design

291-294
Intermedi
Independen
Study

401-404
Advanced
Independent
Study