Intro: What Is a Data Structure?

CS 214, Fall 2019

One definition

A scheme for organizing data to use it efficiently

Data structure goals

- Correctness (does what it promises)
- Efficient use of resources:
  - Time (for operations)
  - Space (memory)
  - Power

Example: array set

How long does it take to find an element? How long to add one?

14	2	65	23	26	80	45

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What if we sort it?

2	14	23	26	45	68	80

Characterizing data structures

- Almost always comes with an *algorithm*
  - (an effective procedure to a class of problems)
- Usually implements an *abstract data type*
  - (a set of operations with rules about their behavior)

Example abstract data type: stack

- Operations: push, pop, peek
- Implementations:
  - Linked list: cons, rest, first
  - Array?

Example abstract data type: set

- Operations: empty?, member?, insert, union, intersect, size
- Implementations:
  - Linked list
  - Array
  - Binary search tree
  - Hash table

Related things that aren't really data structures

- File/serialization/interchange formats (*e.g.,* JSON, XML)
- Databases (though they often use very fancy data structures)

Concrete data structures

Concrete data structures

- struct
- array
- linked list (single, double, circular)
- ring buffer
- hash table
- binary search tree
- adjacency list and adjacency matrix
- binary heap
- union-find
- Bloom filter
- dynamic array
- AVL and red-black trees

Other concepts

- Abstract data types
- Asymptotic analysis (big-O notation)
  - Worst case
  - Average case
  - Amortized worst case
- Hashing

Administrivia

Course staff

Instructor: **Jesse** Tov

- Email: jesse@cs.northwestern.edu
- Office: Mudd 3510
- Office hours: Tu. 9/24 3–5 PM (& more TBD)

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Grad TAs:

- Kaiyu Hou
- Leif Rasmussen

Undergrad TAs:

- Aishwarya Jois
- Calypso Sheridan
- David Lee
- Jonathan Chan
- Lilliana de Souza
- Mario Lizano

Prerequisites

One of:

- CS 111 and CS 211
- (AP CS, CS 111, and CS 295)
- or something equivalent

Course structure

- Lectures will be mostly theoretical
- Homework is programming
- Exams cover both

Grading

- Seven programming assignments worth 50% total
- Two in-class exams worth 25% each
- The map from numbers to letter grades is at my discretion

Exams

No final! Two in-class exams:

- 1st: Thursday, October 31st
- 2nd: Thursday, December 5th

Homework

Seven programming assignments:

- Six done with a partner
- Language: DSSL2 (Data Structures Student Language 2)

Graded by automated testing (which can be picky) and TAs (pickier still)

No late work accepted

Your lowest (except for HW7) will be dropped

Resources

In person:

- Peer TAs
- Grad TAs
- Instructor

Online:

- cs.northwestern.edu/~jesse/course/cs214
- Campuswire board

Books (optional):

- Udi Manber, *Introduction to Algorithms: A Creative Approach*.
- CLRS (Corman, Leiserson, Rivest, Stein): *Introduction to Algorithms*

Stealing

Stealing

- Only turn in code you wrote (or consult instructor)
  - (but you can share tests in this class)
- Avoid poisoning (seeing something you shouldn't)
- Accessory to the crime is as culpable as the criminal
- (Your responsibility to protect your work)

How to avoid stealing

- Start early
- Don’t look at others’ homework
- Don’t post homework code on Piazza
- If you aren’t sure, ask course staff

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Definite consequences:

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Possible consequences (pending investigation):

- Undroppable 0 on assignment
- Fail class
- Other nasty stuff

Next: Boxes and arrows