Lecture 1: Welcome to CSE 373

Hi! :)

Data Structures and Algorithms

Agenda

- Introductions
- First day rigamarole
- Remember 143?
- Meet the ADT

Hello!

I am Ben Jones

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CSE 264

Office Hours: TBD and Open Door

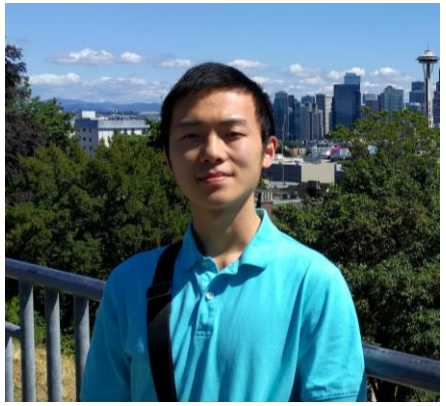
Meet Your TAs

Alex "Homework Wrangler" Okeson

Travis McGaha

Riley Germundson

Siva "The Moderator" Ramamoorthy



Wesley Wu

Course Goals

At the end of this class, you should be able to…

- Implement your own data structures
- Figure out which data structure AND implementation is best to solve a problem
- Write tests to be confident that your implementation are correct
- Work collaboratively with others on code
- Use with professional software engineering tools
- Ace software interviews

Class Style

Please come to lecture and participate!

- Collaboration
- Demos
- A “wrong” answer is a good answer
- Ask questions! Point out mistakes!

Sections

- Practice problems
- Another chance to participate
- Sections start this week

Course Administration

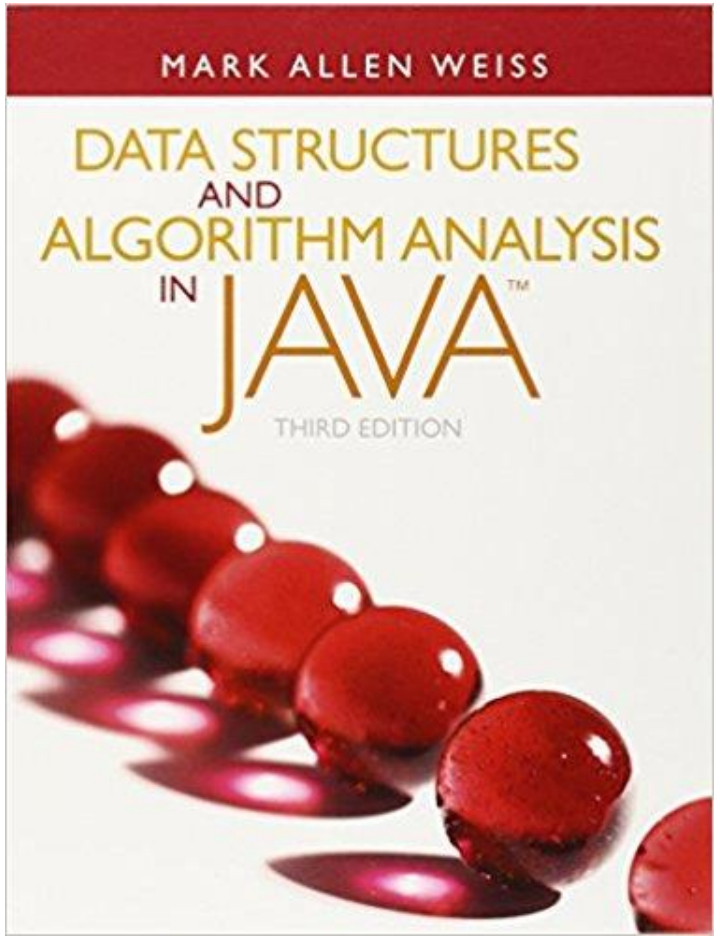
Course Page
- All course content/announcements posted here
- Pay attention for updates!

Canvas
- Grades will be posted here

Office Hours
- Will be posted on Course Page and announced in class
- Will start next week

Piazza
- Great place to discuss questions with other students
- Will be monitored by course staff
- No posting of project code!

Textbook
- Optional!
- Data Structures and Algorithm Analysis in Java by Mark Allen Weiss



Grade Break Down

Homework (65%)

- Projects (50%)
  - Partners required
- Written Assignments (15%)
  - Individual

Exams (35%)

- Midterm Exam – (15%)
- Final Exam – (20%)

Syllabus Highlights

Work on larger projects in pairs

- Find yourself a partner, or be randomly assigned

Collaboration, the Internet and Cheating

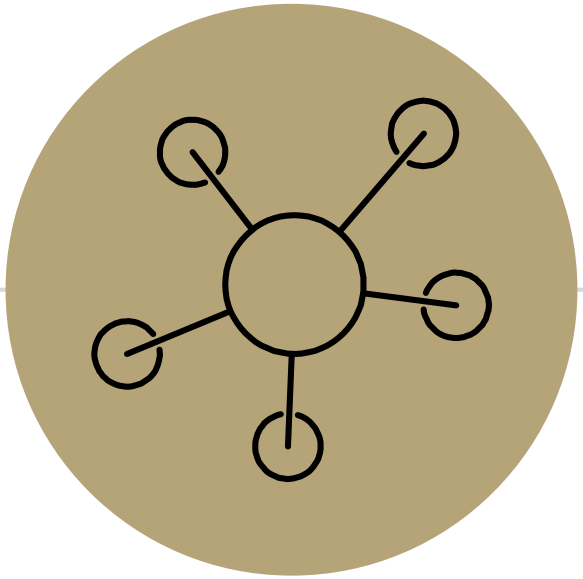
- Don't work without your partner
- "Gilligan's Island Rule"

3 Late Days

- Both partners need a late day
- Max 1 used at a time

Getting Help

- Use Piazza!
- Come to office hours!



Questions?

Clarification on syllabus, General complaining/moaning

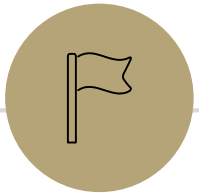
What is this class about?

CSE 143 – OBJECT ORIENTED PROGRAMMING

- Classes and Interfaces
- Methods, variables and conditionals
- Loops and recursion
- Linked lists and binary trees
- Sorting and Searching
- O(n) analysis
- Generics

CSE 373 – DATA STRUCTURES AND ALGORITHMS

- Design decisions
- Design analysis
- Implementations of data structures
- Debugging and testing
- Abstract Data Types
- Code-base development



Data Structures and Algorithms

What are they anyway?

Basic Definitions

Data Structure

- A way of organizing and storing related data points
- Examples from CSE 14X: arrays, linked lists, stacks, queues, trees

Algorithm

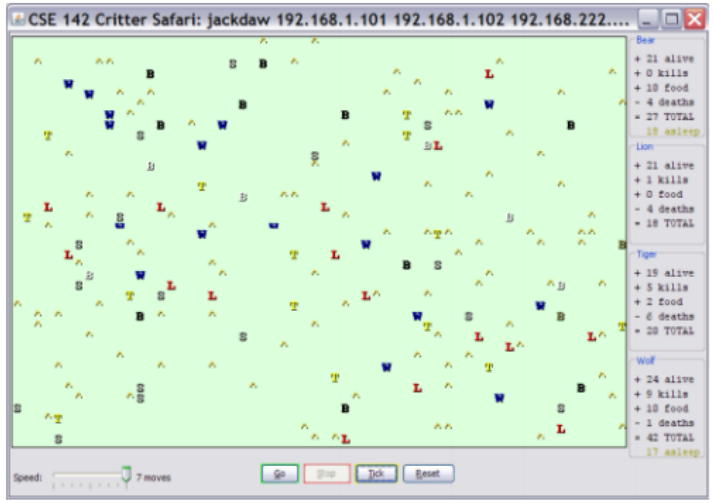
- A series of precise instructions used to perform a task
- Examples from CSE 14X: binary search, merge sort, recursive backtracking

Review: Clients vs Objects

CLIENT CLASSES

A class that is executable, in Java this means it contains a Main method

```
public static void main(String[] args)
```



OBJECT CLASSES

A coded structure that contains data and behavior

Start with the data you want to hold, organize the things you want to enable users to do with that data

1. Ant

constructor	`public Ant(boolean walkSouth)`
color	red
eating behavior	always returns `true`
fighting behavior	always scratch
movement	if the Ant was constructed with a `walkSouth` value of `true`, then alternates between south and east in a zigzag (S, E, S, E, ...); otherwise, if the Ant was constructed with a `walkSouth` value of `false`, then alternates between north and east in a zigzag (N, E, N, E, ...)
toString	`"%"` (percent)

Abstract Data Types (ADT)

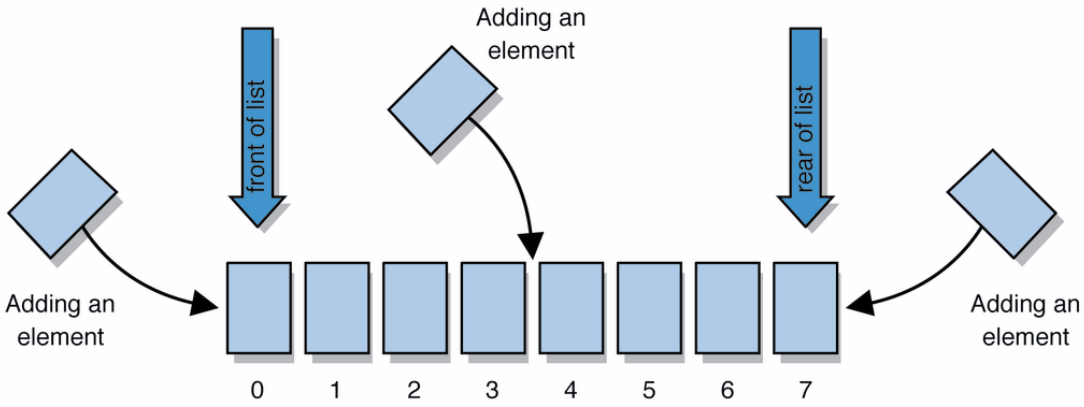
Abstract Data types

- A definition for expected operations and behavior

Start with the operations you want to do then define how those operations will play out on whatever data is being stored

Review: List - a collection storing an ordered sequence of elements

- each element is accessible by a 0-based index
- a list has a size (number of elements that have been added)
- elements can be added to the front, back, or elsewhere
- in Java, a list can be represented as an ArrayList object



Review: Interfaces

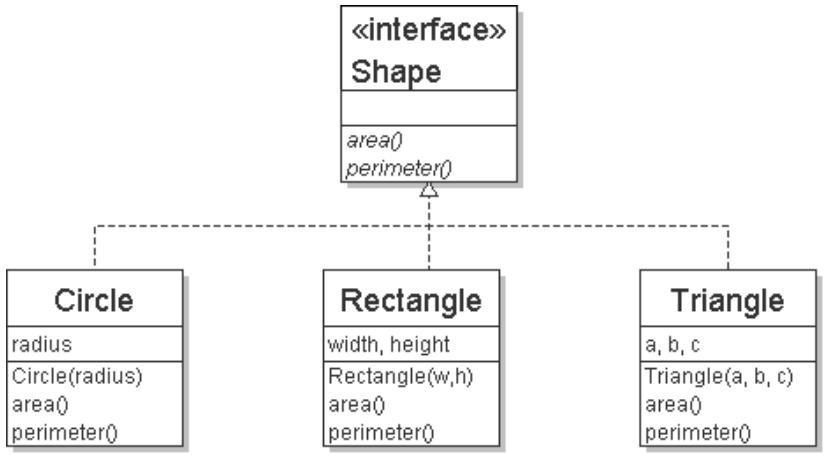
interface: A list of methods that a class promises to implement.

- Interfaces give you an is-a relationship *without* code sharing.
  - A `Rectangle` object can be treated as a `Shape` but inherits no code.
- Analogous to non-programming idea of roles or certifications:
  - "I'm certified as a CPA accountant.
    This assures you I know how to do taxes, audits, and consulting."
  - "I'm 'certified' as a Shape, because I implement the Shape interface.
    This assures you I know how to compute my area and perimeter."

```
public interface name {
    public type name(type name, ..., type name);
    public type name(type name, ..., type name);
    ...
    public type name(type name, ..., type name);
}
```

Example

```
// Describes features common to all
// shapes.
public interface Shape {
    public double area();
    public double perimeter();
}
```



Review: Java Collections

Java provides some implementations of ADTs for you!

You used:

Lists `List<Integer> a = new ArrayList<Integer>();`

Stacks `Stack<Character> c = new Stack<Character>();`

Queues `Queue<String> b = new LinkedList<String>();`

Maps `Map<String, String> d = new TreeMap<String, String>();`

But some data structures you made from scratch… why?

Linked Lists - LinkedIntList was a collection of ListNode

Binary Search Trees – SearchTree was a collection of SearchTreeNodes

Full Definitions

Abstract Data Type (ADT)

- *A definition for expected operations and behavior*
- A mathematical description of a collection with a set of supported operations and how they should behave when called upon
- Describes what a collection does, not how it does it
- Can be expressed as an interface
- Examples: List, Map, Set

Data Structure

- *A way of organizing and storing related data points*
- An object that implements the functionality of a specified ADT
- Describes exactly how the collection will perform the required operations
- Examples: LinkedIntList, ArrayIntList

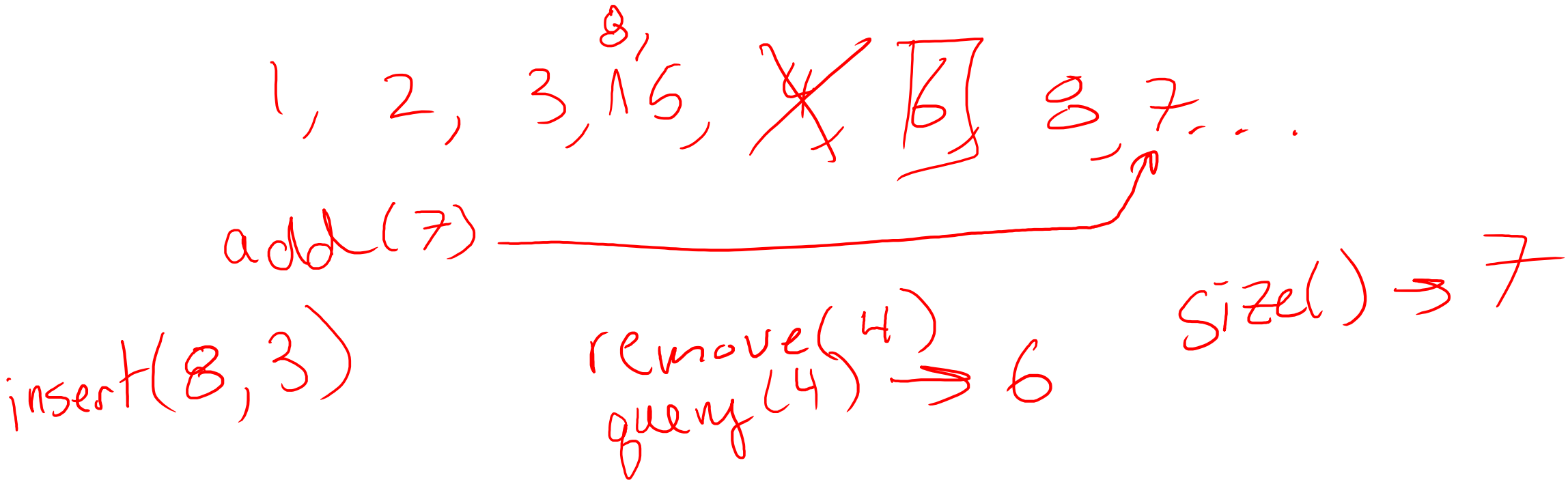
List of ADTs

- List
- Set
- Map
- Stack
- Queue
- Priority Queue
- Graph

Case Study: The List ADT

list: stores an ordered sequence of information.

- Each item is accessible by an index.
- Lists have a variable size as items can be added and removed



Case Study: The List ADT

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Supported Operations:

- **get(index):** returns the item at the given index
- **set(value, index):** sets the item at the given index to the given value
- **append(value):** adds the given item to the end of the list
- **insert(value, index):** insert the given item at the given index maintaining order
- **delete(index):** removes the item at the given index maintaining order
- **size():** returns the number of elements in the list

Case Study: List Implementations

LinkedList (unidirectional first order trace)

TODO list

Skim through full Syllabus on class web page

Sign up for Piazza

Review 142/143 materials. Materials provided on class webpage.

The first homework assignment will be a set of 14X review questions.