Welcome to CSE 373!
CSE 373 Winter 2020

Instructor: Hannah C. Tang

Teaching Assistants:
Aaron Johnston       Ethan Knutson       Nathan Lipiarski
Amanda Park         Farrell Fileas       Sam Long
Anish Velagapudi    Howard Xiao         Yifan Bai
Brian Chan          Jade Watkins        Yuma Tou
Elena Spasova       Lea Quan
Lecture Outline

❖ Introduction: Why Data Structures and Algorithms?

❖ About This Course
  ▪ Projects
  ▪ People
  ▪ Policies
  ▪ Getting the Most out of This Course

❖ Abstract and Concrete Data Types
Data Structures and Algorithms

- **Data Structures:**
  - A way of organizing, storing, accessing, and updating a set of data

- **Algorithms:**
  - A series of precise instructions guaranteed to produce a certain answer
Why: Increase Progress (?) in Society
Why: Discover New Knowledge

Why: Understand Different Disciplines and Problems

Konigsberg Bridges (Bogdan Giuşcă/Wikimedia), Diagram of Seven Bridges (Chris Martin/Wikimedia), Konigsberg Graph (Riojajar~commonswiki/Wikimedia)
Why: Support Daily Life

How to search the internet

About 7,470,000,000 results (0.60 seconds)
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Support Daily Life
Search HuskyMaps

Autosuggest

Navigation Directions

Geolocating places, locations, and map data
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Introductions: Course Staff

❖ Hannah C. Tang
  - UW CSE alumna with 17 years of bugs in industry

❖ TAs:
  - Aaron Johnston, Amanda Park, Anish Velagapudi, Brian Chan, Elena Spasova, Ethan Knutson, Farrell Fileas, Howard Xiao, Jade Watkins, Lea Quan, Nathan Lipiarski, Sam Long, Yifan Bai, Yuma Tou
  - Available in section, drop-in time, and discussion group
  - An invaluable source of information and help

❖ Get to know us
  - We are excited to help you succeed!
Introductions: Students

❖ ~230 students registered
  • Many students drop during the first week of the quarter; keep trying!

❖ In the meantime:
  ▪ Attend lecture, pick a quiz section to attend, do the assignments
  ▪ Email cse373-staff@cs to get added to repos, discussion boards, etc.

❖ Our course size is an asset!
Students and Imposter Syndrome

❖ It’s easy to feel lost, as if everyone is “better” than you.

❖ “Nearly 70% of individuals will experience signs and symptoms of impostor phenomenon at least once in their life.”

❖ Our course size can be an asset!
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Communication

- **Website:** [http://cs.uw.edu/373](http://cs.uw.edu/373)
  - Schedule, policies, materials, assignments, etc.

- **Discussion:** [http://piazza.com/washington/winter2020/cse373](http://piazza.com/washington/winter2020/cse373)
  - Announcements made here
  - Ask and answer questions – staff will monitor and contribute

- **Drop-in Time (“office hours”):** spread throughout the week
  - Can e-mail/private Piazza post to make individual appointments

- **Anonymous feedback:**
  - Comments about anything related to the course where you would feel better not attaching your name
Course Components

❖ Readings and Lectures
  ▪ Pre-lecture reading is graded on participation, not correctness
  ▪ Need more details? “Data Structures and Algorithm Analysis in Java” is available at the Engineering Library for checkout
  ▪ Introduce the concepts; please take notes!!

❖ Sections and QuickChecks
  ▪ Pre-section QuickCheck is graded on participation and correctness
  ▪ Apply the concepts, review materials

❖ Programming Homeworks
  ▪ Approximately one per week
  ▪ We have a late policy; don’t fall behind!

❖ Exams
  ▪ Midterm and Final; more details later in the quarter
Deadlines and Student Conduct

- Late policies
  - **QuickChecks and Reading Quizzes**: no late submissions accepted
  - **Homeworks**: Percentage deducted per day
    - One day late is “cheap”; can’t submit after 4 days.

- Academic Conduct (read the full policy on the web)
  - In short: don’t attempt to gain credit for something you didn’t do and don’t help others do so either
  - This does **not** mean suffer in silence!
    - Learn from the course staff and peers, talk, share ideas; *but* don’t share or copy work that is supposed to be yours
Collaboration is **Strongly** Encouraged

- Discuss confusing points with each other
  - Organizing your thoughts is the best way to learn!
  - Piazza, study groups, the person sitting next to you, ...

- Take initiative!
  - Form study groups with your peers in lecture and quiz section.
  - Review questions from previous quarters or other institutions.
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Hooked on Gadgets

- Gadgets reduce focus and learning
  - Bursts of info (e.g. emails, IMs, etc.) are addictive
  - Heavy multitaskers have more trouble focusing and shutting out irrelevant information

- Seriously, you will learn more if you use **paper** instead!!!
  - What types of activities do you do while taking notes?
Metacognition

❖ **Metacognition**: asking questions about your solution process.

❖ Examples:

  ▪ While debugging: explain to yourself why you’re making this change to your program while debugging.
  ▪ Before running your program: make an explicit prediction of what you expect to see.
  ▪ When coding: be aware when you’re not making progress, so you can take a break or try a different strategy.
  ▪ When designing:
    • Explain the tradeoffs with using a different data structure or algorithm.
    • If one or more requirements change, how would the solution change as a result?
    • Reflect on how you ruled out alternative ideas along the way to a solution.
  ▪ When studying: what is the relationship of this topic to other ideas in the course?
Real world analogues

Minimal working example

Rubber duck debugging
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Data Structures and Algorithms

❖ Data Structures:
  ▪ A way of organizing, storing, accessing, and updating a set of data
  ▪ Examples from 14X: arrays, linked lists, stacks, queues, trees

❖ Algorithms:
  ▪ A series of precise instructions guaranteed to produce a certain answer
  ▪ Examples from 14X: binary search, merge sort, recursive backtracking
Concrete Data Types

A variable’s **data type** (or simply **type**) determines its possible values and operations.

```java
int course;
course = 37;
course = -37;
course = 3.14;
(37 + 3) == 40;
course.equals(373);
```

```java
String course;
course = "37";
course = "-37";
course = 3.14;
(37 + 3) == 40;
("37" + "4").equals("373");
```
Interfaces vs. Implementations

❖ In Java, an **interface** is a data type that specifies what to do but not how to do it.
  ❖ **List**: an ordered sequence of elements.

❖ A **subtype** implements all methods required by the interface.
  ❖ **ArrayList**:Resizable array implementation of the List interface.
  ❖ **LinkedList**: Doubly-linked implementation of the List interface.
Abstract Data Types (ADTs)

- Java interfaces represent the concept of abstract data types.

- An **abstract data type** is a data type that does not specify any one implementation.

- **Data structures** implement ADTs.
  - **Resizable array** can implement List, Stack, Queue, Deque, PQ, etc.
  - **Linked nodes** can implement List, Stack, Queue, Deque, PQ, etc.

**List ADT**. A collection storing an ordered sequence of elements.

- Each element is accessible by a zero-based index.
- A list has a size defined as the number of elements in the list.
- Elements can be added to the front, back, or any index in the list.
- Optionally, elements can be removed.
Intuitively ...

❖ Think of the ADTs and data structures you’ll learn this quarter as a cookbook

▪ ADTs are the chapters/category: Soups, Salads, Cookies, Cakes, etc
  • High-level descriptions of a category of functionality
  • You don’t serve a soup when guests expect a cookie!

▪ Data structures are the recipes: chocolate chip cookies, snickerdoodles, etc
  • Step-by-step, concrete descriptions of an item with specific characteristics
  • Understand your tradeoffs before replacing carrot cake with a wedding cake

❖ When you go out into the world ...

▪ Figure out which category is required
▪ Choose the specific recipe that best fits the situation