Before we start

Use the Zoom chat:

What are you looking forward to for the rest of your summer? and, more importantly: Now that we’re done with the quarter, what’s your favorite data structure?
Announcements – Almost There!

- EX4 late cutoff tomorrow night
- P4 due tonight, late cutoff Saturday night
  - If using late days, please plan ahead with the exam due the same night!
- Extra credit also due Saturday night

<table>
<thead>
<tr>
<th>WED</th>
<th>THU</th>
<th>FRI</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Wrap-Up 1:10pm</td>
<td>EX4 Late Cutoff 11:59pm</td>
<td>Exam II Released 12:01 am</td>
<td>Exam II Due 11:59pm</td>
</tr>
<tr>
<td>P4 Due 11:59pm</td>
<td></td>
<td>Exam II Extra OH 1:10pm</td>
<td>P4 Late Cutoff, Extra Credit Due 11:59pm</td>
</tr>
</tbody>
</table>
Announcements – But First, an Exam

• Exam II
  - Released **Friday morning (8/21) at 12:01am PDT**
  - Due **Saturday evening (8/22) at 11:59pm PDT**
    - No late submission accepted – you cannot use late days on the exam!
  - Review Materials available on the course website
    - 20su-Specific Practice Problem Set + Solutions
    - Section 9 Review Worksheet
    - 19au Final Exam
    - As always, post-lecture reviews, previous section handouts, learning objectives
  - We’ll publish EX3 grades and EX4 solutions before the exam
  - Focus is on post-Exam I content, although you may be asked to use Exam I skills like algorithmic analysis or early ADTs
  - Like Exam I, mostly conceptual. Unlike Exam I, you’ll be required to write some code.
Review Grading Breakdown

• Your grade will consist of the following weighted categories:

<table>
<thead>
<tr>
<th>Category</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Projects</td>
<td>45%</td>
</tr>
<tr>
<td>Individual Exercises</td>
<td>25%</td>
</tr>
<tr>
<td>Exam I</td>
<td>15%</td>
</tr>
<tr>
<td>Exam II</td>
<td>15%</td>
</tr>
</tbody>
</table>

• Instead of curving the class as usual, we’ll use a bucket system:
  - These are *minimum* GPA guarantees – may adjust upward

<table>
<thead>
<tr>
<th>Percentage</th>
<th>GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>95%</td>
<td>4.0</td>
</tr>
<tr>
<td>90%</td>
<td>3.5</td>
</tr>
<tr>
<td>80%</td>
<td>3.0</td>
</tr>
<tr>
<td>60%</td>
<td>2.0</td>
</tr>
<tr>
<td>50%</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Course Evaluations

• *Please* fill these out! They have an *enormous* impact on the course, and a 90% response rate makes them far more useful than 60%.
  - Have to guess what sampling bias is for “missing 40%”

• As a student, you underestimate how much instructors take evals into account – trust me, I’ve been a student here too 😊
  - Every 20su course logistics decision was the result of weeks spent looking at last quarter’s evals

• Looks like we’ll be doing this remote thing for a while, and your insight is the most valuable part of this experiment

• You all have had *amazing* response rates so far. Thanks and keep up the great work!
Course Evaluations

• Evals for lecture and section are open until **Friday**
• Lecture: [https://uw.iasystem.org/survey/228731](https://uw.iasystem.org/survey/228731)
• Sections:
  - AA (12:00, Leona & Keanu): [https://uw.iasystem.org/survey/228950](https://uw.iasystem.org/survey/228950)
  - AB (1:10, Keanu & Siddharth): [https://uw.iasystem.org/survey/228937](https://uw.iasystem.org/survey/228937)
  - AC (1:10, Farrell & Melissa): [https://uw.iasystem.org/survey/228940](https://uw.iasystem.org/survey/228940)
  - AD (2:20, Joyce): [https://uw.iasystem.org/survey/228943](https://uw.iasystem.org/survey/228943)
  - AE (10:50, Leona & Eric): [https://uw.iasystem.org/survey/228941](https://uw.iasystem.org/survey/228941)
  - AF (12:00, Farrell): [https://uw.iasystem.org/survey/228944](https://uw.iasystem.org/survey/228944)
  - AG (1:10, Eric): [https://uw.iasystem.org/survey/228948](https://uw.iasystem.org/survey/228948)

*We’ll end lecture a little early today so you can fill out evals!*
The Stars of the Show

• Let’s get a huge round of **zoom** applause for your TAs!
  - They do so much behind the scenes to keep 373 running smoothly... and that’s on top of office hours, section, Piazza, etc.
  - None of this would be possible without them!

• UW CSE has an award for excellent TAs! Please consider nominating here: https://www.cs.washington.edu/student s/ta/bandes
Time For a Victory Lap

• We made it to the finish line!
• One more lap around the track by the exhausted victors (that’s us 😊)

• Why?
  - It’s easy to lose sight of just how much you’ve accomplished in a quarter!
  - Review the themes of the course that you can carry forward
Why 373?

1. Build a **strong foundation** of data structures and algorithms that will let you tackle the biggest problems in computing

2. Pick up the vocabulary, skills, and practice needed to make **design decisions**. Learn to **evaluate** the tools in your CS toolbox

- Differences between technical implementations
- Evaluation can mean many different things!
1. Build a **strong foundation** of data structures & algorithms
2. Learn to make **design decisions** and **evaluate** your tools
Put Another Way…

1. Build a **strong foundation** of data structures & algorithms  
   =  
   Give you a cooler full of “tried-and-true” fish (that have been around for a while)

2. Learn to make **design decisions** and **evaluate** your tools  
   =  
   Teach you to fish... for your own ideas, data structures, and algorithms going forward
Reinventing the Wheel?

*Studying* the Wheel, So We Can Invent the Jet Engine

- We spent a lot of time this quarter implementing our own data structures
  - But Java has a lot of these built-in. Why?

1. Software engineering skills can’t just be taught, they need to be **practiced**
2. Not just writing code, but **analyzing & experimenting** with it
3. Set you up to **invent** new, more complex data structures when the need arises
4. Understanding the **implementation** (the layer below) makes you more effective as the **client** (the layer above)!
Metacognition

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

• Examples:
  - **While debugging**: explain to yourself why you’re making this change to your program.
  - **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?
Learning to Bake in a CSE Class

• Think of what you’ve learned 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
  - Adapt or invent your own recipe when you need to!
What’s Next?

142
Introduction to Programming
- Methods
- Parameters, returns, values
- Conditionals
- Loops
- File Processing
- Arrays

143
Object Oriented Programming
- Classes and Interfaces
- Recursion
- Linked lists and binary trees
- Sorting and Searching
- O(n) analysis
- Generics

373
Data Structures & Algorithms
- Design Decisions
- Data Structure Implementation
- Debugging & Testing
- Abstract Data Types
- Algorithmic Analysis
- Software Engineering
What’s Next?

In CSE 142 and 143, you learn **programming**. In 373, you open up the world of **computer science**.

And there’s no shortage of places you can take the concepts from this class 😊
If you want to...

• Learn about popular tools used in industry
  - e.g. Writing shell scripts in Linux, Using version control and git in more depth

• Understand exactly how your hardware and code interact at a very low level inside a physical computer
  - Want to go more than one lecture deep to learn how memory actually works?

Consider taking...

CSE 374 Intermediate Programming Concepts and Tools

• Offered 20au (Champion), 21wi (Wilcox), 21sp (Hazen)
If you want to...

• Learn new strategies for problem-solving through programming languages that look completely different from Java

• Learn how programming languages actually work
  - What happens starting the moment you click “run” in IntelliJ?
  - What does the Java compiler even do?

Consider taking...

CSE 413  Programming Languages

• Offered 21sp (Perkins)
If you want to...

• Level up the scope of the applications you can work on by learning how to store, access, and query huge amounts of data
  - *So many* projects in industry incorporate a database
  - Heard of big data™? You’ll want a bit more than an in-memory hash map

• Learn about parallelism and concurrency

Consider taking...

**CSE 414** Database Systems

• Offered 20au (Maas), 21wi (Maas), 21sp (Thompson)
If you want to...

• Use those databases full to the brim with big data™ to do machine learning on new and interesting problems

• Understand why machine learning has so much potential to overturn entire industries
  - And in the process, get practical experience working on ML projects with real datasets

Consider taking...

CSE 416 Machine Learning

• Offered 21sp (Schafer)
If you want to...

• Learn more about the underlying theory behind data structures and algorithms covered in this class
• Learn about designing complex algorithms
• Understand the *limits* of computation and the fundamental problems that remain unsolved in computer science (P vs. NP, anyone?)

Consider taking...

**CSE 417**  Algorithms and Computational Complexity

• Offered 20au (Anderson), 21wi (Weber)
If you want to...

• Build a website or web app
  - Either the frontend (what visitors see in their browser) or the backend (what runs on the server to compute data)

• Learn the fundamentals of a number of web technologies that make it easier for you to learn more on your own

Consider taking...

CSE 154, INFO 343, or INFO 344

• CSE 154 offered 20au (Gibbon), 21sp (Gibbon)
Your Next Language

• Java is our lens, but these concepts generalize to any language!
  - Learning your second language is much easier than learning your first 😊

• Mainstream languages you might be interested in:
  - Python (“pseudocode that runs”)
  - C# (“Java done right”)
  - HTML/CSS/JavaScript (“building blocks of the web”)
  - C/C++ (“if you want full control”)

• Or, consider an unconventional/up-and-coming one:
  - Haskell
  - Racket
  - Rust
  - Prolog
Learning New Things

• Nothing in Computer Science is out of your grasp!
  - This class is designed to give you the foundation to go out and

• Where to next?
  - You can find tutorials on almost any topic via google
  - Coursera: lots of good online courses
  - Google “open source CS curriculum” or “what every CS major should know” if you want a more curated list
  - Try contributing to open source
  - Try attending hackathons!
  - StackOverflow: pick interesting tags, sort by top, and read

• Advice: Take charge of your own education, prioritize practice over passive learning, be persistent, and always let your curiosity lead
These Unprecedented Times

• As much as we want to focus on making 373 an excellent experience, we can’t forget what’s going on in the world around us

• I know online learning hasn’t been easy for anyone
  - Thank you for letting us know your experiences and feedback
  - Thank you for reaching out to ask for help when you needed it
  - Thank you for being so understanding when my Zoom cuts out on the reg

• As a course staff, we are blown away by how much you’ve engaged with the course despite the fact that it all happens in a rectangle on your computer screen. Thank you.
ASK ME ANYTHING!
Thanks for a great quarter!

– The CSE 373 20SU Staff 😊