# CSE 331
# Software Design & Implementation

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Course Victory Lap

(Based on slides by Mike Ernst, David Notkin, Hal Perkins)

# Today

- Reminder: Do your course evaluations (!)
- Final-exam information
- Last few topics in previous lecture
- Course “victory lap”
  - High-level overview of main ideas and goals
  - Connection to homeworks
  - Context
- Also:
  - Thank-yous
  - Time permitting: Free-form Q&A

# Final-exam information

- Tuesday, 2:30-4:20PM
- Very heavily weighted toward second half of course
- See email from me and sample exams
- As usual, “tough but fair and rewarding”

# Victory Lap

A victory lap is an extra trip around the track

- By the exhausted victors (that's us) ☺

Review course goals

- Slides from Lecture 1
- What makes CSE331 special

# Huge thanks to the folks who made it work

Infrastructure: Xin, Chris

Sections: Meg, Aaron

Grading: Whitney, Ben, Xin, Chris, Aaron

Office hours, email questions, etc.: all

*This course is itself a sophisticated system requiring savvy design and implementation*

*3 slides from Lecture 1…*

# 10 weeks ago: Welcome!

We have 10 weeks to move well beyond novice *programmer*:

- Larger programs
  - Small programs are easy: "code it up"
  - Complexity changes everything: "design an artifact"
  - Analogy: using hammers and saws vs. making cabinets (but not yet building houses)
- Principled, systematic software: What does "it's right" mean? How do we know "it's right"? What are best practices for "getting it right"?
- Effective use of languages and tools: Java, IDEs, debuggers, JUnit, JavaDoc, Subversion, …
  - Principles are ultimately more important than details
    - You will forever learn details of new tools/versions

# 10 weeks ago: Goals

- CSE 331 will teach you to how to write correct programs
- What does it mean for a program to be correct?
  - Specifications
- What are ways to achieve correctness?
  - Principled design and development
  - Abstraction and modularity
  - Documentation
- What are ways to verify correctness?
  - Testing
  - Reasoning and verification

# 10 weeks ago: Managing complexity

- Abstraction and specification
  - Procedural, data, and control flow abstractions
  - Why they are useful and how to use them
- Writing, understanding, and reasoning about code
  - Will use Java, but the issues apply in all languages
  - Some focus on object-oriented programming
- Program design and documentation
  - What makes a design good or bad (example: modularity)
  - Design processes and tools
- Pragmatic considerations
  - Testing
  - Debugging and defensive programming
  - [more in CSE403: Managing software projects]

*Some new slides to tie the pieces together…*

# Divide and conquer: Modularity, abstraction, specs

No one person can understand all of a realistic system

- Modularity permits focusing on just one part
- Abstraction enables ignoring detail
- Specifications (and documentation) formally describe behavior
- Reasoning relies on all three to understand/fix errors
  - Or avoid them in the first place
  - Proving, testing, debugging: all are intellectually challenging

# How CSE 331 fits together

| Lectures: ideas | ⇒ Assignments: get practice |
|---|---|
| Specifications | ⇒ Design classes |
| Testing | ⇒ Write tests |
| Subtyping | ⇒ Write subclasses |
| Equality & identity | ⇒ Override equals, use collections |
| Generics | ⇒ Write generic classes |
| Design patterns | ⇒ Larger designs; MVC |
| Reasoning, debugging | ⇒ Correctness, testing |
| Events | ⇒ GUIs |
| Systems integration | ⇒ N/A |

# What you have learned in CSE 331

Compare your skills today to 10 weeks ago

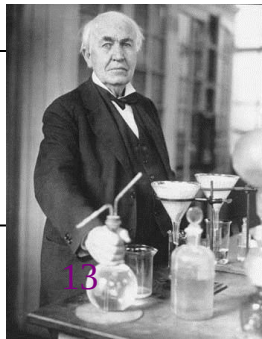
- Theory: abstraction, specification, design
- Practice: implementation, testing
- Theory & practice: correctness

Bottom line aspiration: Much of what we've done would be *easy* for you today

This is a measure of how much you have learned

There is no such thing as a "born" programmer!

> Genius is 1% inspiration and 99% perspiration.
> Thomas A. Edison



# What you will learn later

- Your next project can be much more ambitious
  - But beware of "second system" effect
- Know your limits
  - Be humble (reality helps you with this)
- You will continue to learn
  - Building interesting systems is never easy
    - Like any worthwhile endeavor
  - Practice is a good teacher
    - Requires thoughtful introspection
    - Don't learn *only* by trial and error!
  - Voraciously consume ideas *and* tools

# What comes next?

Courses

- CSE 403 Software Engineering
  - Focuses more on requirements, software lifecycle, teamwork
- Capstone projects
- Any class that requires software design and implementation

Research

- In software engineering & programming systems
- In any topic that involves software

Having an impact on the world

- Jobs (and job interviews)
- Larger programming projects

# Last slide

- System building is fun!
  - It's even more fun when you're successful
- Pay attention to what matters
  - Take advantage of the techniques and tools you've learned (and will learn!)
- On a personal note:
  - Don't be a stranger: I love to hear how you do in CSE and beyond as alumni
- Time for "ask anything you want"?