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# CSE 331

# Software Design & Implementation

Dan Grossman

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Course Victory Lap

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

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# Today

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- Reminder: Do your course evaluations (!)
- Final-exam information
- Last few topics in previous lecture as needed
- 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

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- Monday, 8:30-10:20AM
- Very heavily weighted toward second half of course
- See email from me and sample exams
- As usual, “tough but fair and rewarding”

# Victory Lap

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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

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Infrastructure: Vinod, Chris

Sections: Kevin, Vinod

Grading: Uldarico, Naruto, Chris, Kevin, Vinod

Office hours, email questions, etc.: all

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

*Except for svn problems (“not our fault” ☹), everything has been  
eerily smooth.*

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*3 slides from Lecture 1...*

# 10 weeks ago: Welcome!

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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

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- 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

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- 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]

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*Some new slides to tie the pieces together...*

# Divide and conquer: Modularity, abstraction, specs

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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

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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

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Compare your skills today to 10 weeks ago

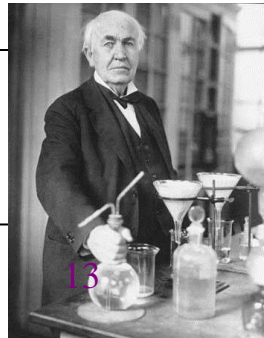
- Theory: abstraction, specification, design
- Practice: implementation, testing
- Theory & practice: correctness

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

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- 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?

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## 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

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- 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”?