CSE 331
Software Design & Implementation

Dan Grossman

Autumn 2019

Course Wrapup

Today

- Reminder: Fill out your course evaluations (!)
- Final exam information
- A look back at CSE 331
  - High-level overview of main ideas and goals
  - Connection to homeworks
  - Context
- Also:
  - Thank-yous
- Project demos
- Maybe: “Ask Dan Anything”

Final exam information

- Monday, 8:30-10:20, here
- Comprehensive but biased towards the 2nd half of the course
- Old exams on the web
  - Some questions won't apply if we didn't do similar things this quarter; also React/JS is pretty new
- See email for more information and review-session information

CSE 331

What was it all about?

But first….

Huge thanks to the folks who made it work

Course staff: Ten Amazing TAs

This course is itself a sophisticated
(or at least really, really complicated) system
requiring savvy design and implementation

And a big thanks to **you** for all you've done!

4 slides from Lecture 1…

What is the goal of CSE 331?

How to build harder-to-build software

- Move from CSE 143 problems toward what you'll see in upper-level CSE courses and in industry

Specifically, how to write code of

- Higher **quality**
- Increased **complexity**

We will discuss *tools* and *techniques* to help with this

  - There are *timeless principles* to both

What is high quality code?

In summary, we want our code to be:

1. Correct
2. Easy to change
3. Easy to understand
4. Easy to scale (modular)

These qualities also allow for increased complexity

What we will cover in CSE 331

- Everything we cover relates to the 4 goals
- We'll use Java but the principles apply in any setting

Correctness

1. Tools
   - Git, IntelliJ, JUnit, Javadoc, …
   - Java libraries: equality & hashing
   - Adv. Java: generics, assertions, …
   - debugging
2. Inspection
   - reasoning about code
   - specifications
3. Testing
   - test design
   - coverage

Changeability

- specifications, ADTs
- listeners & callbacks

Understandability

- specifications, ADTs
- Adv. Java: exceptions
- subtypes

Modularity

- module design & design patterns
- event-driven programming, MVC, GUIs

Back to 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

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

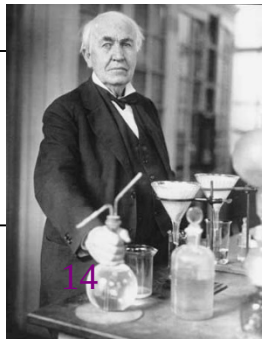
- Theory: abstraction, specification, design
- Practice: implementation, testing
- Theory & practice: correctness

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
  - Students are amazing; I believe in you! ☺
- Closing thoughts?