CSE 331
Software Design and Implementation

Lecture 24
Wrap Up

Zach Tatlock / Winter 2016

Today

- Reminder: course evals
- Project demos
- Final-exam information

- A look back at CSE 331
  - High-level overview of main ideas and goals
  - Connection to homeworks
  - Context
- Also:
  - Thank-yous

Final-exam information

Monday, 8:30-10:20 AM

Comprehensive but weighted towards the 2nd half of the course

Old exams on the web

- Some questions won’t apply if we didn’t do similar things

CSE 331

What was it all about?

But first….

Huge thanks to the folks who made it work

Course staff: Vinod, Chris, Justin, Deric, Cindy

Special thanks to all of you for lots of good test questions :)

This course is itself a sophisticated system
requiring design, implementation, and ***debugging*** *;)*

Credits

Great course material based on work by:

- Michael Ernst
- Hal Perkins
- Dan Grossman
- David Notkin
- Dozens of amazing TAs
- Hundreds of incredible students (you!)

From our first lecture…

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, git, Checker Framework, …

- 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

We've come far in CSE 331!

Compare your skills today to 10 weeks ago

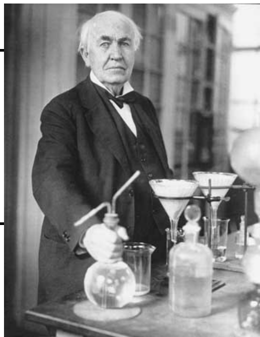
- Theory: abstraction, specification, design
- Practice: implementation, testing
- Theory & practice: correctness

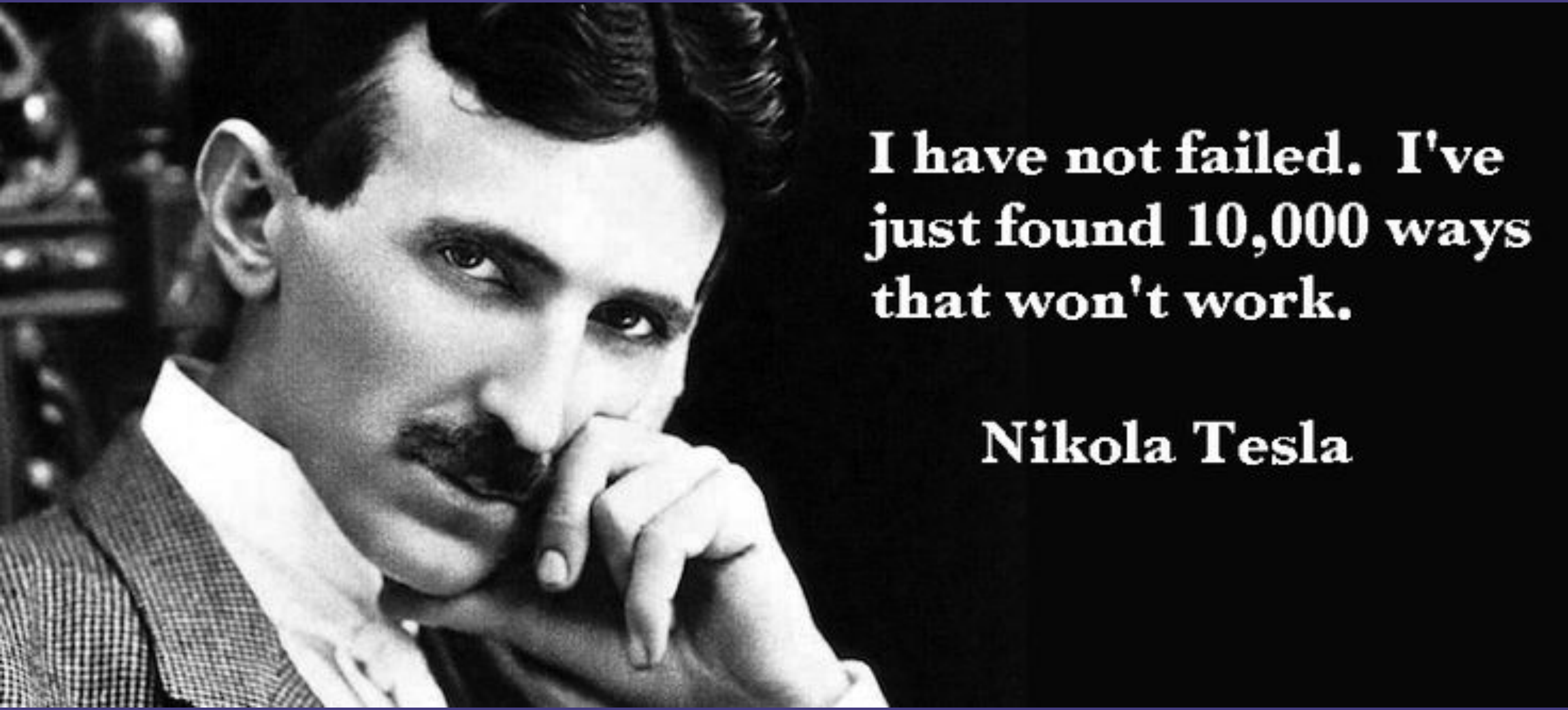
Bottom line aspiration: Much of what we've done would be *easy* for you today

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





I have not failed. I've just found 10,000 ways that won't work.

Nikola Tesla

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 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

Final 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

Closing thoughts?