CSE 331
Software Design & Implementation

Hal Perkins

Winter 2012

Wrapup

10 weeks ago…

- We have 10 weeks to move to a level well above novice programmer:
  - Larger programs
  - Principled, systematic programming: What does it mean to get it right? How do we know when we get there? What are best practices for doing this?
  - Effective use of languages and tools: Java, IDEs, debuggers, JUnit, JavaDoc, svn
    - The principles are ultimately more important than the details

A huge thanks to the folks who made it work

Krysta Yousoufian

Zachary Stein

Jackson Roberts

Laure Thompson

CSE 331 goals

Enable students to

- manage complexity
- ensure correctness
- write modest programs

CSE 331 topics

Manage complexity:

- Abstraction
- Specification
- Modularity
- Program design & organization
  - OO design, dependences, design patterns, tradeoffs
- Subtyping
- Documentation

Ensure correctness:

- Reasoning
- Testing
- Debugging

Write programs:

- Practice (and feedback – we were late on that – sorry!)
- Introduction to: tools (version control, debuggers), understanding libraries, software process, requirements, usability

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 to avoid them in the first place

Getting it right ahead of time

Design: predicting implications

Understanding the strengths and weaknesses

- If you don’t understand a design, you can’t use it

Documentation matters!

- It is often the most important part of a user interface
- What’s obvious to you may not be obvious to others

Testing

Helps you understand what you didn't understand while designing and implementing

A good test suite exercises each behavior

- Theory: revealing subdomains, proves correctness
- Practice: code coverage, value coverage, boundary values
- Practice: testing reveals errors, never proves correctness

A good test suite makes a developer fearless during maintenance

Maintenance

Maintenance accounts for most of the effort spent on a *successful* software system

- often 90% or more

A good design enables the system to adapt to new requirements while maintaining quality

- Think about the long term, but don't prematurely optimize

Good documentation enables others to understand the design

Correctness

In the end, only correctness matters

- *Near*-correctness is often easy!
- Getting it right can be difficult

How to determine the goal?

- Requirements
- Design documents for the customer

How to increase the likelihood of achieving the goal?

- Unlikely without use of modularity, abstraction, specification, documentation, design, …
- Doing the job right is usually justified by return on investment (ROI)

How to verify that you achieved it?

- Testing
- Reasoning (formal or informal) helps!
- Use proofs and tools as appropriate

Working in a team

No one person can understand all of a realistic system

- Break the system into pieces
- Use modularity, abstraction, specification, documentation

Different points of view bring value

Work effectively with others

- Sometimes challenging, usually worth it

Manage your resources effectively

- Time, people
- Engineering is about tradeoffs

Both technical and management contributions are critical

What you have learned in CSE 331

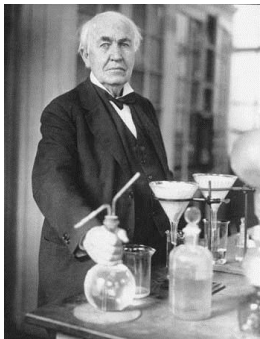
Compare your skills today to 3 months ago

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

Your next project can be more ambitious

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



What you will learn later

Your next project can be much more ambitious

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!

What comes next?

Classes

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

Research

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

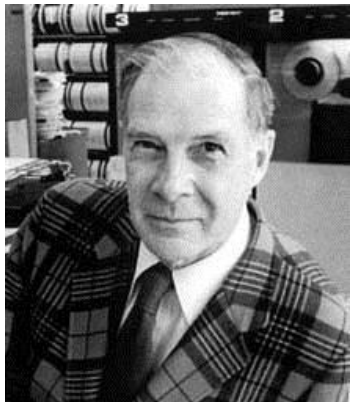
Having an impact on the world

- Jobs (and job interviews)
- Larger programming projects

The purpose of computing is insight, not numbers.

Richard W. Hamming

Numerical Methods for Scientists and Engineers



Go forth and conquer

System building is fun!

- It's even more fun when you build it successfully

Pay attention to what matters

- Use the techniques and tools of CSE 331 effectively