CSE 331
Software Design & Implementation

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Autumn 2013

Wrapup

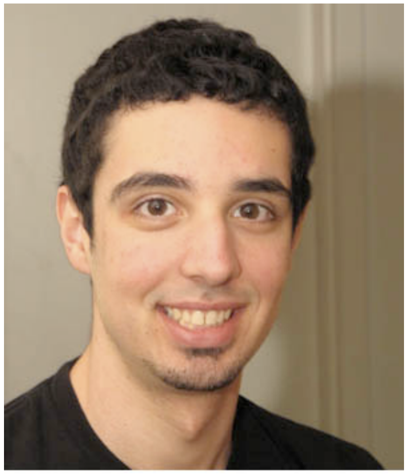
10 weeks ago…

We have 10 weeks to move to a level well above novice programmer:

- 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
  - (but learning current tools is time well spent)
- Larger programs

A huge thanks to the folks who made it work

Riley Klingler



Alex Mariakakis

Uldarico Muico

Zachary Simon

And our guest pundit…

Dan Grossman

CSE 331 goals

Enable you to

- manage complexity
- ensure correctness
- write modest programs

  (modest by industry standards, that is….)

And learn more about the software world so it won't all be new when you encounter it later

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
- 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

- Examples: understanding interconnections, module dependency diagrams

Understanding the strengths and weaknesses

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

Documentation matters!

- Google + stackoverflow != documentation

Documentation

Everyone wants good documentation when using a system

Not everyone likes writing documentation

Documentation is often the most important part of a user interface

What's obvious to you may not be obvious to others

An undocumented software system has zero commercial value.

John Chapin
CTO of Vanu, Inc.

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

A good test suite greatly reduces the risks of changes

And is a big part of the documentation/history of the project (along with the bug database/history)

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

- Diversity is not just a “feel good” issue

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

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
Polymorphism	⇒ Write generic class
Design patterns	⇒ Larger designs
Reasoning, debugging	⇒ Correctness, testing
Events	⇒ GUIs
Usability, teamwork	⇒ (For fun and for future use)

What you have learned in CSE 331

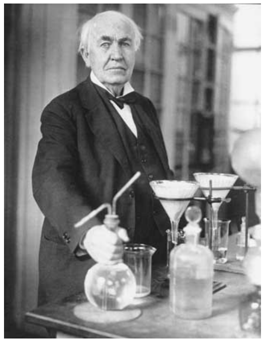
Compare your skills today to 10 weeks ago

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

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’re successful

Pay attention to what matters

- Take advantage of the techniques and tools you’ve learned (and will learn!)