CSE 331 wrapup

CSE 331
University of Washington

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Goal from 10 weeks ago

Move beyond being a 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, Subversion
  – The principles are ultimately more important than the details

• Larger programs
A huge **thanks** to the folks who made it work

Tristan Huber    David Mailhot    Yosan Namara    Jackson Roberts    William Smith
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
- 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
  Example: understanding interconnections, using module dependency diagram (MDD)

Understanding the strengths and weaknesses
  If you don’t understand a design, you can’t use it

Documentation matters!
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 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!

*Correctness* can be difficult

How to determine the goal?

- Requirements elicitation
- 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

Returnin gave a little practice
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
How CSE 331 fits together

Lectures: ideas
Specifications
Testing
Subtyping
Equality & identity
Polymorphism
Design patterns
Reasoning, debugging
Events
Usability, teamwork

⇒ Assignments: get practice
⇒ Design classes
⇒ Write tests
⇒ Write subclasses
⇒ Override equals, use collections
⇒ Write generic class
⇒ Larger designs
⇒ Correctness, returning
⇒ GUIs
⇒ (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: The assignments 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, 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

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