CPS 108, Fall 2005

- Object oriented programming and design, we'll use Java and C++ (at least)
  - Language independent concepts including design patterns, e.g., Model-View-Controller, iterator, factory, strategy, …
  - Design independent concepts, e.g., coupling, cohesion, testing, refactoring, profiling, …

- Non OO programming and design, we'll use C++ (and its C-subset)
  - From Java/ArrayList to C++/vector to C/int *
  - From classes to functions, from references to pointers

Goals for students in Compsci 108

- Adept at solving problems requiring programming
  - Design, test, implement, release, revise, maintain

- Reasonably facile with basic Java idioms/libraries
  - How to read the API, knowing what to ignore
  - Basic language features, basic libraries

- Basic knowledge of C++ (and C) programming
  - Beyond the old Compsci 100
  - Java-style use of STL, towards advanced?

More goals for 108 students

- Know patterns catalog, vocabulary and use
  - HFDP rather than GOF (and more TLAs/FLAs)

- Experience working in teams
  - How to accommodate team needs, balance against individual needs (and goals)

- Comfort in working alone, how to get and use help
  - Peers, UTAs, TA, prof, Internet, …

Administrivia

- check website and bulletin board regularly
  - See links to bulletin board and other stuff

- Grading (see web pages)
  - group projects: small, medium, large
  - mastery programs (solo or semi-solo endeavors)
  - readings and summaries
  - tests
Administrivia (continued)

- Evaluating team projects, role of TA, UTA, consultants
  - face-to-face evaluation, early feedback

- Compiling, tools, environments, Linux, Windows, Mac
  - g++ 3.3, 3.4, 4.0?,
  - Java 5 (requires 10.4 on Mac)
  - Eclipse in all environments
  - Command-line tools???

Classes: Review/Overview

- A class encapsulates state and behavior
  - Behavior first when designing a class
  - Information hiding: who knows state/behavior?

- State is private; some behavior is public
  - Private/protected helper functions
  - A class is called an object factory, creates lots of instances

How do classes and objects work?

- Classes communicate and collaborate
  - Parameters: send and receive
  - Containment: has a reference to
  - Inheritance: is-a

- Understanding inheritance and interfaces
  - What is polymorphism?
  - When is polymorphism not appropriate?
  - What is an interface in Java, what about C++?

Design Criteria

Good design comes from experience, experience comes from bad design  
Fred Brooks

- Design with goals:
  - ease of use
  - portability
  - ease of re-use
  - efficiency
  - first to market
  - ??????
How to code

- **Coding/Implementation goals:**
  - Make it run
  - Make it right
  - Make it fast
  - Make it small
- **spiral design (or RAD or !waterfall or ...)**
  - What’s the design methodology?

XP and Refactoring

*(See books by Kent Beck (XP) and Martin Fowler (refactoring))*

- **eXtreme Programming (XP) is an agile design process**
  - Communication: unit tests, pair programming, estimation
  - Simplicity: what is the simplest approach that works?
  - Feedback: system and clients; programs and stories
  - Courage: throw code away, dare to be great/different

- **Refactoring**
  - Change internal structure without changing observable behavior
  - Don’t worry (too much) about upfront design
  - Simplicity over flexibility (see XP)

Modules, design, coding, refactor, XP

- Make it run, make it right, make it fast, make it small
- Do the simplest thing that can possibly work (XP)
  - Design so that refactoring is possible
  - Don’t lose sight of where you’re going, keep change in mind, but not as the driving force [it will evolve]

- **Refactor: functionality doesn’t change, code does**
  - Should mean that new tests aren’t written, just re-run
  - Depends on modularity of code, testing in pieces

- **What’s a module in Java?**
  - Could be a class, a file, a directory, a package, a jar file
  - We should, at least, use classes and packages

Design Heuristics: class/program/function

*(see text by Arthur Riel)*

- **Coupling**
  - Classes/modules are independent of each other
  - Goal: minimal, loose coupling
  - Do classes collaborate and/or communicate?

- **Cohesion**
  - Classes/modules capture one abstraction/model
  - Keep things as simple as possible, but no simpler
  - Goal: strong cohesion (avoid kitchen sink)

- **The open/closed principle**
  - Classes/programs: open to extensibility, closed to modification
Eric Raymond

- Open source evangelist
  - The Cathedral and the Bazaar
  - How to construct software
    “Good programmers know what to write. Great ones know what to rewrite (and reuse).”
- How to convince someone that guns are a good idea? Put this sign up:
  - THIS HOME IS A GUN-FREE ZONE

David Parnas (ACM fellow)

I would advise students to pay more attention to the fundamental ideas rather than the latest technology. The technology will be out-of-date before they graduate. Fundamental ideas never get out of date. However, what worries me about what I just said is that some people would think of Turing machines and Gödel’s theorem as fundamentals. I think those things are fundamental but they are also nearly irrelevant. I think there are fundamental design principles, for example structured programming principles, the good ideas in "Object Oriented" programming, etc.