Architectural Design

Overview: Basic principles and approaches

Design tasks

- External design
  - as seen by end-user
- Architectural design
  - Overall architecture
    - selection of architectural style
    - may not be repeated in each project
  - Subsystem/module breakdown
    - closely related to schedule and team structure
- Module design
  - may be divided into preliminary and detailed design

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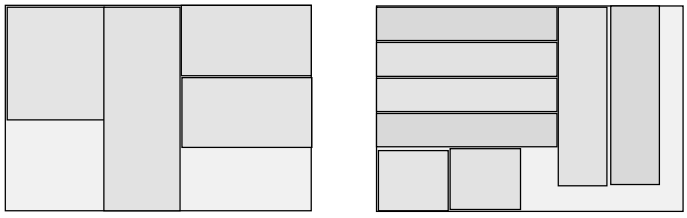
Modular design

- Division into modules and subsystems with precisely defined interfaces
- A module is
  - Unit of understanding (fits entirely in one head)
  - Work unit (programmer/designer assignment)
  - Unit of replacement (and firewall for mistakes)
- Subsystems may be modules or collections of modules

What are the issues?

- The need for modularity is universally agreed, from far back
- The approaches and techniques for modularity are the challenge



Goals of Modular Design

- Intellectual manageability
- Parallel development
  - Module interface specifications must be self-contained, small enough to be understood, and a sufficient basis for refinement, testing, etc. on a unit-by-unit basis
- Evolution & Maintenance
  - Modules tend to localize change; interfaces change less than implementations
- ... *each goal implies desirable properties*

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Interfaces

- Module interface is a contract
  - Everything a user of a module is permitted to assume
  - Everything a developer of a module is required to ensure
- Simplicity (or complexity) is in the contract
  - Interface is complete input/output relation or pre/post condition, not just the calling convention

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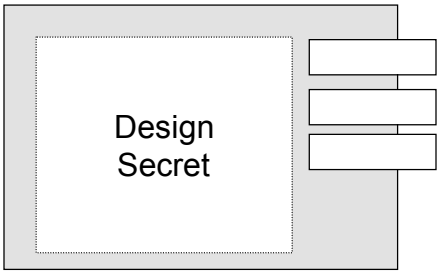
Information Hiding

- Key concept: A module localizes and encapsulates a design decision
- Method: Identify anticipated changes
- Examples
  - Hardware encapsulation modules: Publish abstract properties of a device, hide details of hardware interface
  - Data structure modules: Publish properties of abstract data type, hide implementation details

Evaluating Abstraction



The "public" interface presents an abstraction to the outside world

The interface is "abstract" to the extent that there are other choices for the secret. If there is only one possible implementation, it is not abstract.

The Architectural Design

Consists of

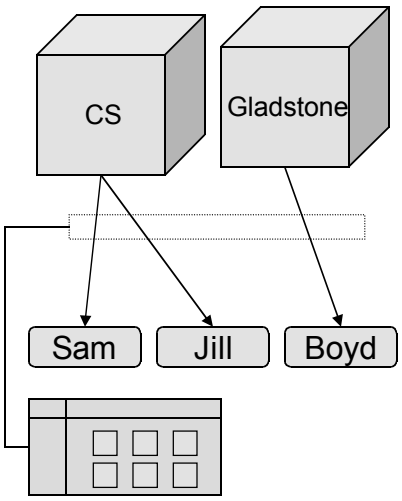
- Decomposition principles
  - criteria and patterns used throughout; rationale
- Module breakdown
  - list of parts, consistent with decomposition principles
- Overall organization
  - how the parts are related: dependence, communication, etc.

Exercise: Spell Checker Plug-in

- What needs to be done?
  - Given a dictionary of roots and variants, and given a word, confirm that the word is in the dictionary or provide a set of suggestions.
- What should be hidden from the checker?
- What should be hidden in the checker?
- How might the spell-checker itself be organized?

Exercise: Collaborative Spam Filter

- Task: Allow group members to determine whether each incoming email message was received by others in the group, *without revealing message contents*.



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Design Factoring with Shared Data Structures

- Key data structures may define system interfaces
  - In place of the familiar procedure call interface
- Modularity principles are realized through data design
  - Separation of concerns, layering, etc.

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