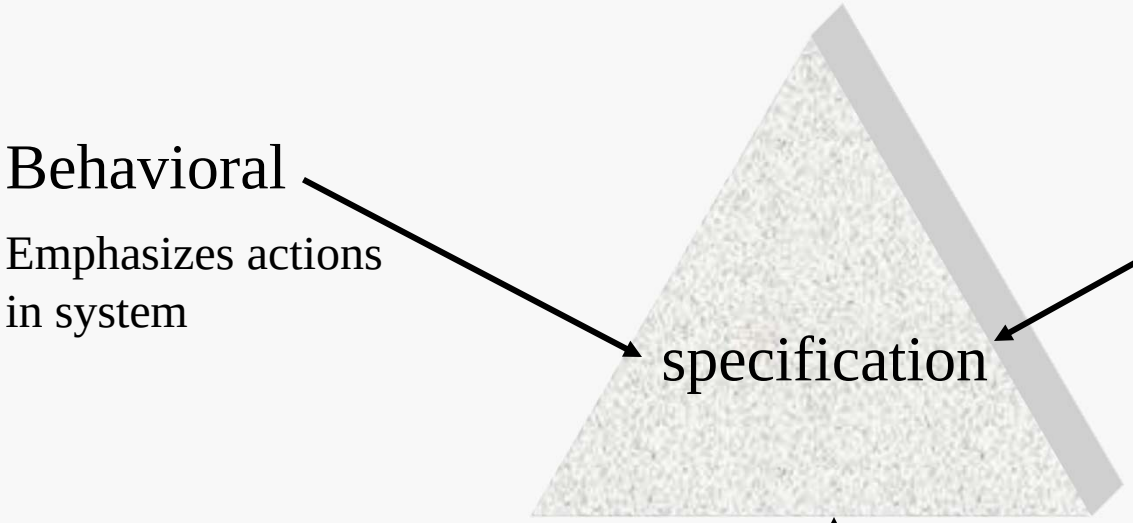
Class Design: Perspectives



Behavioral

Emphasizes actions in system

Informational

Emphasizes role of information/data/state and how it's manipulated

specification

Structural

Emphasizes relationships among components

Example: Library System

Behavioral (actions):

- Patrons are registered
- Books are checked out

Structural (relationships):

- Catalog is made of books
- Book may be checked out to a patron

Informational (state):

- What's the status (available, checked out, ???) of a book?
- What books does a patron have checked out?

Behavioral Perspective

Consider some action in a program…

What object...

- initiates action?

What objects...

- help perform action?
- are changed by action?
- are interrogated during action?

Consider registering a patron…

Controller (procedural)...

- initiates the action

Circulation Desk…

- performs the action

Patron List…

- is changed by the action

Patron List…

- is interrogated during the action

Behavioral Categories

Actor (does something)
Circulation Desk

Reactor (system events, external & user events)
Controller, Parser??

Agent (messenger, server, finder, communicator)
Catalog, PatronList

Transformer (data formatter, data filter)
Parser

Structural Perspective

What objects...

- are involved in relationship?
- are necessary to sustain (implement, realize, maintain) relationship?

What objects not in relationship...

- are aware of and exploit relationship?

Consider a relationship: book is checked out to patron

Circulation Desk…

- is involved in the relationship

Catalog and PatronList…

- are necessary to sustain the relationship

???...

- is aware of and exploits the relationship

Structural Categories

Acquaintance (symmetric, asymmetric)

- CirculationDesk knows about PatronList, asymmetric relationship

Containment (collaborator, controller)

- CirculationDesk controls/uses PatronList and Catalog

Collection (peer, iterator, coordinator)

- PatronList contains and manages Patrons
- CirculationDesk contains and manages CheckedOut objects

Informational Perspective

What objects...

- represent the data or state?
- read data or interrogate state?
- write data or update state?

Consider a state: status of book

CheckedOut list and Catalog implicitly…

- represent (stores) the state information

CirculationDesk…

- interrogates the state of a book (via …)

CirculationDesk…

- updates the state of a book

Data Versus State

Data	State
Definition: Information processed by the system	Definition: Information used by system to control processing
Example: checkout command	Example: BookStatus (Avail, CheckedOut, etc.)

Evaluating a Class Design

Evaluation is needed to accept, revise or reject a class design.

Five aspects to be evaluated:

- Abstraction: useful?
- Responsibilities: reasonable?
- Interface: clean, simple?
- Usage: “right” set of methods?
- Implementation: reasonable?

Tests for Adequacy of Abstraction

Identity:

Are class purpose and method purposes well-defined and connected?

Clarity:

Can purpose of class be given in brief, dictionary-style definition?

Uniformity:

Do operations have uniform level of abstraction?

Good or Bad Abstractions?

class Date:

Date represents a specific instant in time, with millisecond precision.

class TimeZone:

TimeZone represents a time zone offset, and also figures out daylight savings.

Tests for Adequacy of Responsibilities

Clear:

Does class have specific responsibilities?

Limited:

Do responsibilities fit the abstraction (no more/less)?

Coherent:

Do responsibilities make sense as a whole?

Complete:

Does class completely capture abstraction?

Tests for Adequacy of Interface

Naming:

Do names clearly express the intended effect?

Symmetry:

Are names and effects of pairs of inverse operations clear?

Flexibility:

Are methods adequately overloaded?

Convenience:

Are default values used when possible?

Example of Poor Naming

```
class ItemList {
private:
// . . .
public:
   void Delete(Item item);
        // Take Item's node out of list and delete Item

   void Remove(Item item);
        // Take Item's node out of the list but do not
        // delete Item

   void Erase(Item item);
        // Keep Item's node in List, but with no information
};
```

Hard to remember difference!

Tests for Adequacy of Usage

Examine how objects of the class are used in different contexts (see below…)

Incorporate all operations that may be useful in these contexts… up to a point…

```
class Location {
 private:
   int xCoord, yCoord;  //coordinates
public:
   Location(int x, int y);
   int xCoord();       //return xCoord value
   int yCoord();       //return yCoord value
};

// usage:
Location point(100,100);
// shift point:
point = Location( point.xCoord()+5, point.yCoord()+10 );
```

Revised Location Class

```
class Location {
 private:
   int xCoord, yCoord;  //coordinates
public:
   Location(int x, int y);
   int XCoord();       //return xCoord value
   int YCoord();       //return yCoord value
   void ShiftBy(int dx, int dy);  // shift by relative coordinates
};

// Revised usage:
Location point(100,100);

point.ShiftBy(5, 10);   // shift point
```

Implementation

Least important, mostly easily changed aspect to be evaluated.

- poorly engineered design leads to problematic implementation
- massaging a problematic implementation (without redesign) rarely produces any effective improvement
- it's only code…

Overly complex implementation may mean:

- class is not well conceived
- class has been given too much responsibility