SFWR ENG 3A04: Software Design II

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Acknowledgments: Material based on *Software Architecture Design* by Tao et al. (Chapter 4)

Outline of Part I

1. OO Analysis and Design
    - OO Analysis
    - OO Design
2. Questions???

Outline of Part II

3. Overview
4. Principle of Low Coupling and High Cohesion
5. Open-Closed Principle
6. Liskov substitution principle
7. Dependency Inversion Principle
8. Law of Demeter
9. Other Design Principles for Security
   - Principle of Least Privilege
   - Principle of Fail-Safe Defaults
   - Principle of Economy of Mechanism
   - Principle of Complete Mediation
   - Principle of Open Design
   - Principle of Separation of Privilege
   - Principle of Least Common Mechanism
   - Principle of Psychological Acceptability

Part I

Review of Previous Lecture

Part II

Today's Lecture

Overview

- A design process is not to simply identify one possible solution for a problem and then furnish the details of it

General Design Principles Overview

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- These principles build on the ideas of simplicity and restriction
- Simplicity makes the proposed solutions easy to understand (Less can go wrong with simple designs)

General Design Principles Principle of Low Coupling and High Cohesion

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- Effective modularization is accomplished by maximizing cohesion and minimizing coupling
- This principle helps to decompose complex tasks into simpler ones

General Design Principles

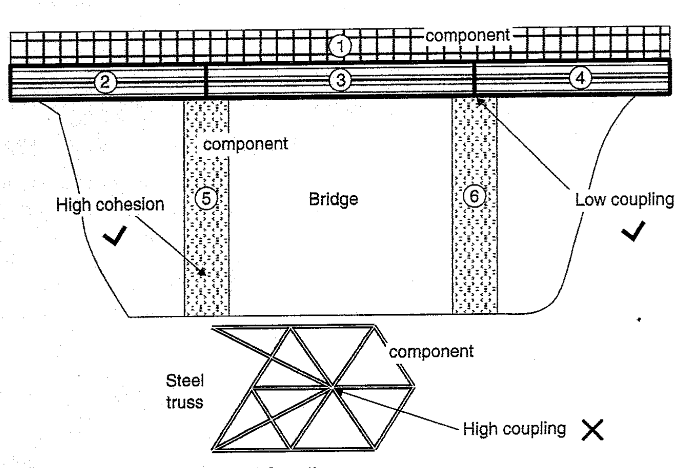

Figure: Cohesion and Coupling

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- Tight coupling might be removed by introducing new classes or inheritance

General Design Principles Overview

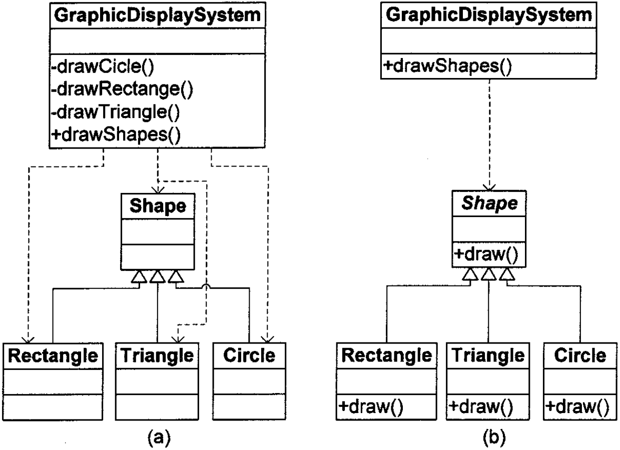

Figure: Vertical override operation (Used for decoupling)

General Design Principles Principle of Low Coupling and High Cohesion

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is equivalent to

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- Information hiding is the hiding of design decisions that are most likely to change (measured through Low Coupling and High Cohesion)

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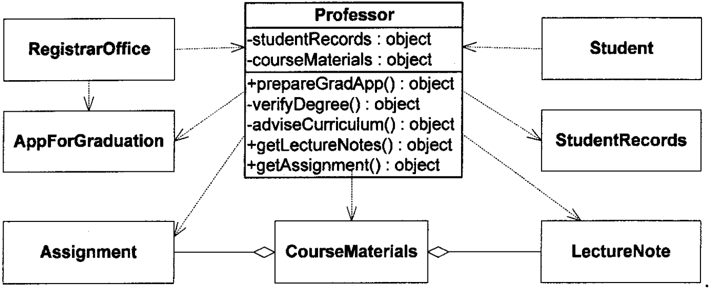
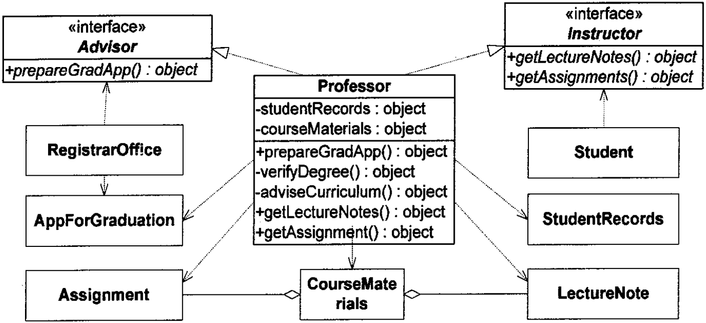


Figure: An initial design of a Professor class

General Design Principles Overview



«interface»
Advisor
+prepareGradApp() : object

Professor
-studentRecords : object
-courseMaterials : object
+prepareGradApp() : object
-verifyDegree() : object
-adviseCurriculum() : object
+getLectureNotes() : object
+getAssignment() : object

«interface»
Instructor
+getLectureNotes() : object
+getAssignments() : object

RegistrarOffice

AppForGraduation

Assignment

CourseMaterials

Student

StudentRecords

LectureNote

Figure: An improved design of a Professor class

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- The 7 ± 2 guideline applies to each of these

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Each of these modules is quite cohesive

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Great deal of coupling among these 5 parts

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Should be done at a high level (expensive at low level)

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- Technical approach for achieving Open-Closed Principle is the abstraction via inheritance and polymorphism

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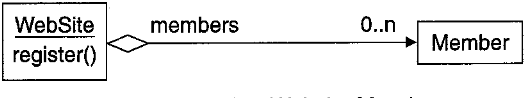

Figure: Registering Website Members (Rigid)

General Design Principles Open-Closed Principle

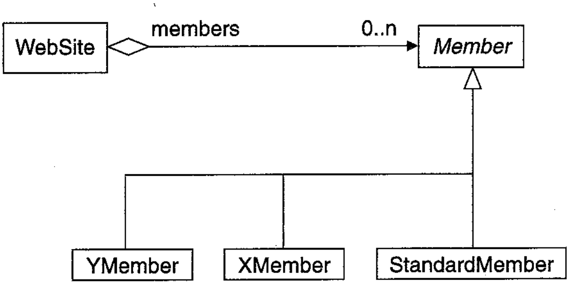

Figure: Registering Website Members (Flexible)

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- Minimize the use of global variables
- There are many other important OO design principles

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High level modules should not depend upon low level modules. Both should depend upon abstractions. Abstractions should not depend upon details. Details should depend upon abstractions.

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This defines a very powerful rule for designing and programming: Design to an interface, not an implementation

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In a sense, it follows what has been referred to as the Hollywood Principle: don't call us, we will call you

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- A method should have limited knowledge of an object model

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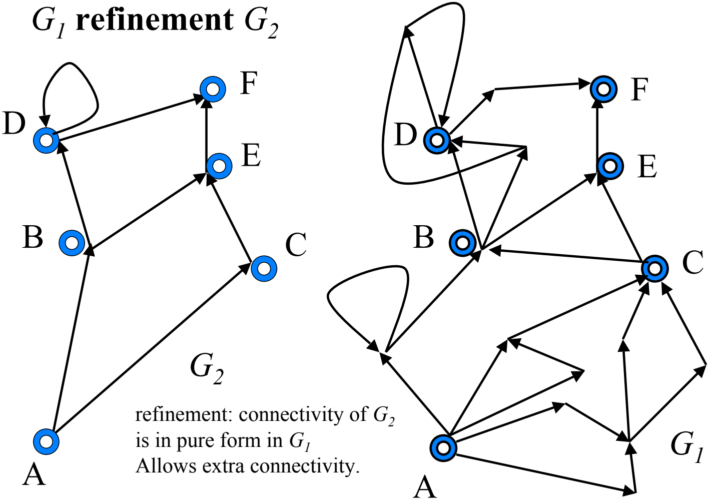
G_1 refinement G_2



refinement: connectivity of G_2 is in pure form in G_1
Allows extra connectivity.

Other Design Principles for Security

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- This is analogue to the "need to know" rule

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- If the subject is unable to complete its action or task, it should undo those changes it made in the security state of the system before it terminates

- Even if the program fails, the system is still safe

Principle (Economy of Mechanism)

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- If the subject tries to read the object again, the system should check that the subject is still allowed to read the object

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- Keeping cryptographic keys and passwords secret does not violate this principle

General Design Principles Other Design Principles for Security

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- Systems and programs granting access to resources should do so only when more than one condition is met

Other Design Principles for Security

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Other Design Principles for Security

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- It recognizes the human element in security
- Configuring and executing a program should be as easy and as intuitive as possible
- In practice, the principle of psychological acceptability is interpreted to mean that the security mechanism may add some extra burden, but that burden must be both minimal and reasonable