Information Systems Concepts

Refining the Requirements Model

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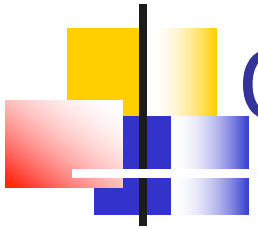
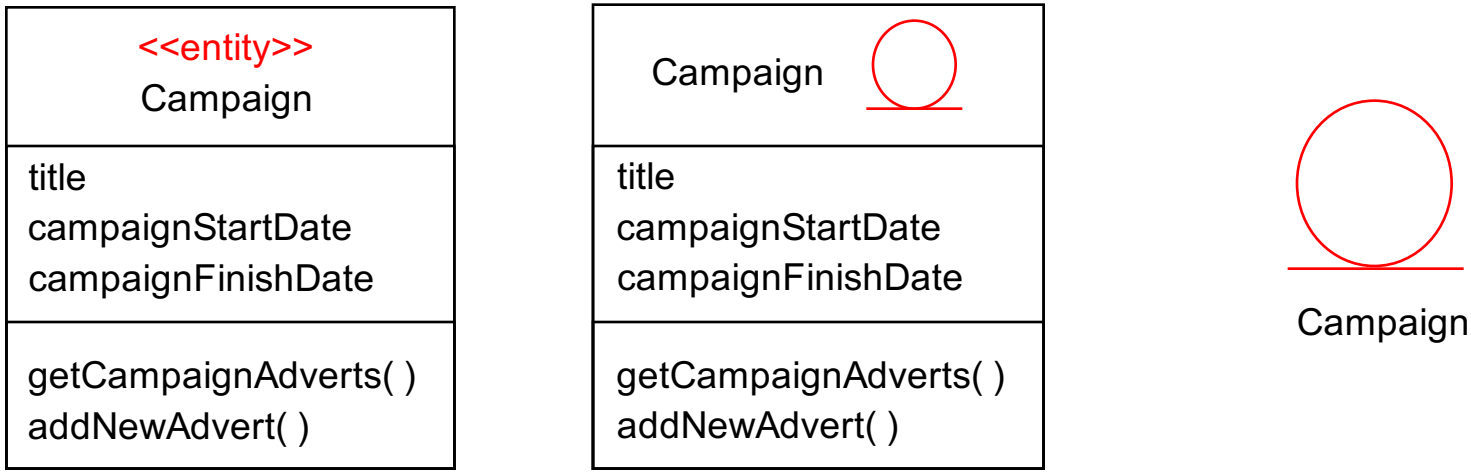
Based on Chapter 7, 8, 14 and 20 of Bennett, McRobb and Farmer:
Object Oriented Systems Analysis and Design Using UML, (4th Edition), McGraw Hill, 2010



Outline

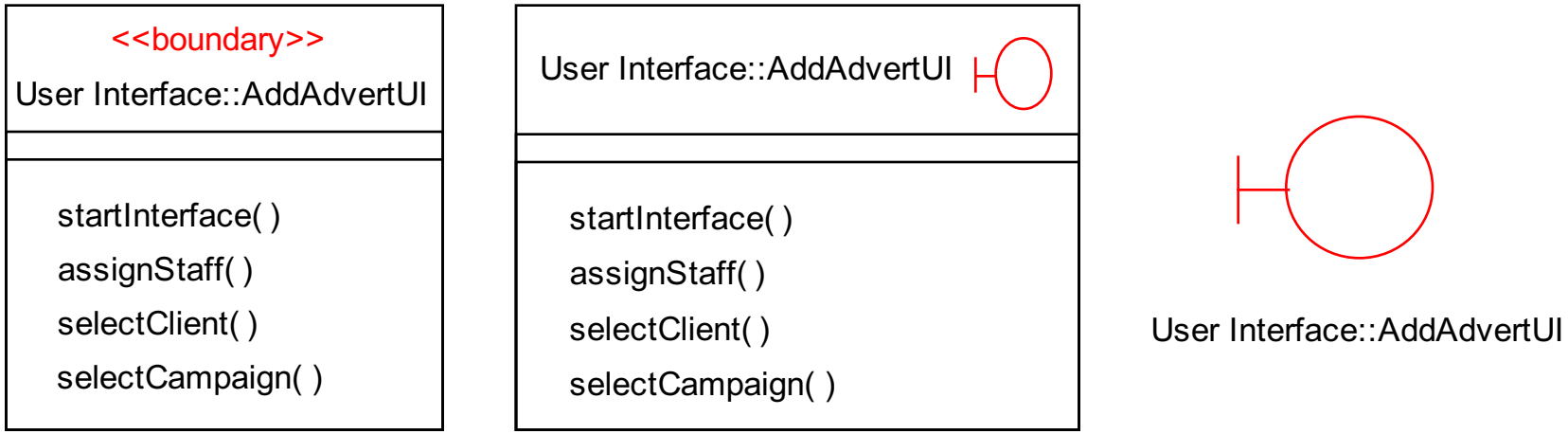
- Software and Specification Reuse
  - Section 20.2 (pp. 585 – 586)
  - Section 8.2 (pp. 234 – 237)
  - Section 8.4 (pp. 246 – 247)
  - Section 8.5.1 – 8.5.2 (pp. 252 – 253)
- Adding Further Structure (to Class Diagrams)
  - Section 8.3.1 – 8.3.3 (pp. 237 – 244)
  - Section 14.4.4 (pp. 409 – 410)

Stereotypes: Entity Classes



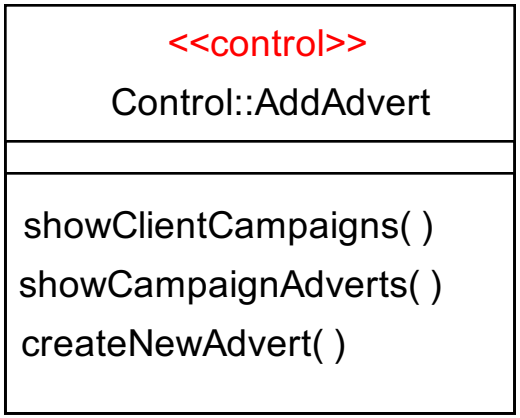
- Stereotypes differentiate the roles of objects
  - *Entity* objects represent information and behaviour in the application domain

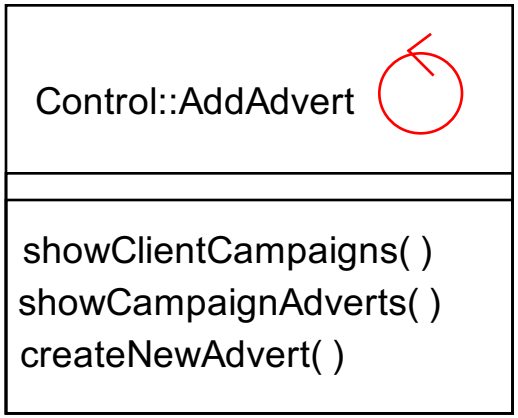
Stereotypes: Boundary Classes

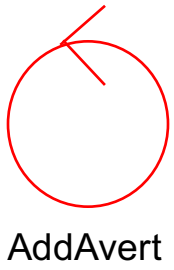


- Stereotypes differentiate the roles of objects
  - *Boundary* objects model interaction between the system and actors (and other systems), e.g., user interface

Stereotypes: Control Classes

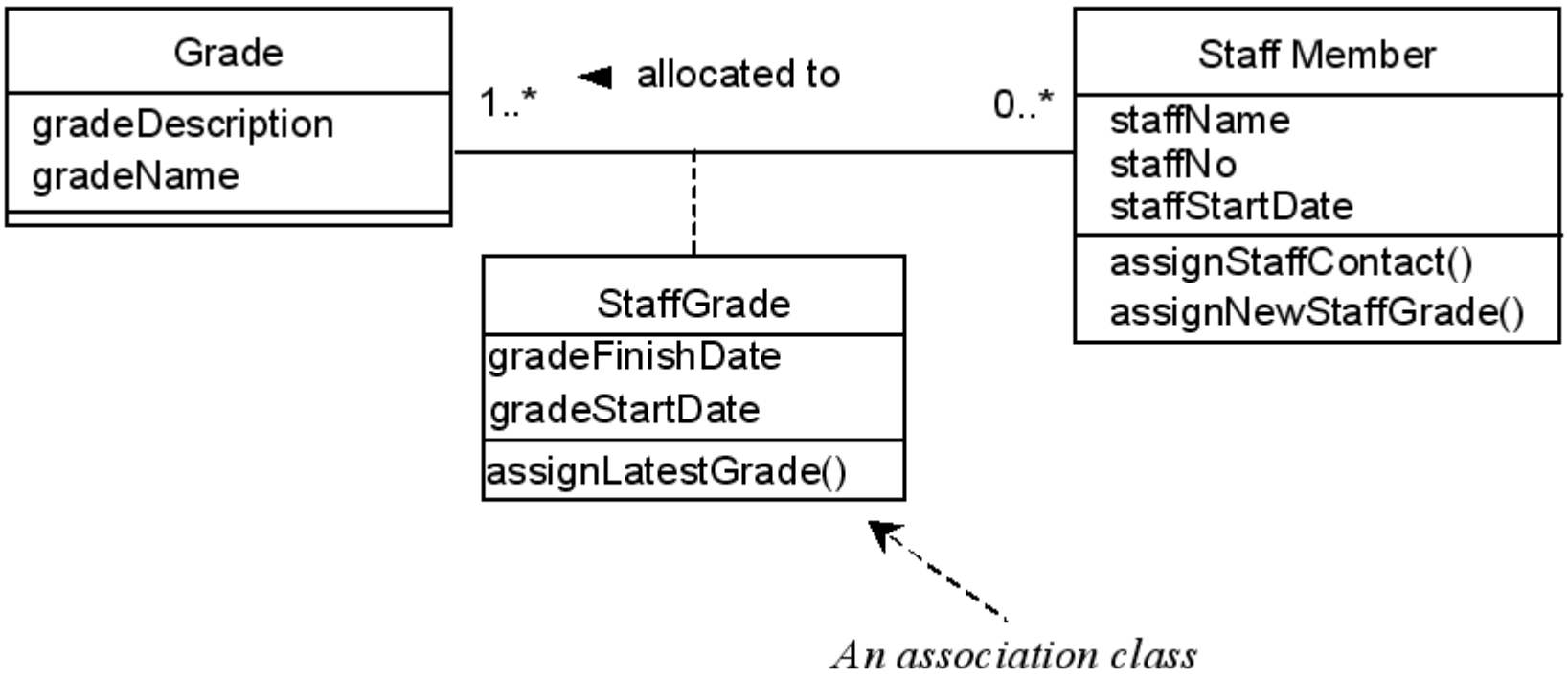






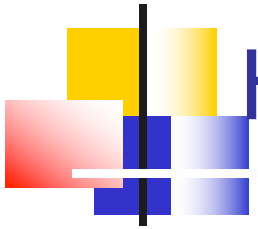
- Stereotypes differentiate the roles of objects
  - *Control* objects co-ordinate and control other objects (often correspond to Use Cases)

Association Classes



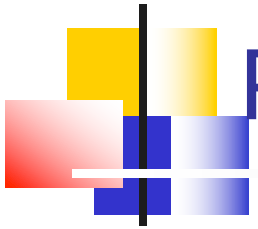
Why Reuse?

- The arguments for reuse are
  - partly **economic**
    - saving time and effort in software development including software testing and quality assurance
  - partly concerned with **quality**
    - fewer defects
  - partly about business **flexibility**
    - faster time to market



How O-O Contributes to Reuse

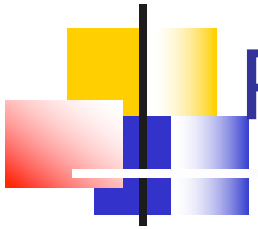
- Inheritance and Encapsulation
  - Two main forms of *abstraction* that O-O relies on to achieve reuse
- Components
- Patterns



Reuse: Encapsulation

- allows one class or component to be replaced by another with different internal details, as long as they adhere to the same external interface
  - thus classes or components can be used in systems for which they were not originally designed
- a group of classes can be encapsulated through aggregation or composition to become a reusable subassembly

Universal Serial Bus (USB)
http://en.wikipedia.org/wiki/Universal_Serial_Bus
Plug and Play

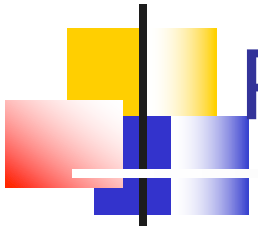


Reuse: Inheritance

- encourages identifying those aspects of a design or specification that has general application to a variety of situations or problems
- allows the creation of new specialised classes when needed, with little effort

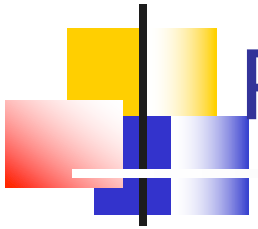
"Do not reinvent the wheel!"

http://en.wikipedia.org/wiki/Wheel
http://images.google.co.uk/images?q=wheel&hl=en
same circular form and central shaft



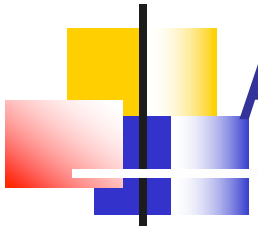
Reuse: Components

- For example, a house (bricks, tiles, doors, windows, pipes, etc.), a home theatre (a big screen TV, a DVD player, a decoder, an amplifier, speakers, etc.), …
- Software development has concentrated on inventing new solutions. Recently, the emphasis has shifted. Much software is now assembled from components that already exist.



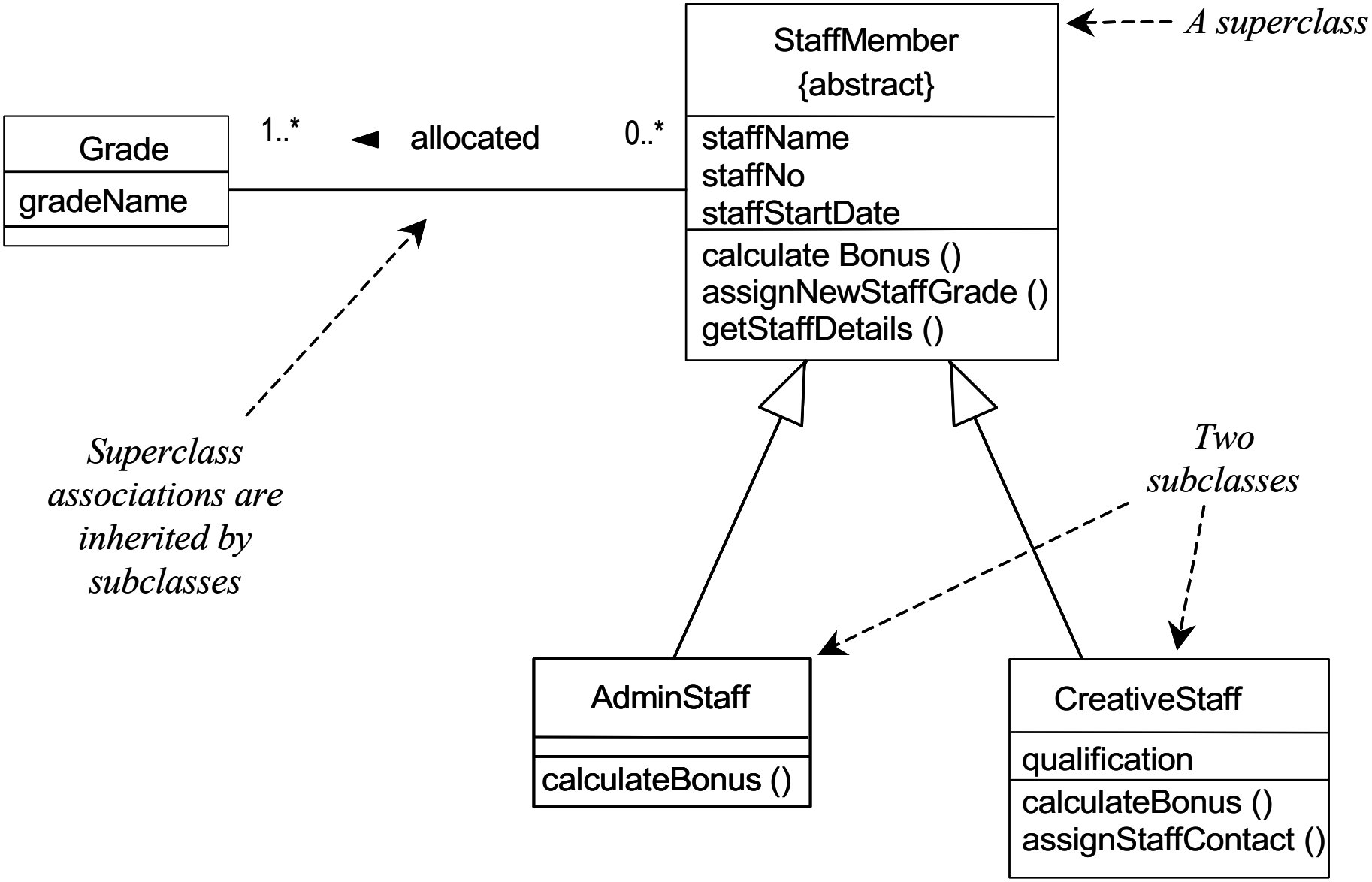
Reuse: Patterns

- next year, Information Systems Management



Adding Generalization Structure

- A generalization structure can be added when two classes are similar in most respects, but differ in some details such as
  - behaviour (operations or methods)
  - data (attributes)
  - associations with other classes


StaffMember
{abstract}
staffName
staffNo
staffStartDate
calculate Bonus ()
assignNewStaffGrade ()
getStaffDetails ()
A superclass
Grade
gradeName
1..*
allocated
0..*
Superclass associations are inherited by subclasses
Two subclasses
AdminStaff
calculateBonus ()
CreativeStaff
qualification
calculateBonus ()
assignStaffContact ()

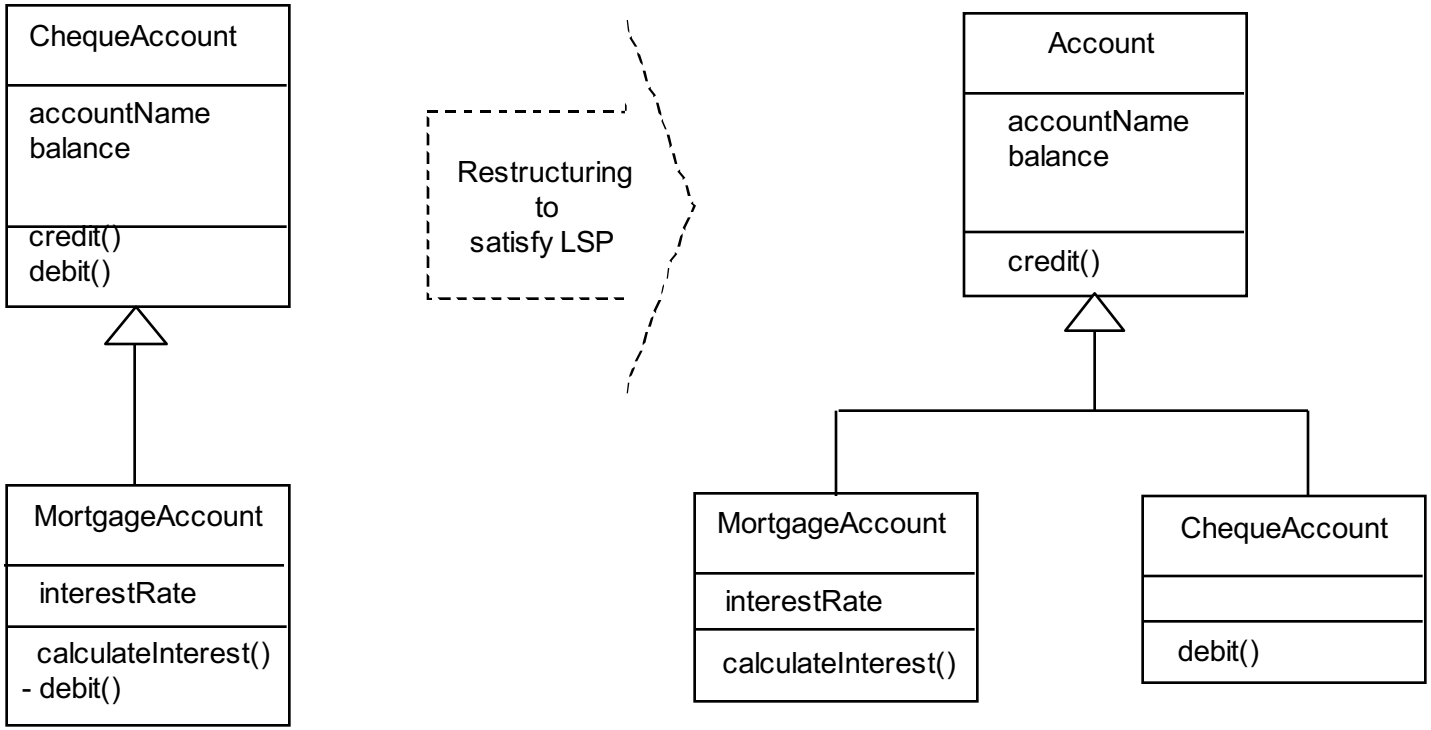
Liskov Substitution Principle

- In object interactions, it should be possible to treat a *derived* object **as if** it were a *base* object without integrity problems.
  - If the principle is not applied, then it may be possible to violate the integrity of the derived object.

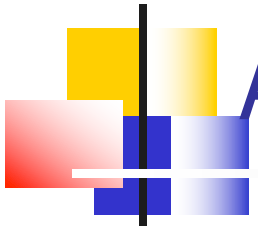
Prof Barbara Liskov

2009 A. M. Turing Award winner

Liskov Substitution Principle



Disinheritance of **debit()** means that the left-hand hierarchy is not Liskov compliant

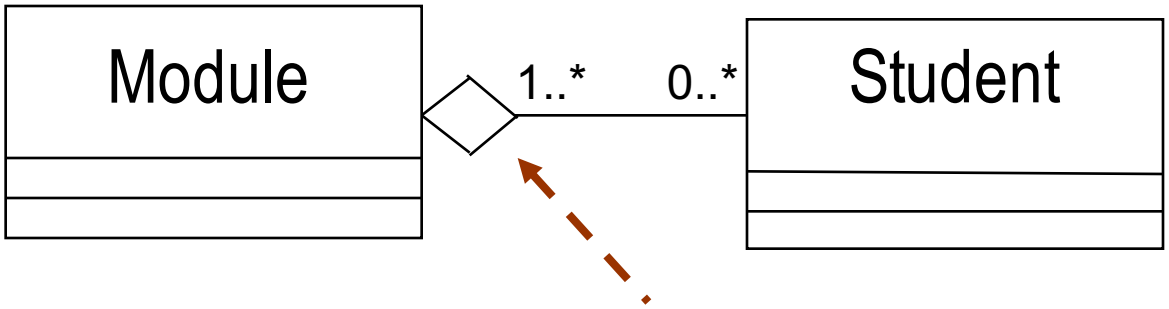


Aggregation and Composition

- Two special types of association
  - Aggregation represents a **whole-part** relationship between classes
  - Composition expresses a similar relationship but differs in showing a *stronger* form of ownership by the whole
    - Each part may belong to only one whole at a time.
    - When the whole is destroyed, so are all its parts.

Notation: Aggregation

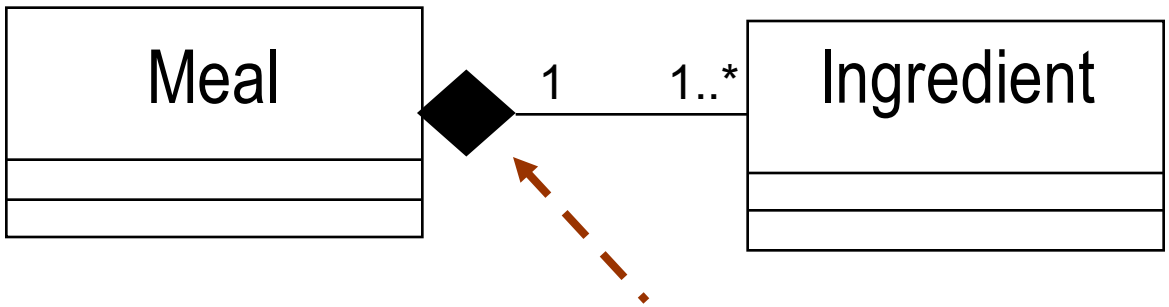
- A student could be in a number of modules
- If a module is cancelled, students are not destroyed

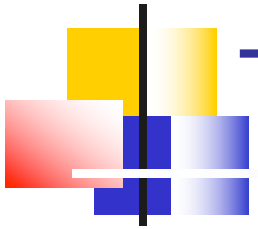


unfilled diamond denotes aggregation

Notation: Composition

- An ingredient is in only one meal at a time
- If you drop your meal on the floor, you probably lose the ingredients too





Take Home Messages

- Software and Specification Reuse
  - Why Reuse
  - How O-O Contributes to Reuse
- Adding Further Structure (to Class Diagrams)
  - Generalization/Specialization
    - Liskov Substituion Principle
  - Aggregation and Composition