

Object-Oriented Systems

CS60059

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About The Instructor

- RAJIB MALL
- B.E. , M.E., Ph.D from Indian Institute of Science, Bangalore
- Worked with Motorola (India)
 - Senior engineer and later as project manager
- Shifted to IIT, Kharagpur in 1994
 - Currently Professor



Motivation for Crediting this Course

- You have got a sophisticated gun 
- You are the proud owner of the nice gun!
- Wanted to use it... 
- Opportunity came ... 
- You claimed you make good use of your gun! 

Motivation cont...

- You learnt Java, C++, ...
- You know the syntax and semantics well.
- You have written small programs that work.
- You claimed you are an expert object-oriented software developer!!
- **This syndrome is not restricted to students alone...**

Plan of The Course

- Basic concepts
 - UML
 - Designing using UML
 - ~~Testing OO programs?~~
- ≈ 35%
- Object-oriented principles
- ≈ 5%
- Patterns
- ≈ 60%

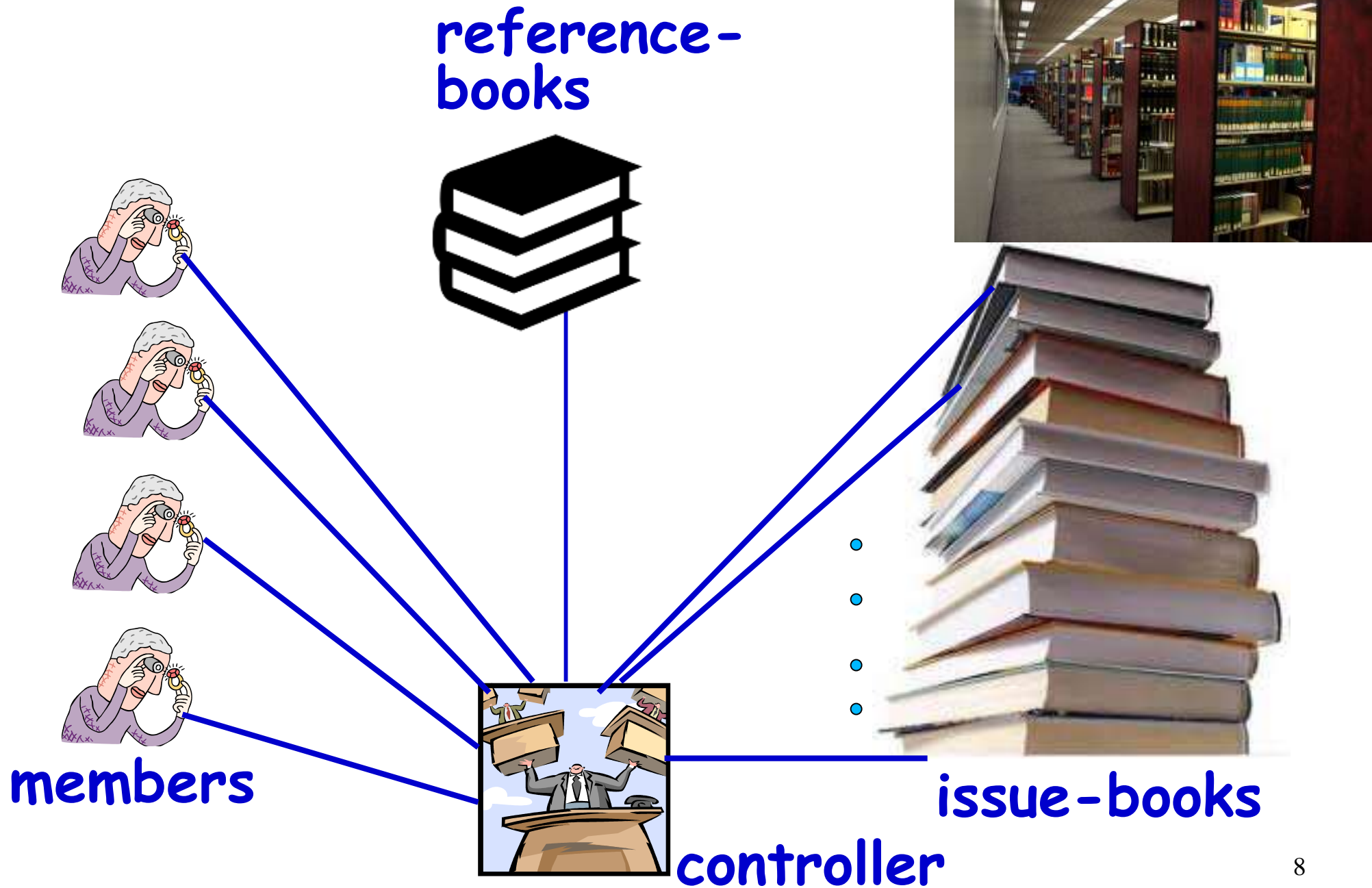
Grading

- Class Test 1 --- End Aug 10%
- Mid Sem --- End Sep 25%
- Class Test 2 --- End Oct 10%
- End Sem --- End Nov 50%
- Class attendance + Participation -- 5%
- Bonus (Extra Marks) --- ???

Introduction

- Object-oriented design (OOD) techniques are now extremely popular:
 - Inception in early 1980's and nearing maturity.
 - Widespread acceptance in industry and academics.
 - Unified Modelling Language (UML) became an ISO standard (ISO/IEC 19501) in 2004.

Schematic Object-Oriented Solution for LIS

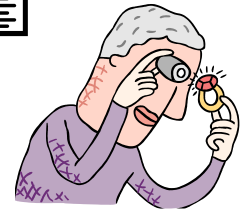
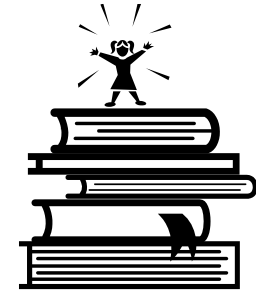


Object-Oriented Development

- A system is designed as a set of interacting objects.

- **Objects are often real-world entities:**

- Examples: an employee, a book etc.

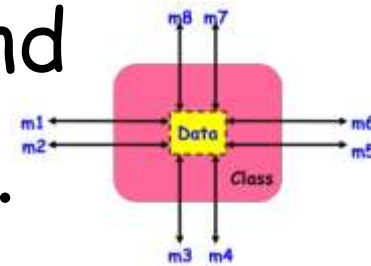


- **Can also be conceptual objects :**

- Controller, manager, etc.



- An object consists of data (attributes) and functions (methods) that operate on data.



- **Encapsulation.**

Class Diagram

Class

- Template for object creation:



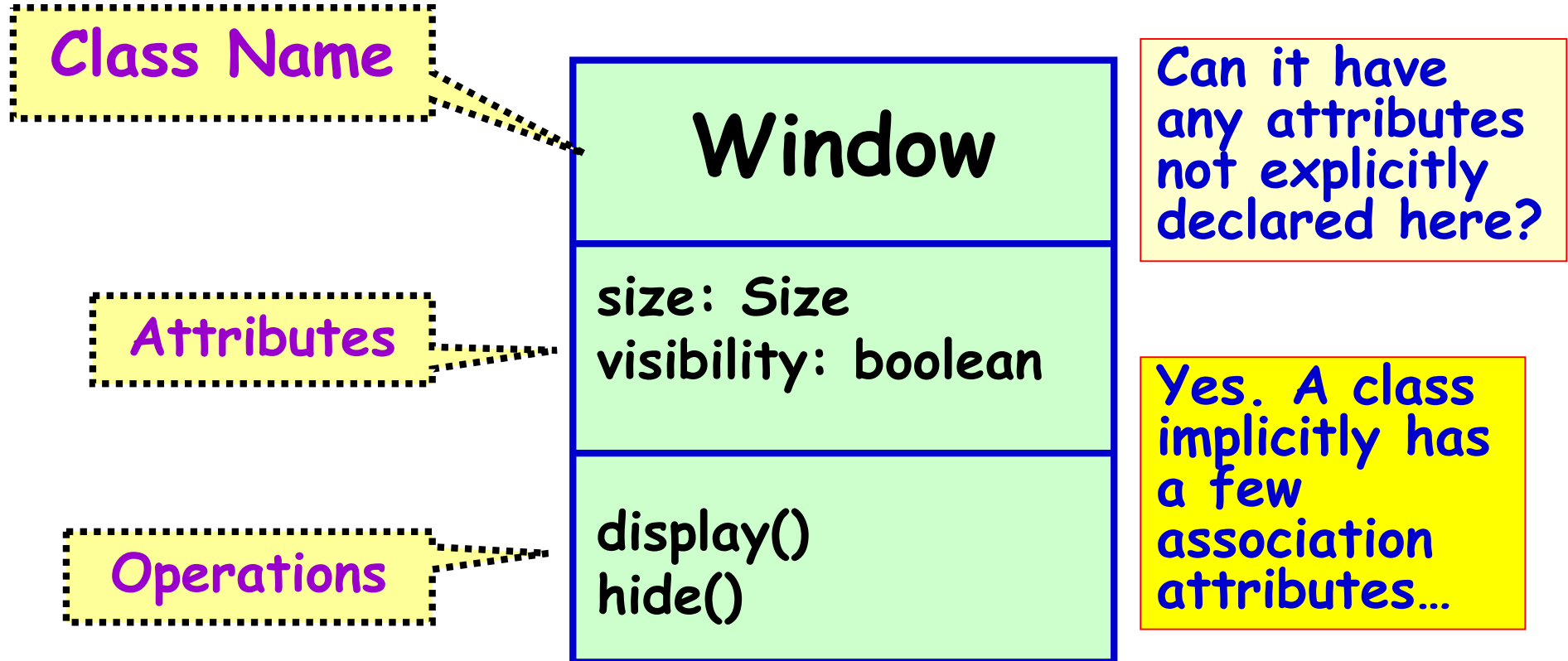
- Instantiated into objects



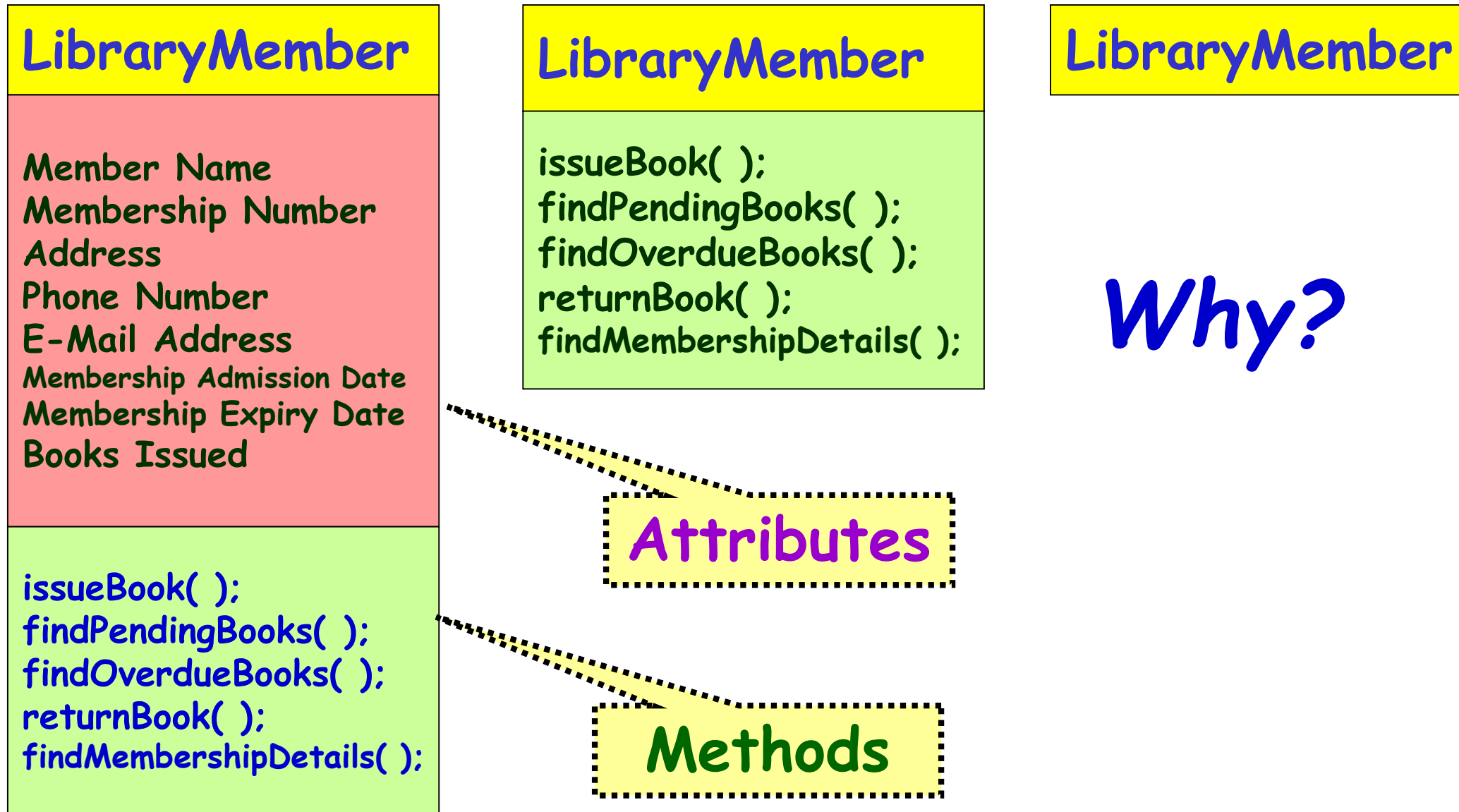
- Examples: Employee, Book, etc.
- Sometimes not intended to produce instances:
 - Abstract classes

UML Class Representation

- A class represents a set of objects having similar attributes, operations, relationships and behavior.



Alternate Representations of a Class in UML



Class Attribute Examples

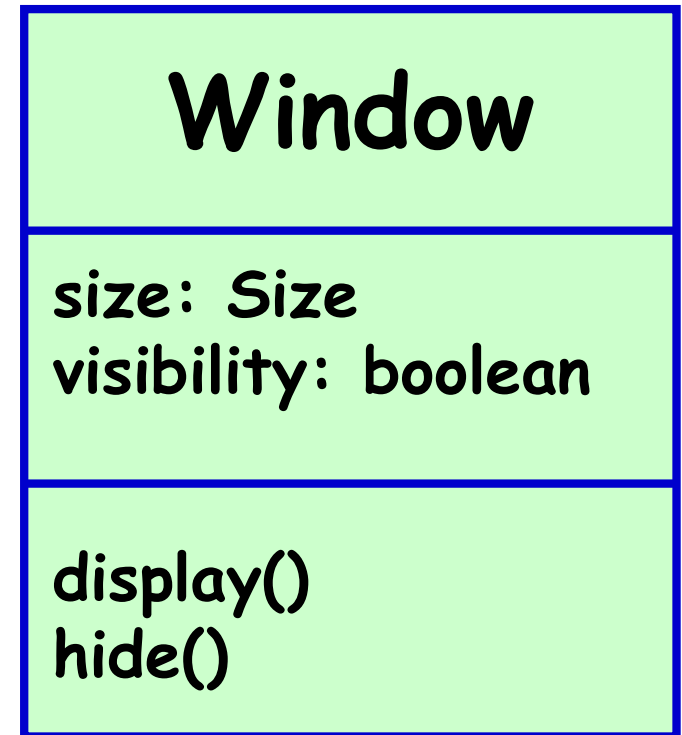
Java Syntax	UML Syntax
Date birthday	
Public int duration=100	
Private Student students[0..MAX_Size]	

Visibility of Class of Members

Visibilty	Java Syntax	UML Syntax
public	public	+
protected	protected	#
?		~
private	private	-

Methods

- Methods are the operations supported by an object:
 - Means for manipulating the data of an object.
 - Invoked by sending a message (method call).
 - **Examples:** display(), calculate_salary(), issue-book(), getMemberDetails(), etc.



Method Examples

Java Syntax	UML Syntax?
<code>void move(int dx, int dy)</code>	
<code>public int getSize()</code>	

Are Methods and Messages Synonyms?

- No
- Message was the original concept in object-orientation...
- Methods are the later simplifications...
- Sometimes used as synonyms

Are Methods and Operations Synonyms?

- No
- An operation can be implemented by multiple methods.
 - Known as polymorphism
 - In the absence of polymorphism--the two terms are synonyms.

I DON'T NEED TO
SEE YOUR RÉSUMÉ.
THAT'S THE OLD WAY
OF HIRING.



NOW WE USE DATA
FROM THE INTERNET
TO SEE WHAT YOU'VE
BEEN UP TO LATELY.

EW.



I'LL
SHOW
MYSELF
OUT.

YOU'LL
UNDERSTAND
IF I DON'T
SHAKE YOUR
HAND.

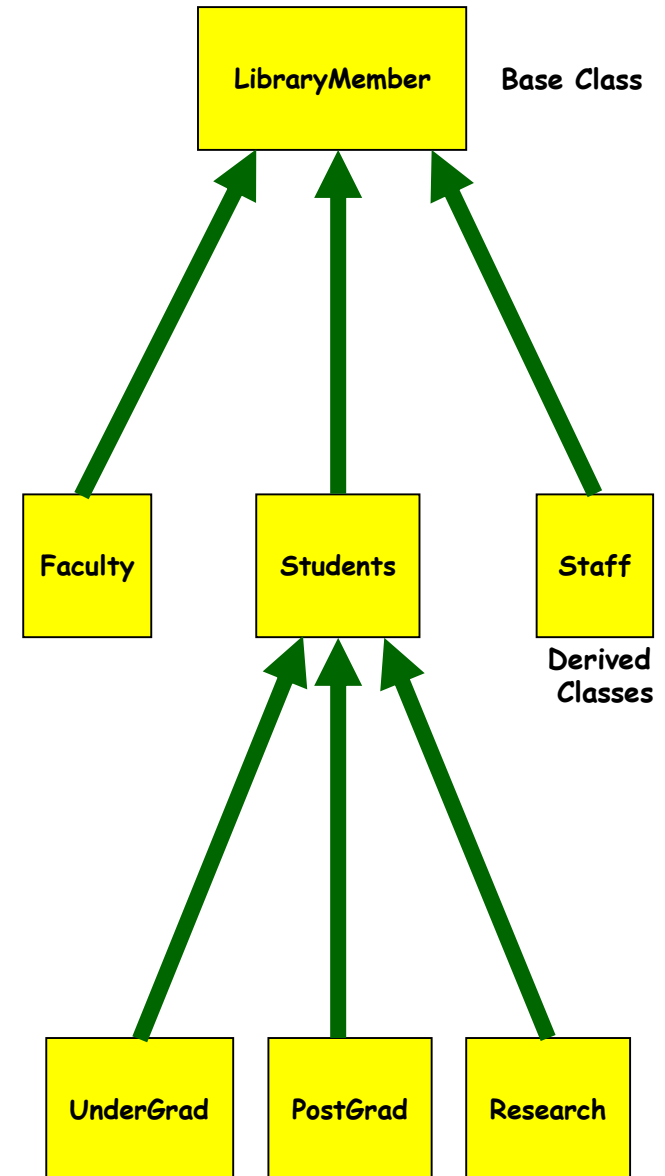


What Are the Different Types of Relationships That May Exist Among the Classes in an OO Program?

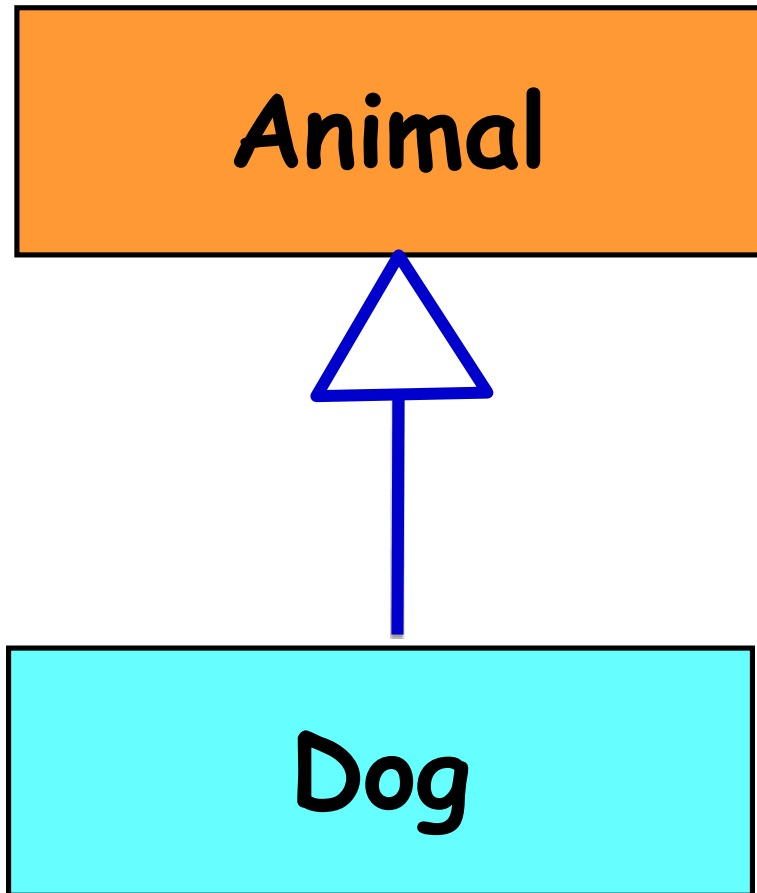
- Four types of class relationships:
 - Inheritance
 - Association
 - Aggregation/Composition
 - Dependency

Inheritance

- Allows us to define a new class (derived class) by extending an existing class (base class).
 - Represents generalization-specialization relationship.
 - Allows redefinition of the existing methods (method overriding).

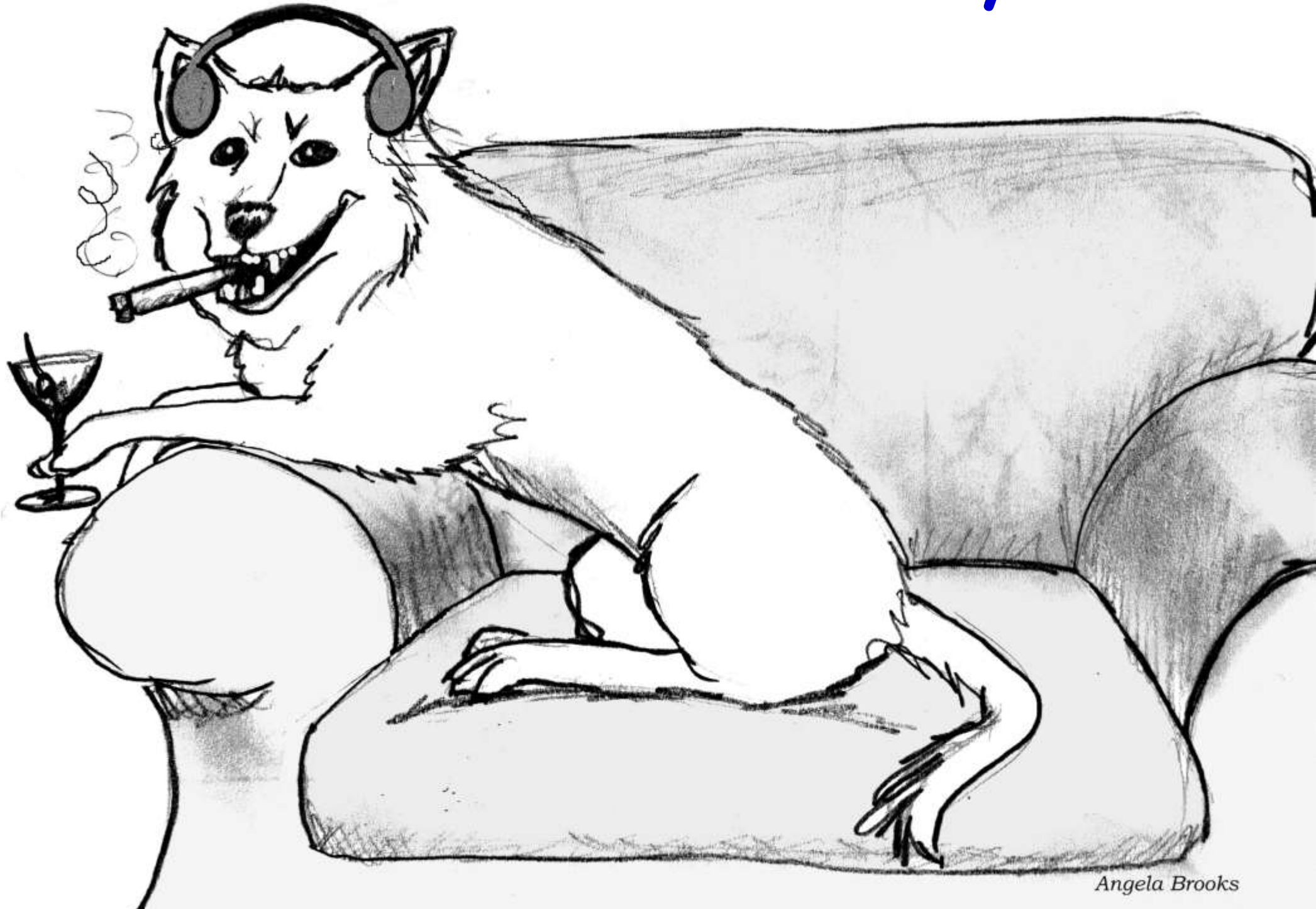


Inheritance Example



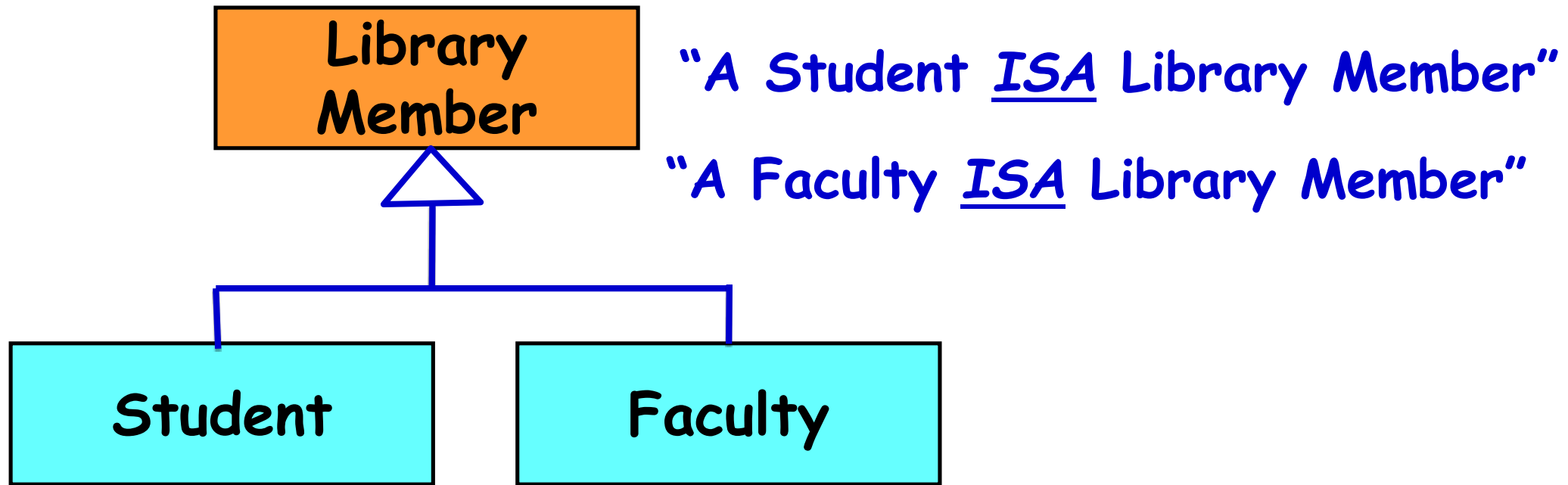
"A Dog ISA Animal"

Hmmm... not really...



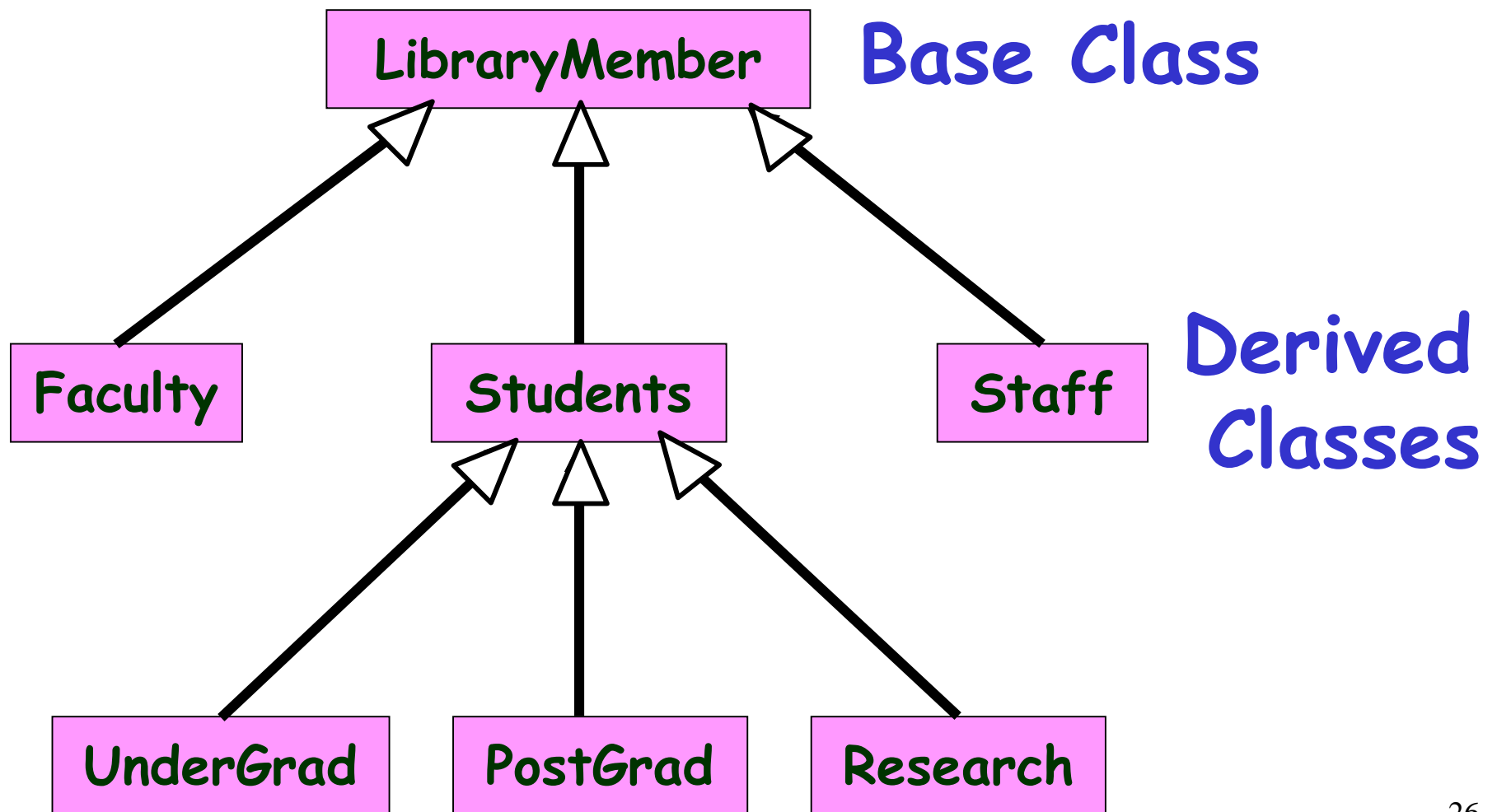
Angela Brooks

Inheritance: One More Example

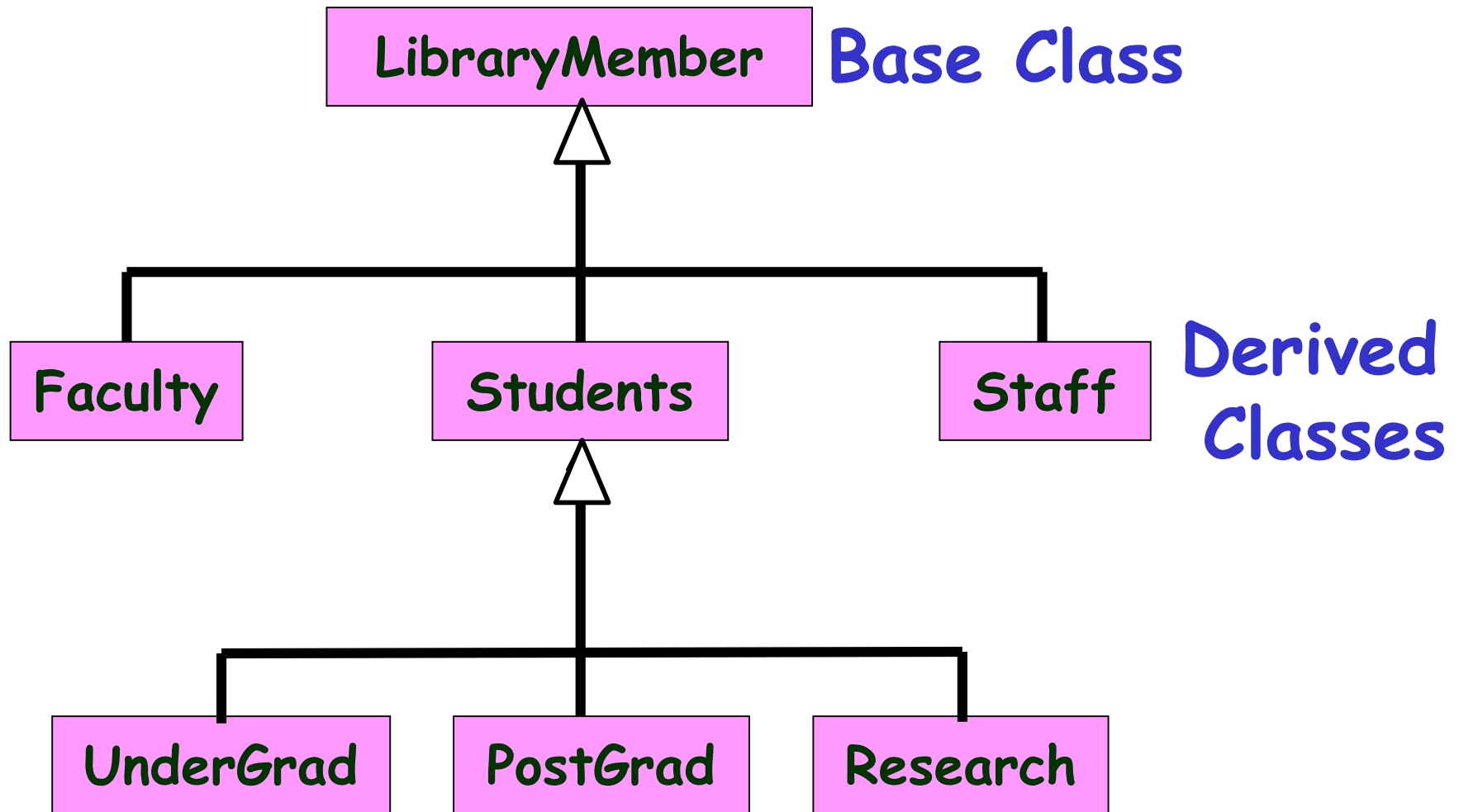


Inheritance: Semantics

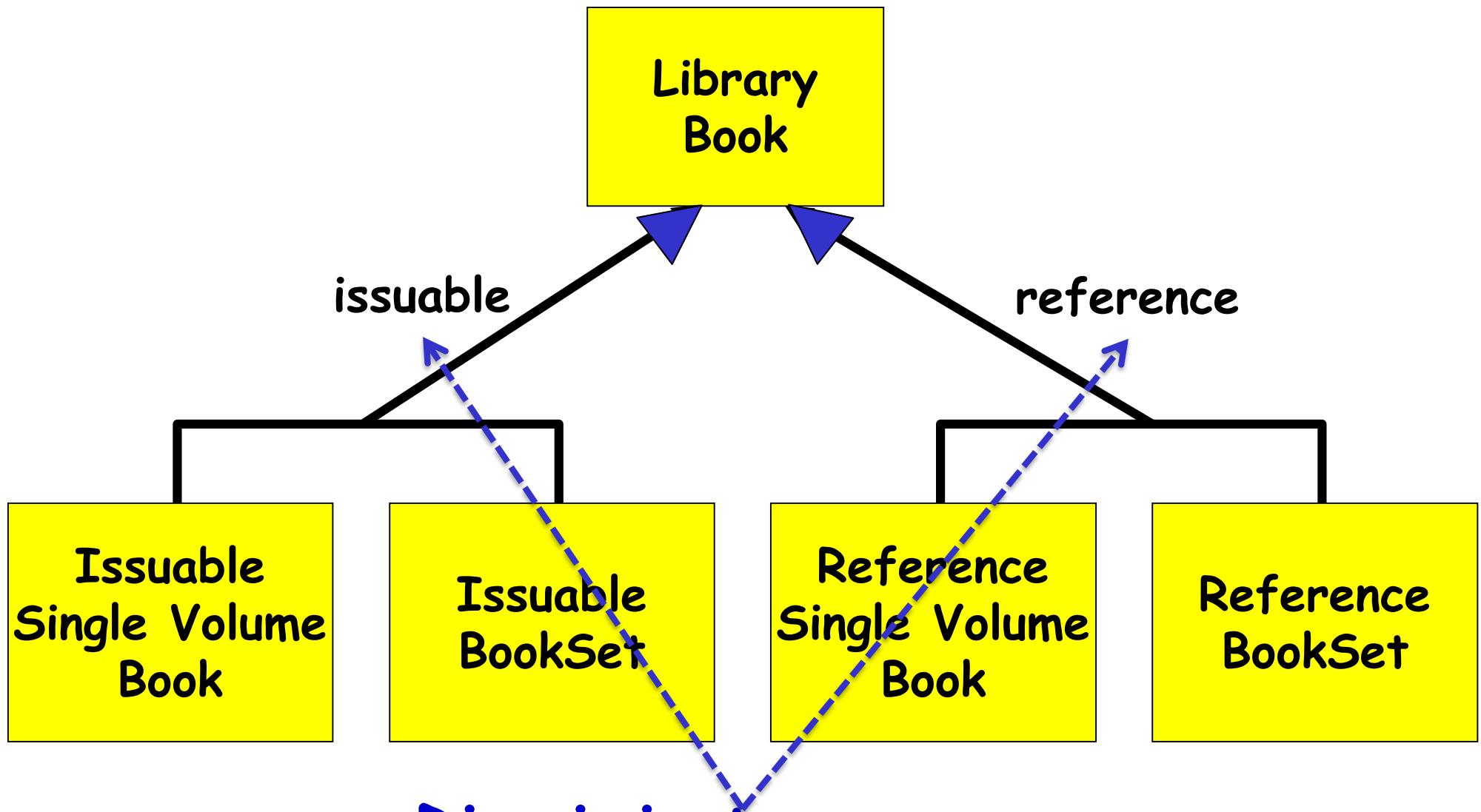
- Lets a subclass inherit attributes and methods of a base class.



Inheritance: An Alternate Representation

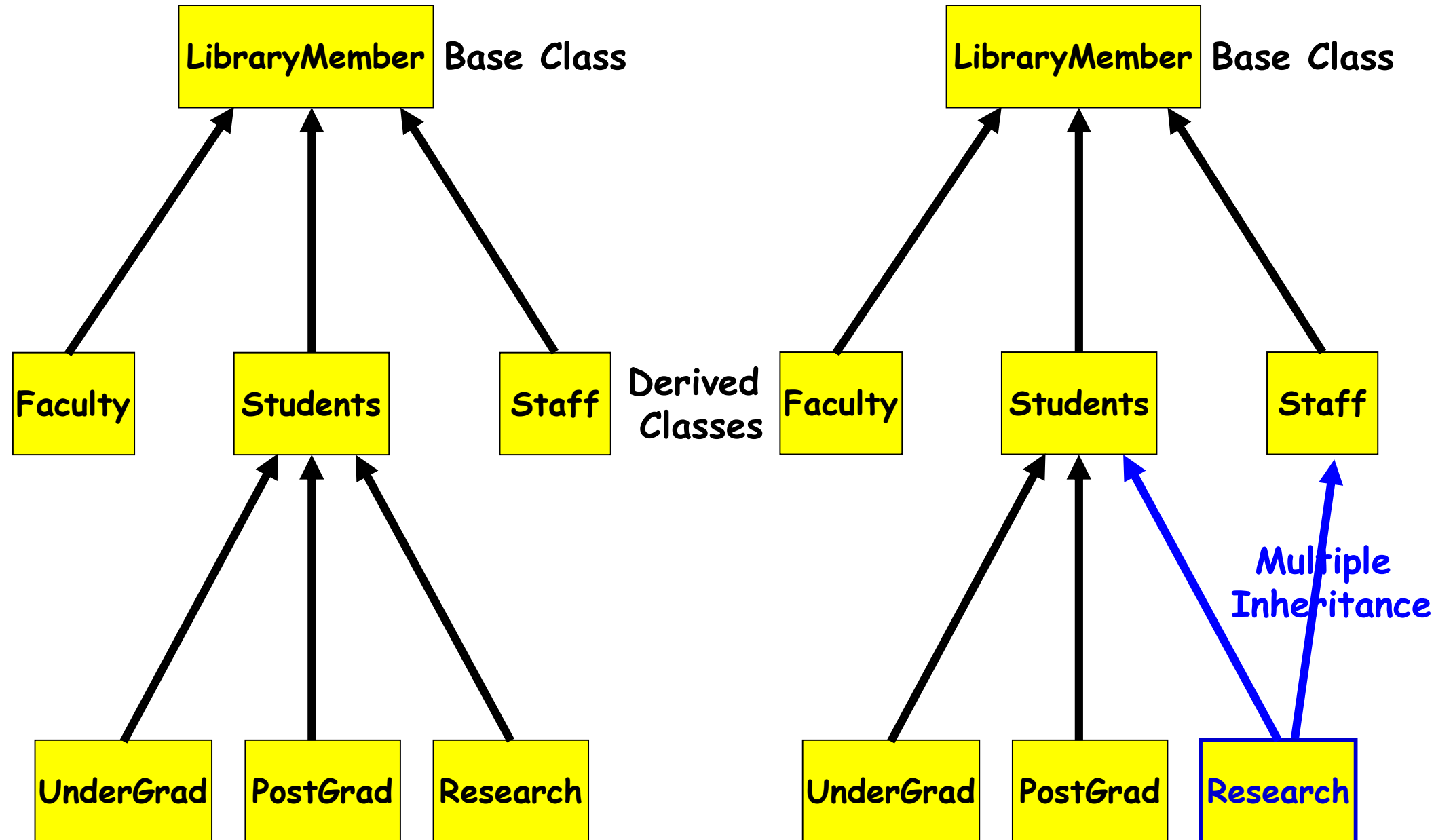


Inheritance Example



Discriminator: allows to group subclasses into clusters that correspond to a semantic category.

Multiple Inheritance



Multiple Inheritance: Can Cause Repeated Inheritance...

- May lead to inconsistency
- In C++ handled by using virtual base class
- In Java handled by using Interface class

