Tecniche di Progettazione: Design Patterns

Delegation vs inheritance

Delegation vs inheritance [Mark Grand98]

- Inheritance
  - defines a new class, which use the interface of a parent class while adding extra, more problem-specific methods.
- Delegation
  - is a way of reusing and extending the behavior of a class by writing a new class that incorporates the functionality of the original class by using an instance of the original class and calling its methods.
- No. 1 issue in OO is if a class A should inherit from B or A should use B.

Motivation

- Inheritance is a wonderful thing, but sometimes it isn't what you want.
  - Often you start inheriting from a class but then find that many of the superclass operations aren't really true of the subclass. In this case you have an interface that's not a true reflection of what the class does.
  - Or you may find that you are inheriting a whole load of data that is not appropriate for the subclass.
  - Or you may find that there are protected superclass methods that don't make much sense with the subclass.

Motivation (continued)

- You can live with the situation and use convention to say that although it is a subclass, it’s using only part of the superclass function. But that results in code that says one thing when your intention is something else—a confusion you should remove.

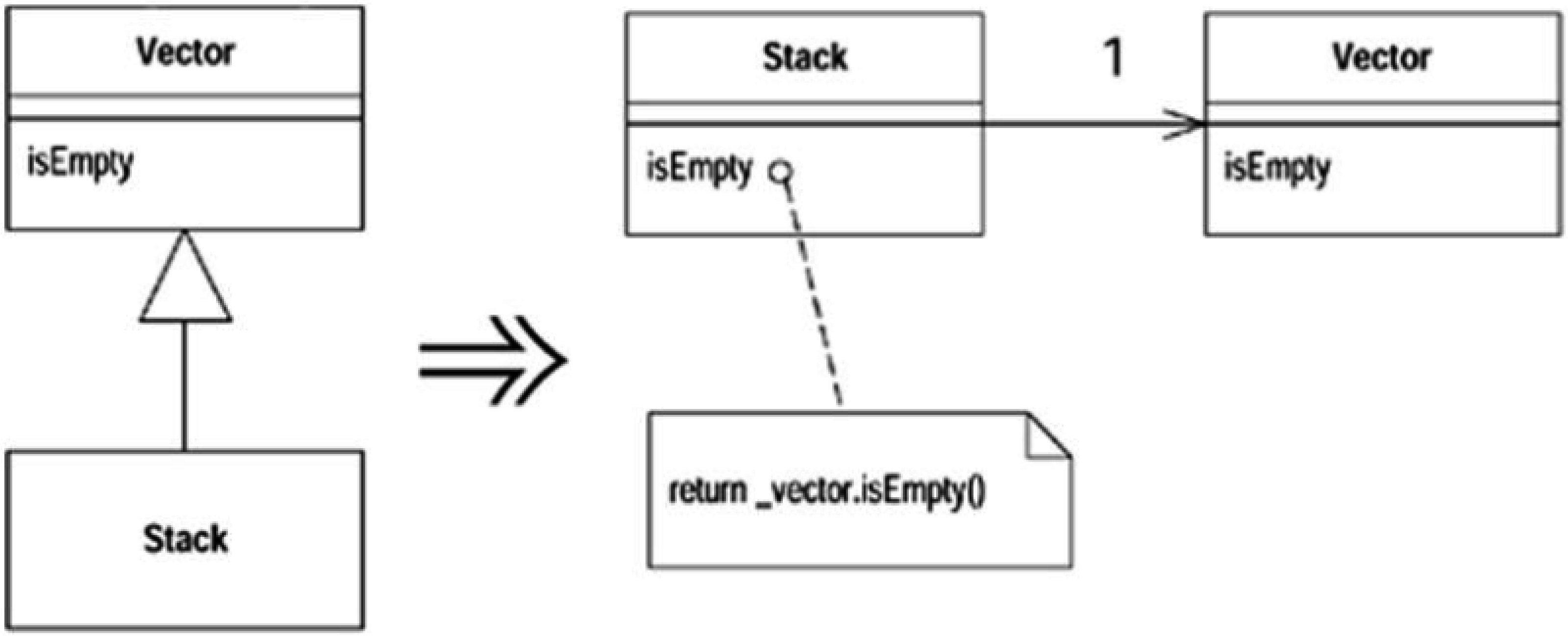
- Remember: SOLID: Interface Segregation Principle
  - *Clients should not be forced to depend upon interfaces that they don't use*

Motivation (continued)

- By using delegation instead:
  - you make it clear that you are making only partial use of the delegated class.
  - you control which aspects of the interface to take and which to ignore.
- The cost is extra delegating methods that are boring to write but are too simple to go wrong.

Replace Inheritance with Delegation

- Create a field for the superclass, adjust methods to delegate to the superclass, and remove the subclassing.



Mechanics

1. Create a field in the subclass that refers to an instance of the superclass. Initialize it to this.
2. Change each method defined in the subclass to use the delegate field. Compile&test after changing each method.
   - *You won't be able to replace any methods that invoke a method on* super *that is defined on the subclass, or they may get into an infinite recurse. These methods can be replaced only after you have broken the inheritance.*
3. Remove the subclass declaration and replace the delegate assignment with an assignment to a new object.
4. For each superclass method used by a client, add a simple delegating method.
5. Compile and test.

Example

- One of the classic examples of inappropriate inheritance is making a stack a subclass of vector. Java1.1 does this in its utilities (naughty boys!), but in this case I use a simplified form of stack:

```
class MyStack extends Vector {
        public void push(Object element) {insertElementAt(element,0); }
        public Object pop() { Object result = firstElement();
                                                removeElementAt(0); return result; }
    }
```

- Looking at the users of the class, I realize that clients do only four things with stack: push, pop, size, and isEmpty. The latter two are inherited from Vector.

Example (continued)

- I begin the delegation by creating a field for the delegated vector. I link this field to this so that I can mix delegation and inheritance while I carry out the refactoring:

```
private Vector _vector = this;
```

- Now I start replacing methods to get them to use the delegation. I begin with push:

```
public void push(Object element) {
    _vector.insertElementAt(element,0); }
```

- I can compile and test here, and everything will still work.

Example (continued)

- Now pop:

```
public Object pop() {
    Object result = _vector.firstElement();
    _vector.removeElementAt(0);
    return result;
    }
```

Example (continued)

- Once I’ve completed these subclass methods, I need to break the link to the superclass:

```
class MyStack
private Vector _vector = new Vector();
```

- I then add simple delegating methods for superclass methods used by clients:

```
public int size() { return _vector.size(); }
public boolean isEmpty() { return _vector.isEmpty(); }
```

- Now I can compile and test. If I forgot to add a delegating method, the compilation will tell me.

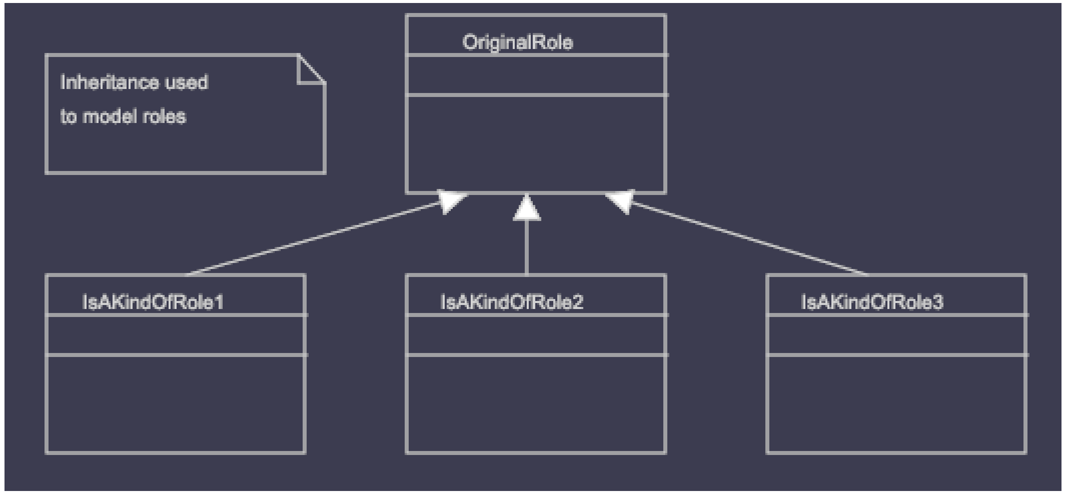
Interface vs class inheritance

- Class inheritance: implementation reuse
  - dangerous when overriding to nothing
  - See the non flying (rubber) duck in the head first book, p. 4-5.

- Interface Inheritance: subtypes
  - Flyable and Quackable duck, subtypes of Duck, with *fly* and *quack* functionalities, resp.
  - But then no code reuse for those funcionalities
  - And… there might be different fly behaviours even among the ducks that do fly.

Delegation (When not using inheritance) [Mark Grand98]

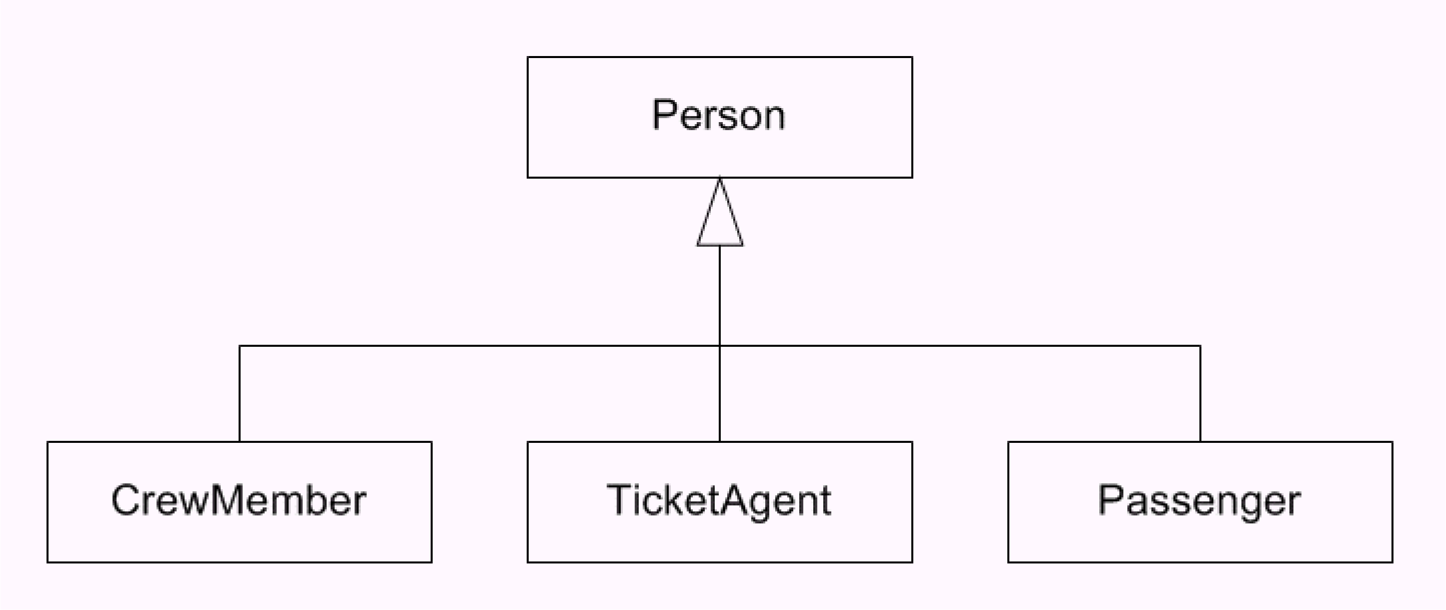
- Inheritance is a common way of extending and reusing the functionality of a class.
- However, inheritance is inappropriate for many situations:
  - Inheritance is useful for capturing **is-a-kind-of relationships** which are rather **static** in nature.
  - **is-a-role-played-by relationships** are awkward to model by inheritance, where delegation could be a better choice.



Using instances of a class to play multiple roles. (see airline ex.)

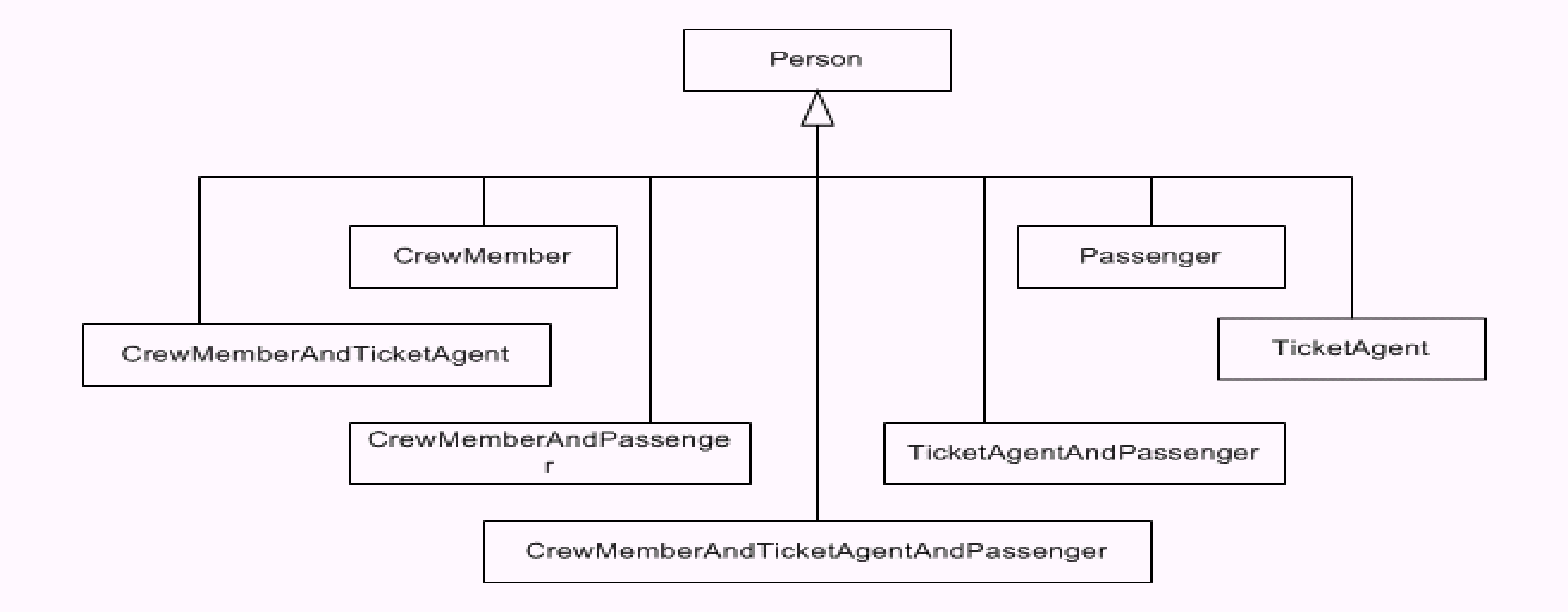
Inheritance vs delegation: changing roles

- Don't use inheritance where roles interchange.
  - For example, an airline reservation system may include such roles as passenger, ticket selling agent and flight crew.
  - A class called Person may use subclasses corresponding to each of these roles.



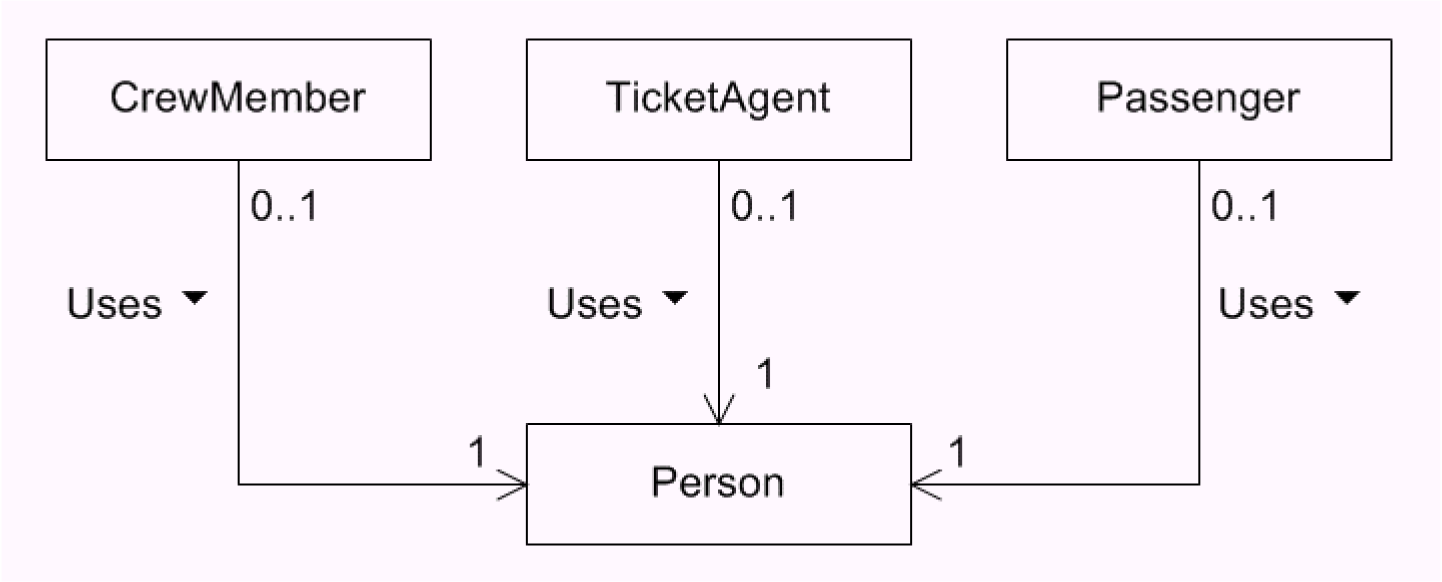
Example (cont'd)

- The problem is that the same person can fill more than one of these roles.
  - A person who is normally part of a flight crew can also be a passenger…
  - This way, the number of subclasses would increase exponentially.



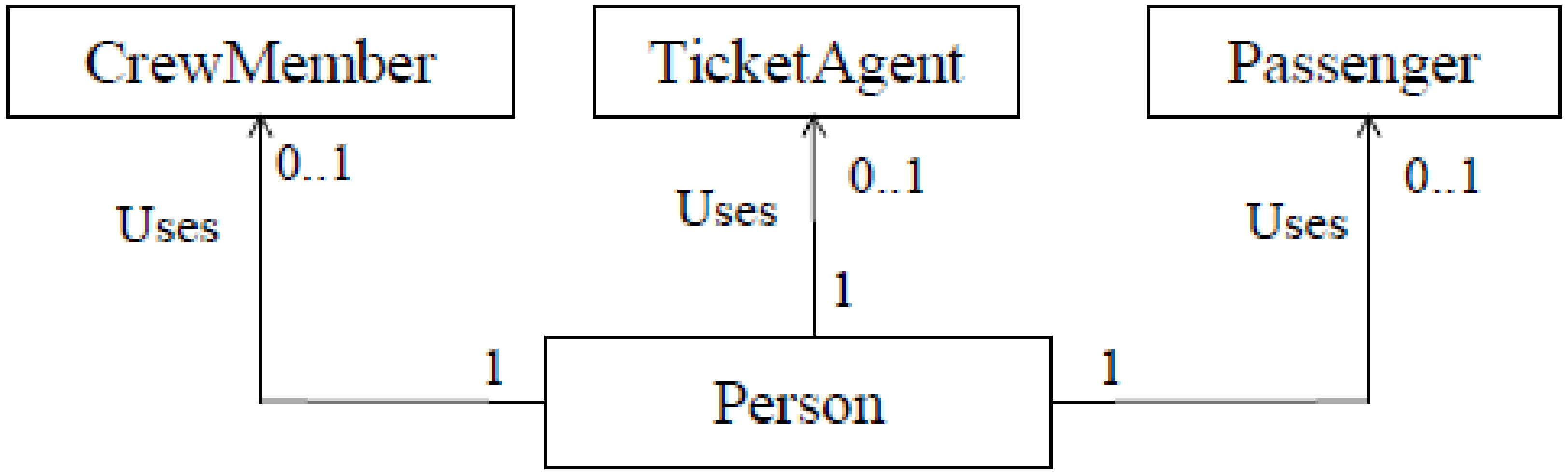
Example (cont'd)

- If person A, CrewMember, becomes now also a Passenger, a new object Passenger is created, referring A.



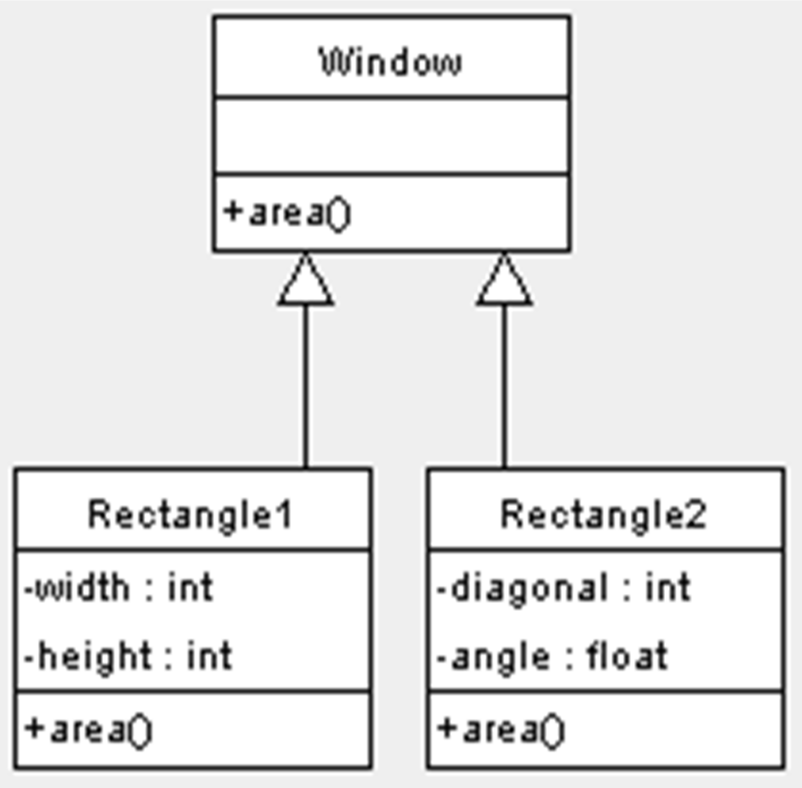
Example (cont'd)

- Not a good solution
  - problems with using the specific methods, which were unforeseen.



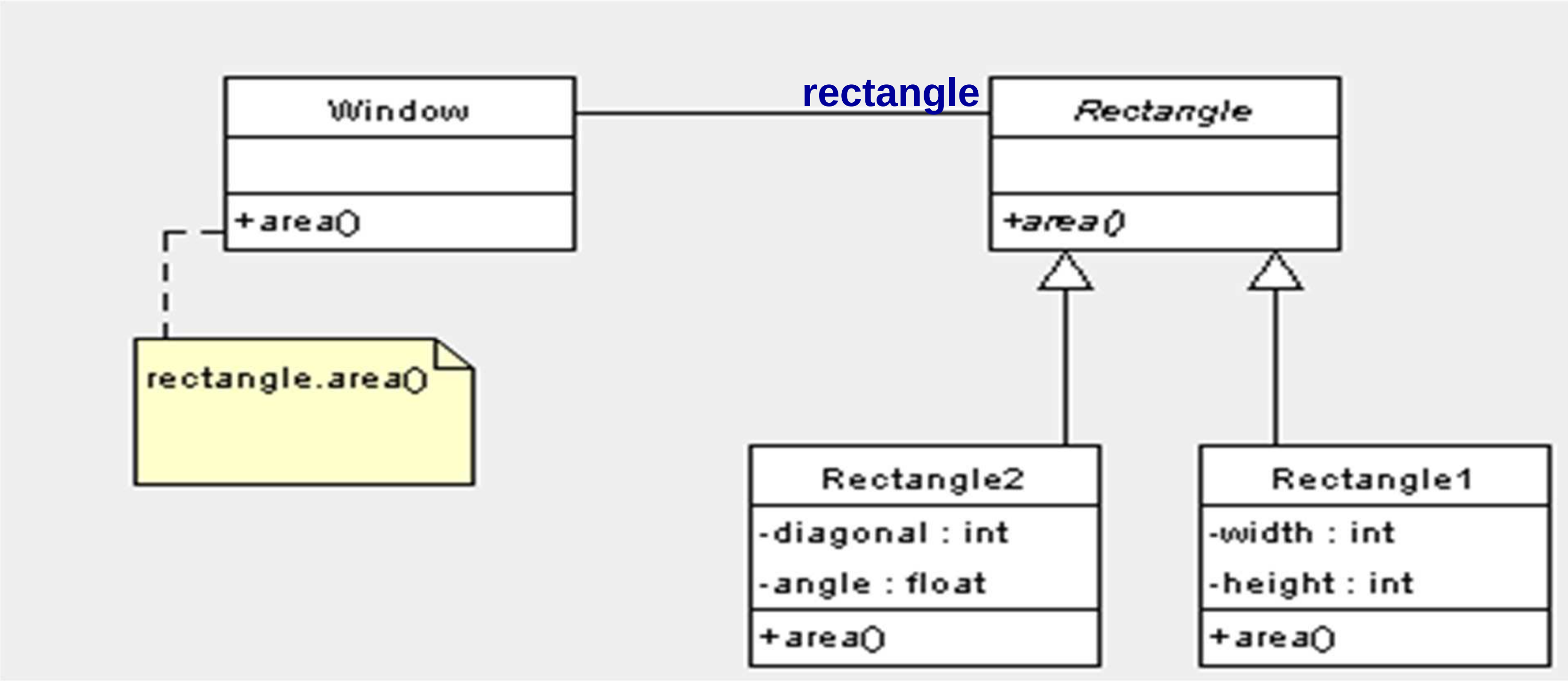
Inheritance vs delegation: killing ex.

- If you want to let the Window client change the implementation of area, you need define different specializations, and rebuild the whole object to perform the change.



- … and you can't change the implementation inherited from super classes at runtime (obviously because inheritance is defined at compile time).

Inheritance vs delegation: killing ex. (cont'd)



- With delegation, you only need to change the object relative to the delegated operation you want to change

Inheritance vs delegation:languages

- In Java or C#, an object cannot change its type once it has been instantiated.
- So, if your object need to appear as a different object or behave differently depending on an object state or conditions, then use Composition
- Refer to State and Strategy Design Patterns.
- If the object need to be of the same type, then use Inheritance

Inheritance vs delegation: hiding

- Don't use inheritance if you end up in a situation where a class is trying to hide a method or variable inherited from a superclass.
    - If you define a field in a subclass that has the same name as an accessible field in its superclass, the subclass's field *hides* the superclass's version.
        - E.g., if a superclass declares a public field, subclasses will either inherit or hide it. (You can't override a field.)
    - If a subclass hides a field, the superclass's version is still part of the subclass's object data; however methods in the subclass can access the superclass's version only by using the super keyword, as in super.fieldName.

Inheritance vs delegation: utility classes

- Don't use inheritance of a utility class
  - you're not in control of the parent class and it may change scope later
    - inheriting java.util.Vector is a very, very bad idea: at any point some methods can be declared deprecated.

  - It's always easier to replace changing a class you just use – than one you inherit from.
  - Besides, inheritance exposes a subclass to details of its parent's class implementation, that's why it's often said that inheritance breaks encapsulation (in a sense that you really need to focus on interfaces only not implementation, so reusing by sub classing is not always preferred).

Places where not to use inheritance (but rather delegation) (continued)

- Don't use inheritance from a class, which is written very specifically to a narrow problem - because that will make it more difficult to inherit from another class later.
  - Client classes that use the problem domain class may be written in a way that assumes the problem domain class is a subclass of the utility class. If the implementation of the problem domain changes in a way that results in its having a different superclass, those client classes that rely on its having its original superclass will break.
  - An even more serious problem is that client classes can call the public methods of the utility superclass, which defeats its encapsulation.

Potential Drawbacks of Delegation

- There may be some minor performance penalty for invoking an operation across object boundaries as opposed to using an inherited method.
- Delegation can’t be used with partially abstract (uninstantiable) classes
- Delegation does not impose any disciplined structure on the design.