Delegation vs inheritance

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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.

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.

Example

java.util

Class Stack<E>

java.lang.Object
  java.util.AbstractCollection<E>
    java.util.AbstractList<E>
      java.util.Vector<E>
        java.util.Stack<E>

All Implemented Interfaces:

Serializable, Cloneable, Iterable<E>, Collection<E>, List<E>, RandomAccess

One of the classic examples of inappropriate inheritance is making a stack a subclass of vector.

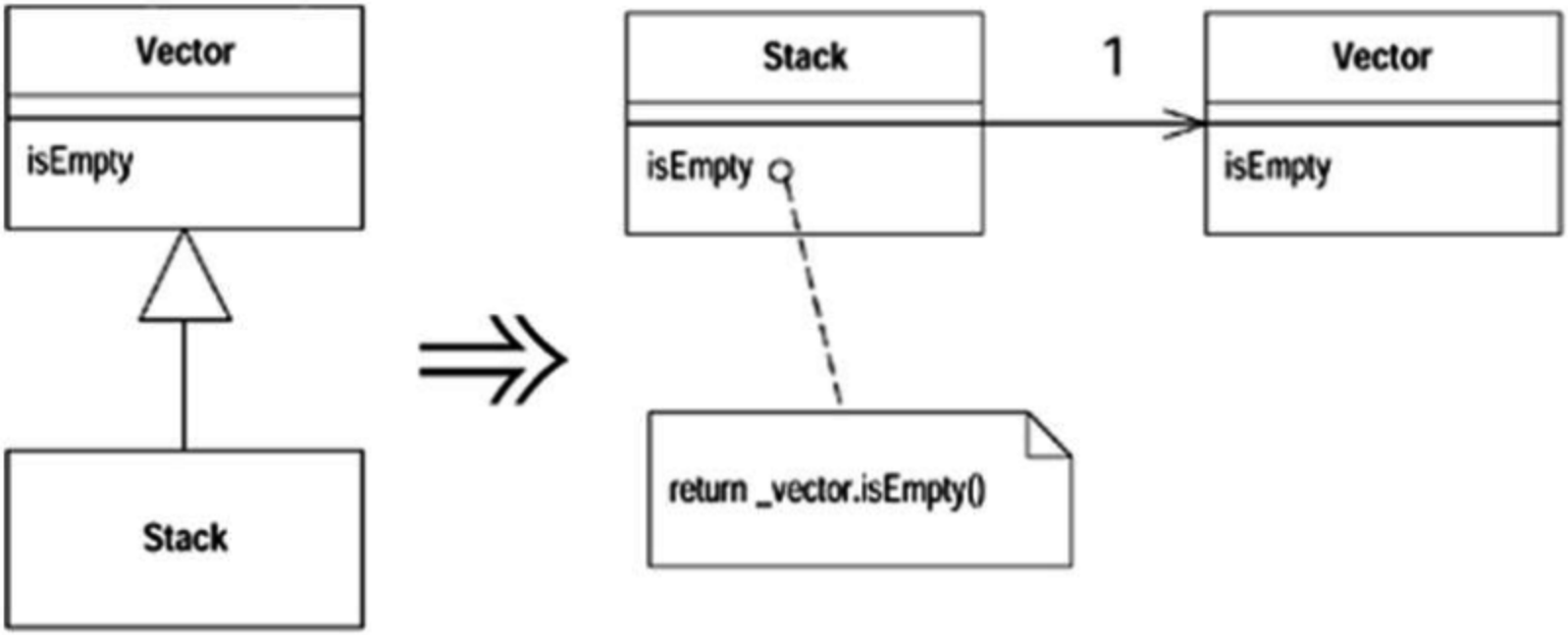
In this case I use a simplified form of stack:

```
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.

Replace Inheritance with Delegation

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



Example (continued)

1. create 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;
```

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

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

3. compile and test, and everything will still work.

Example (continued)

4. Now pop:

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

Example (continued)

5. Once completed the subclass methods, break the link to the superclass:

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

6. Add simple delegating methods for superclass methods used by clients:

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

7. Compile and test. If a delegating method was forgot to add, the compilation will tell.

Mechanics

Create a field in the subclass that refers to an instance of the superclass. Initialize it to this.

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.*

Remove the subclass declaration and replace the delegate assignment with an assignment to a new object.

For each superclass method used by a client, add a simple delegating method.

Compile and test.

Delegation (When not to use inheritance)

Inheritance is a common way of extending and reusing the functionality of a class.

- Inheritance is useful for capturing is-a-kind-of relationships which are rather static in nature.

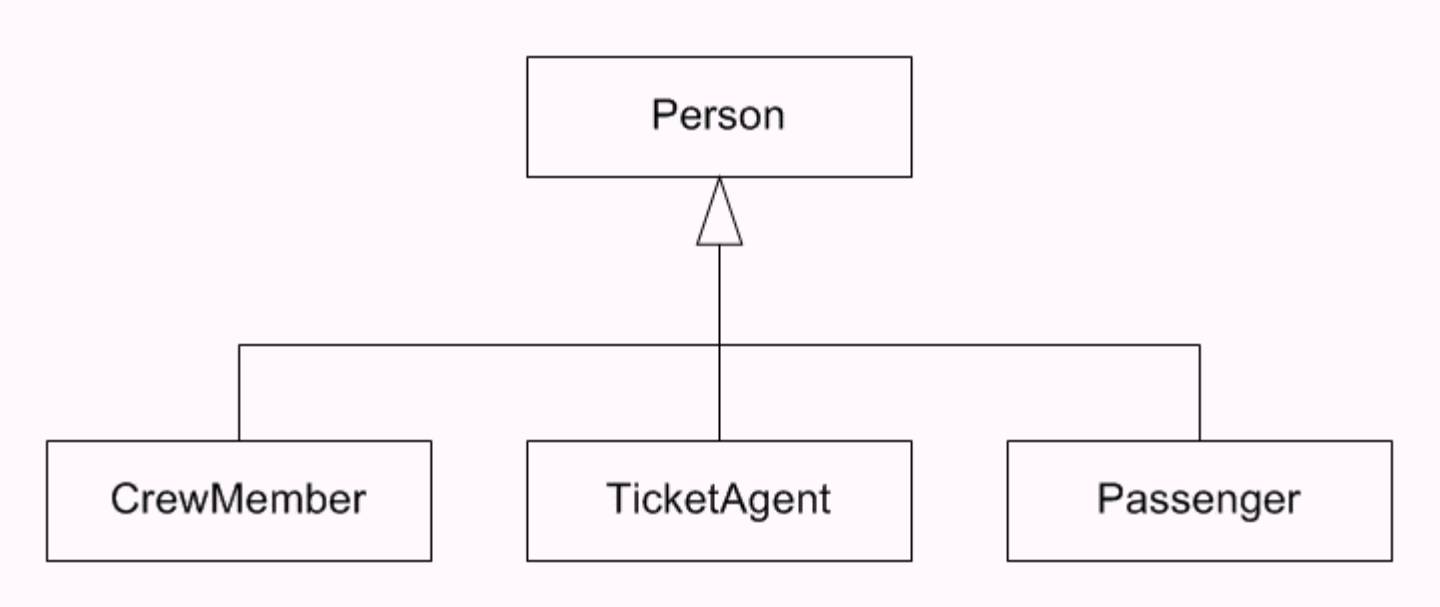
However, inheritance is inappropriate for many situations:

- is-a-role-played-by relationships are awkward to model by inheritance, where delegation could be a better choice.

Inheritance vs delegation: changing roles

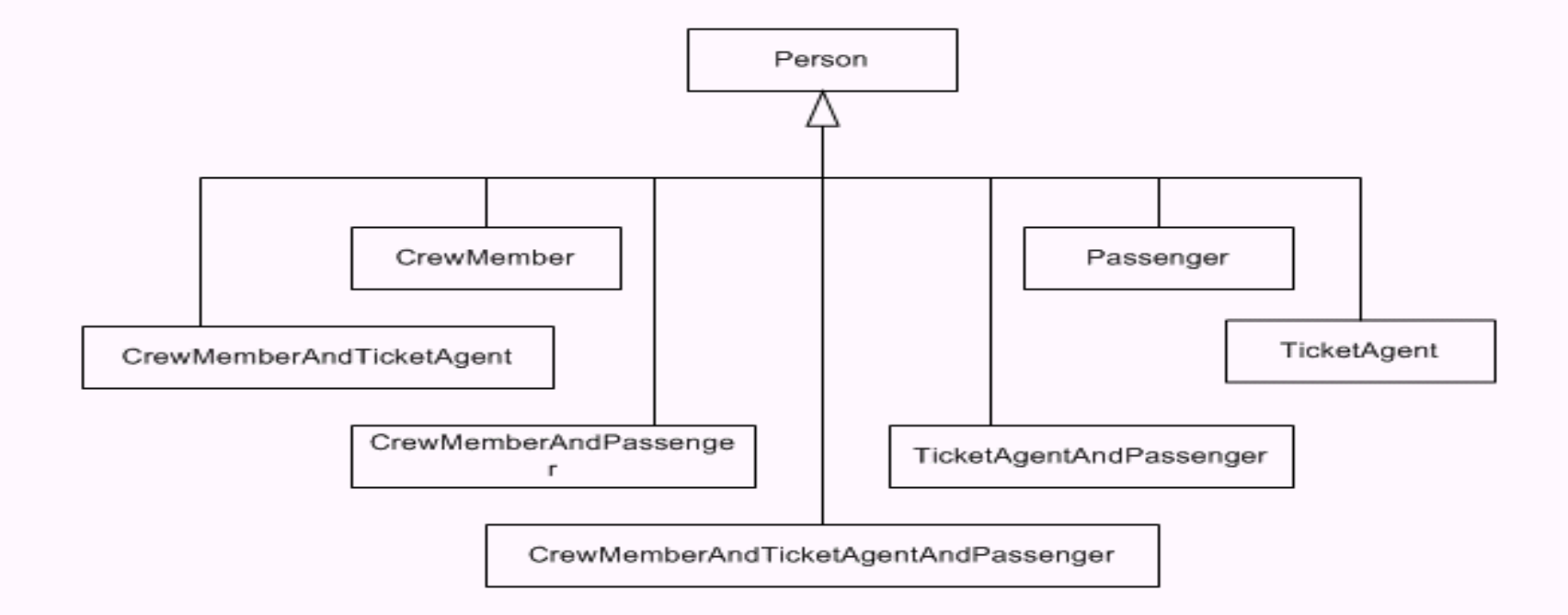
Don't use inheritance where roles interchange.

- 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.



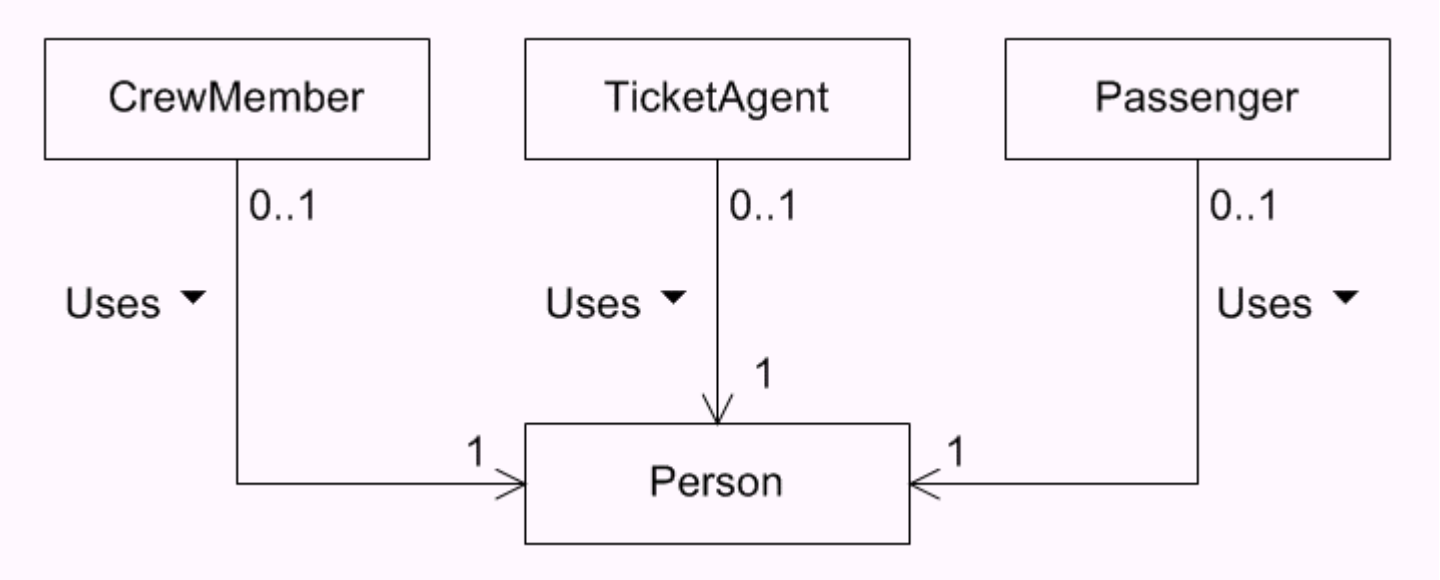
Example (cont'd)

- 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.

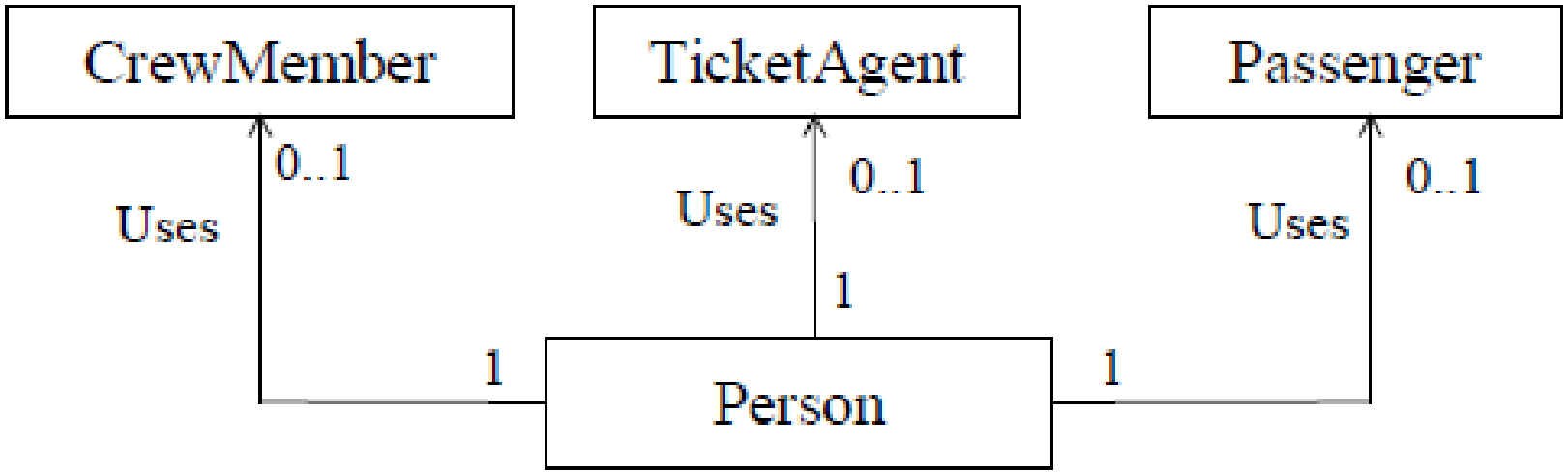


Example (cont'd)

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



Example (cont'd)



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, State or Strategy Design Patterns.

If the object need to be of the same type, then use Inheritance or implement interfaces

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 since sun may later declare methods 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.

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.