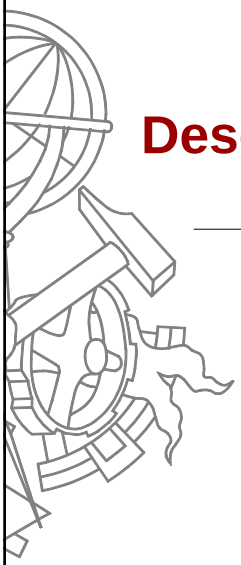

Ambientes de Desenvolvimento Avançados

http://www.dei.isep.ipp.pt/~jtavares/ADAV/ADAV.htm

Aula 13

Engenharia Informática

2006/2007

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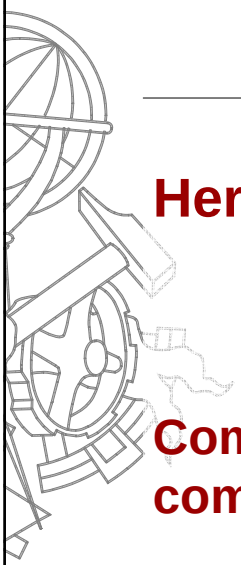


Herança *versus* Composição

Como implementar a composição

Formas de Herança

- Three facets of inheritance
  - ***Implementation inheritance***
    (sub-classing) sharing of implementation fragments
  - ***Interface inheritance***
    (sub-typing) sharing of contract fragments
  - ***Substitutivity***
    Promise of substitutability
- How to avoid inheritance ?

Problema da classe base frágil

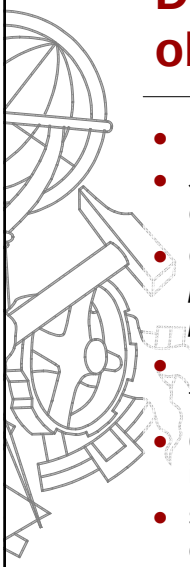
- can super-class (base class) evolve without breaking subclasses?
- eg old applications with new revision of OS
- two issues: *syntactic* and *semantic* fragile base class problem

Problema da classe base frágil

- Semantic
  - How can a subclass remain valid in the presence of different version of its super-classes ?
    - Parameters
    - Methods name
    - Return type

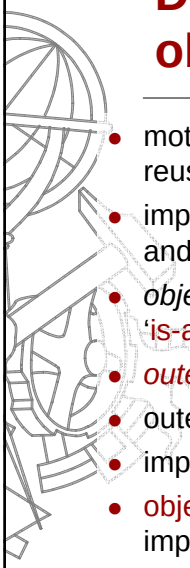
Contracts | Versions | Re-entrance

Das classes à composição de objectos



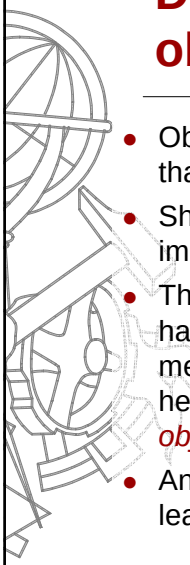
Das classes à composição de objectos

- Kiczales and Lamping, 1992
- *specialization interface* is the special interface between class and subclass
- eg in Java, client interface (outside package) includes only *public* features; specialization interface includes also *protected* features
- restricts access to interfaces, but doesn't restrict usage by those with access
- distinction between client and descendent interfaces important for controlling implementation inheritance
- sub-class needs to know something about implementation of class



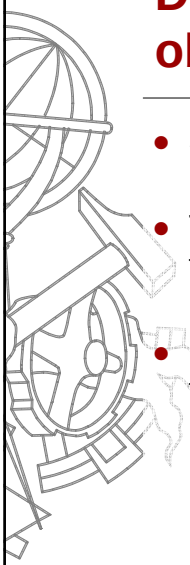
Das classes à composição de objectos

- motivation for *implementation inheritance* is flexible code reuse
- improving super-class improves sub-classes? re-entrance and up-calls make this difficult
- *object composition* a simpler alternative ('has-a' instead of 'is-a')
- *outer object* has the only reference to *inner object*
- outer object *forwards* messages to inner object
- improving inner object improves outer object
- object composition and forwarding a close approximation to implementation inheritance, without some of the problems



Das classes à composição de objectos

- Object composition is a much simpler form of composition than implementation inheritance;
- Shares several of the often quoted advantages of implementation inheritance;
- The idea is very simple – whenever an object does not have the means to perform some task locally, it can send messages to other objects, asking for support, and if the helping object is a part of the helped object, this is called *object composition*;
- An object is part of another one if references to it do note leave that object.



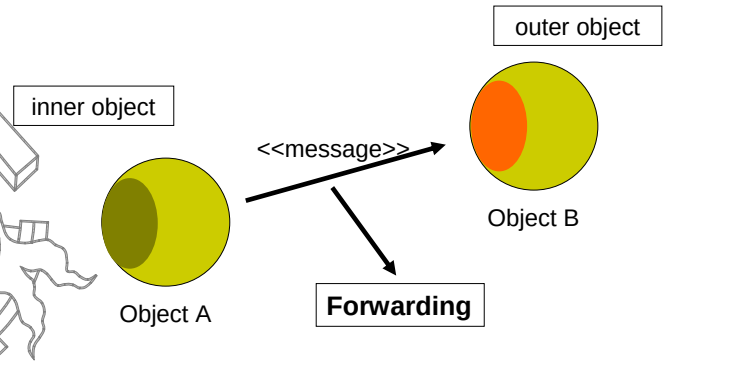
Das classes à composição de objectos

- Sending a message on from one object to another is called **forwarding (*re-encaminhamento*)**;
- The combination of object composition and forwarding comes fairly close to what is achieved by implementation inheritance;
- However, it does not get so close that it also has the disadvantages of implementation inheritance.

Das classes à composição de objectos

- An outer object does not re-implement the functionality of the inner object when it forwards messages;
- It reuses the implementation of the inner object;
- If the implementation of the inner object is changed, then this change will “spread” to the outer object;
- The difference between object composition with forwarding and implementation inheritance is called “implicit self-recursion” or “possession of a common self”

Das classes à composição de objectos



Difference between **Inheritance** and **Forwarding**?

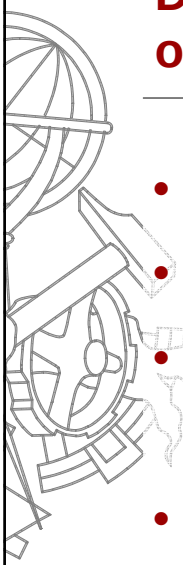
Delegation?

Das classes à composição de objectos

Possession of a common self

- instance of sub-class shares identity with that of its super-class;
- control can return from a super-class back to a sub-class – invocation of the last overriding version of the method;
- composition of objects has no single identity;
- once control passed from outer to inner object, outer object cannot interfere.

Das classes à composição de objectos



Delegation

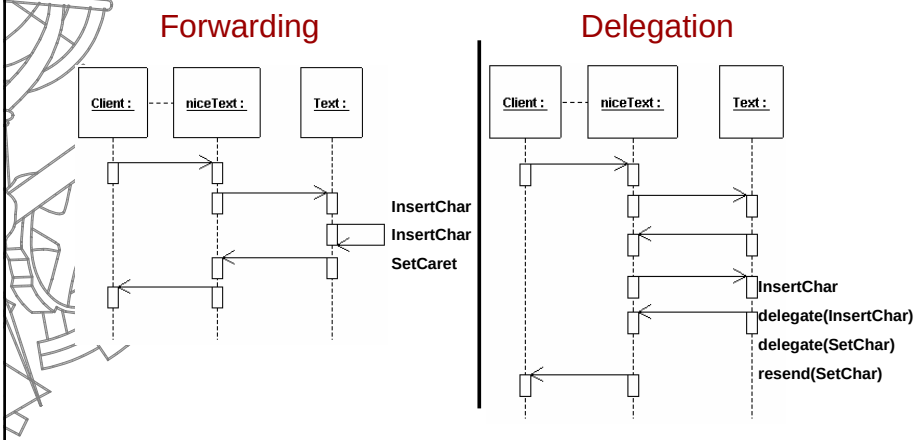
- Composition + forwarding lacks the notion of a common “self;
- If a common identity is required, it has to be designed in;
- If an object was not designed for composition under a common identity, it cannot be used in such context – mechanisms build in to resend messages to an outer object;
- Object composition supports dynamic and late composition.

Das classes à composição de objectos

Delegation (*cont*)

- The concept of message passing by delegation is relatively simple;
- Each message-send is classified either as regular send (forwarding) or self-recursive one (delegation)
- Whenever a message is delegated (instead of forwarded), the identity of the first delegator in the current message is remembered;
- Any subsequently delegated message is dispatched back to the original delegator.

Re-encaminhamento x Delegação



Re-encaminhamento x Delegação

Resumo

- Forwarding
  - Regular Message
- Delegation
  - Self-recursive one
  - Strengthened
  - Identity is remembered
- What the difference between Forwarding and Delegation?

Delegação x Herança

Gamma et al. (1995)

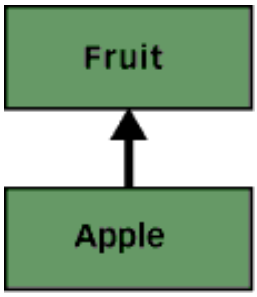
"Delegation has a disadvantage that it shares with other techniques that make software more flexible through object composition: dynamic, highly parameterized software is harder to understand than more static software. [...] Delegation is a good design choice only when it simplifies more than it complicates. [...] Delegation works best when it is used in highly stylized ways – that is, in standard patterns."

Das classes à composição de objectos

Exemplo : Herança

```
class Fruit
{
    //...
}

class Apple extends Fruit
{
    //...
}
```

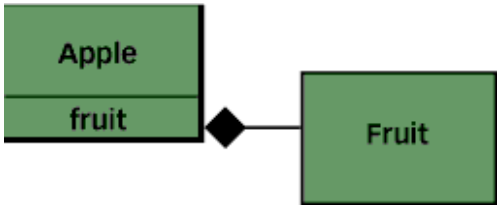


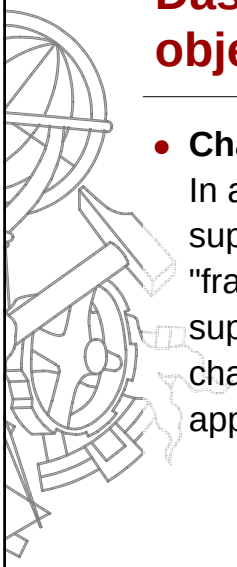
Das classes à composição de objectos

Exemplo : Composição

```
class Fruit
{
    //...
}

class Apple
{
    private Fruit fruit = new Fruit();
    //...
}
```





Das classes à composição de objectos

- **Changing the super-class interface**
  In an inheritance relationship, super-classes are often said to be "fragile," because one little change to a super-class can ripple out and require changes in many other places in the application's code.

Das classes à composição de objectos

- **The composition alternative**
  - Given that the inheritance relationship makes it hard to change the interface of a super-class, it is worth looking at an alternative approach provided by composition.
  - It turns out that when your goal is code reuse, composition provides an approach that yields easier-to-change code.

Das classes à composição de objectos

```
class Fruit {
   // Return int number of pieces of peel that
   // resulted from the peeling activity.
   public int peel() {
       System.out.println("Peeling is appealing.");
       return 1;
   }
}

class Apple extends Fruit {
}

class Example1 {
   public static void main(String[] args) {
       Apple apple = new Apple();
       int pieces = apple.peel();
   }
}
```


Das classes à composição de objectos

Change the return value of `peel()` to type `Peel`, will break the code for `Example1`

```
class Peel {
   private int peelCount;
   public Peel(int peelCount) {
       this.peelCount = peelCount;
   }
   public int getPeelCount() {
       return peelCount;
   }
   //...
}
```

Das classes à composição de objectos

```
class Fruit {
   // Return a Peel object that
   // results from the peeling activity.
   public Peel peel() {
        System.out.println("Peeling is appealing.");
        return new Peel(1);
   }
}
// Apple still compiles and works fine
class Apple extends Fruit {
}
// This old implementation of Example1
// is broken and won't compile.
class Example1 {
   public static void main(String[] args) {
        Apple apple = new Apple();
        int pieces = apple.peel();
   }
}
```


Das classes à composição de objectos

- **Code reuse via composition**
  - Composition provides an alternative way for `Apple` to reuse `Fruit`'s implementation of `peel()`.
  - Instead of extending `Fruit`, `Apple` can hold a reference to a `Fruit` instance and define its own `peel()` method that simply invokes `peel()` on the `Fruit`.

Das classes à composição de objectos

```
class Fruit {
   // Return int number of pieces of peel that
   // resulted from the peeling activity.
   public int peel() {
        System.out.println("Peeling is appealing.");
        return 1;
   }
}

class Apple {
   private Fruit fruit = new Fruit();
   public int peel() {
        return fruit.peel();
   }
}

class Example1 {
   public static void main(String[] args) {
        Apple apple = new Apple();
        int pieces = apple.peel();
   }
}
```

Original

Das classes à composição de objectos

Change the return value of `peel()` to type `Peel`, will break the code for `Example1`

```
class Peel {
   private int peelCount;
   public Peel(int peelCount) {
        this.peelCount = peelCount;
   }
   public int getPeelCount() {
        return peelCount;
   }
   //...
}
```

Das classes à composição de objectos

```
class Fruit {
  // Return int number of pieces of peel that resulted from the peeling activity.
  public Peel peel() {
     System.out.println("Peeling is appealing.");
     return new Peel(1);
  }
}
// Apple must be changed to accommodate the change to Fruit
class Apple {
  private Fruit fruit = new Fruit();
  public int peel() {
     Peel peel = fruit.peel();
     return peel.getPeelCount();
  }
}
// This old implementation of Example2 - still works fine.
class Example1 {
  public static void main(String[] args) {
     Apple apple = new Apple();
     int pieces = apple.peel();
  }
}
```

Alterado

Das classes à composição de objectos

- The composition approach to code reuse provides stronger encapsulation than inheritance, because a change to a back-end class needn't break any code that relies only on the front-end class.
- For example, changing the return type of `Fruit`'s `peel()` method from the previous example doesn't force a change in `Apple`'s interface and therefore needn't break `Example2`'s code.

Das classes à composição de objectos

Possession of a common self

- instance of sub-class shares identity with that of its super-class;
- control can return from a super-class back to a sub-class – invocation of the last overriding version of the method;
- composition of objects has no single identity;
- once control passed from outer to inner object, outer object cannot interfere.

Das classes à composição de objectos

- **Delegation**
  - Although object composition is very useful, one may question whether it is as powerful for reuse as inheritance.
  - Specifically, using inheritance, an inherited method can always refer to the receiving object using the `this` member variable in C++ or C#.
  - In delegation, the receiving object delegates operations to a delegate (one of the objects it is composed of).
  - The same effect (as `this`) is achieved by having the receiving object pass a reference to itself to the delegate.
  - Using delegation, a method can always refer to the original recipient of the message, regardless of the number of indirections due to object composition.
  - Delegation allows object composition to be as powerful for reuse as inheritance. Several design patterns make use of this strategy.

Das classes à composição de objectos

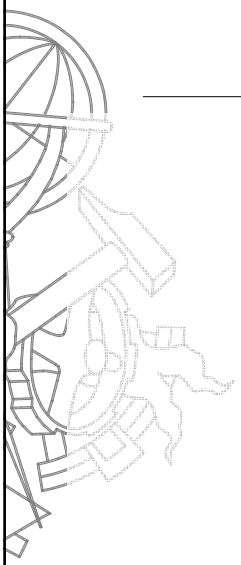
```
class Fruit {
    Object outer = null;
    Fruit(Object o) {
        outer = o;
    }
    public int peel() {
        outer.method();
        System.out.println("Peeling is appealing.");
        return 1;
    }
}

class Apple {
    private Fruit fruit = new Fruit(this);
    public int peel() {
        return fruit.peel();
    }
    public void method() { ... }
}
```


Re-encaminhamento x Delegação

Resumo

- Forwarding
  - Regular Message
- Delegation
  - Self-recursive one
  - Strengthened
  - Identity is remembered
- What the difference between Forwarding and Delegation?



Questões

?