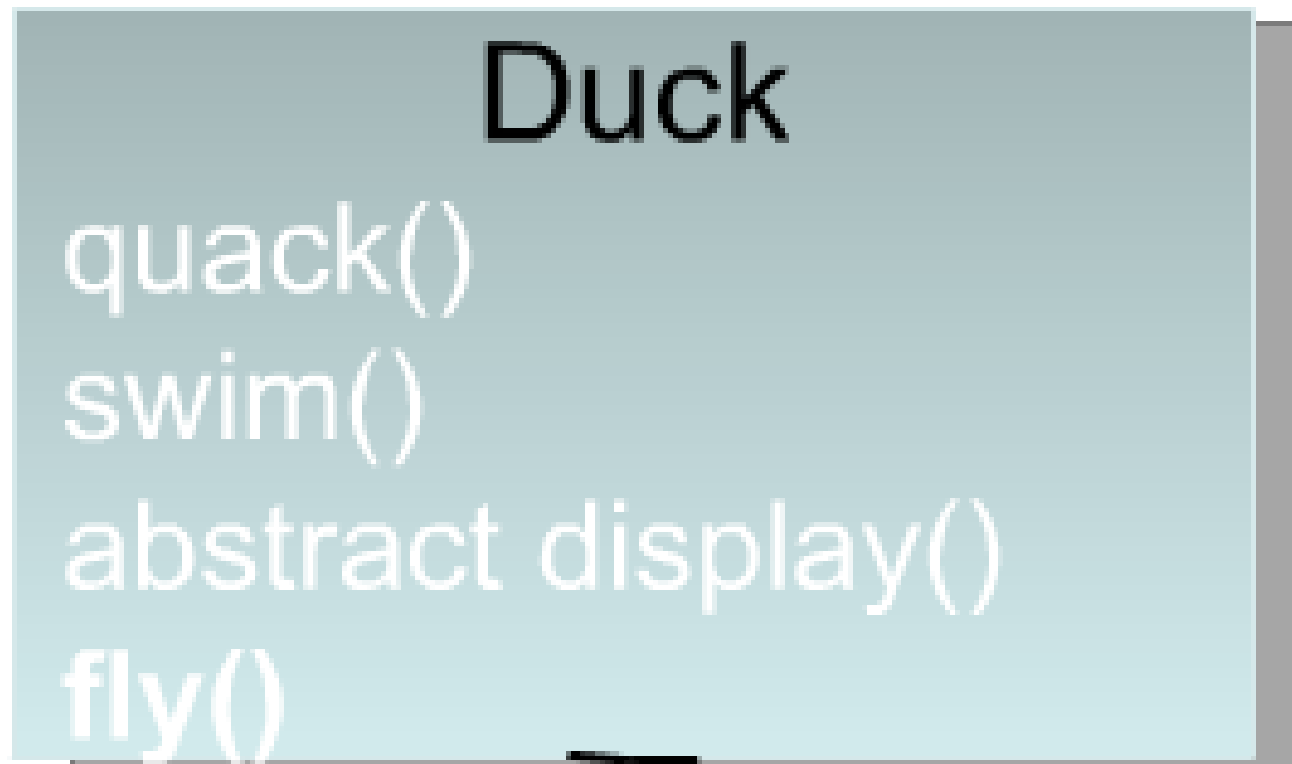


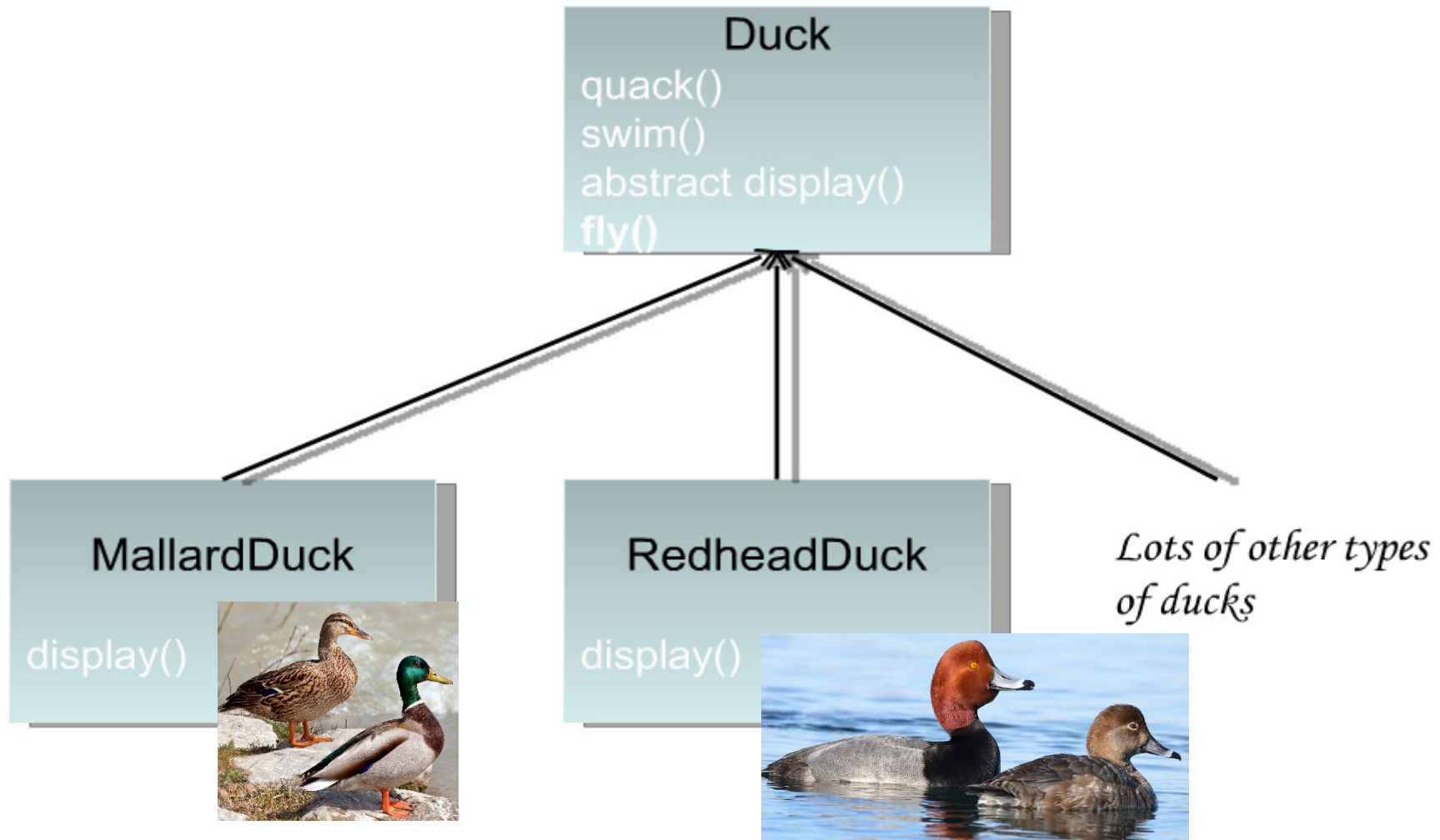
Tecniche di Progettazione: Design Patterns

GoF: Strategy

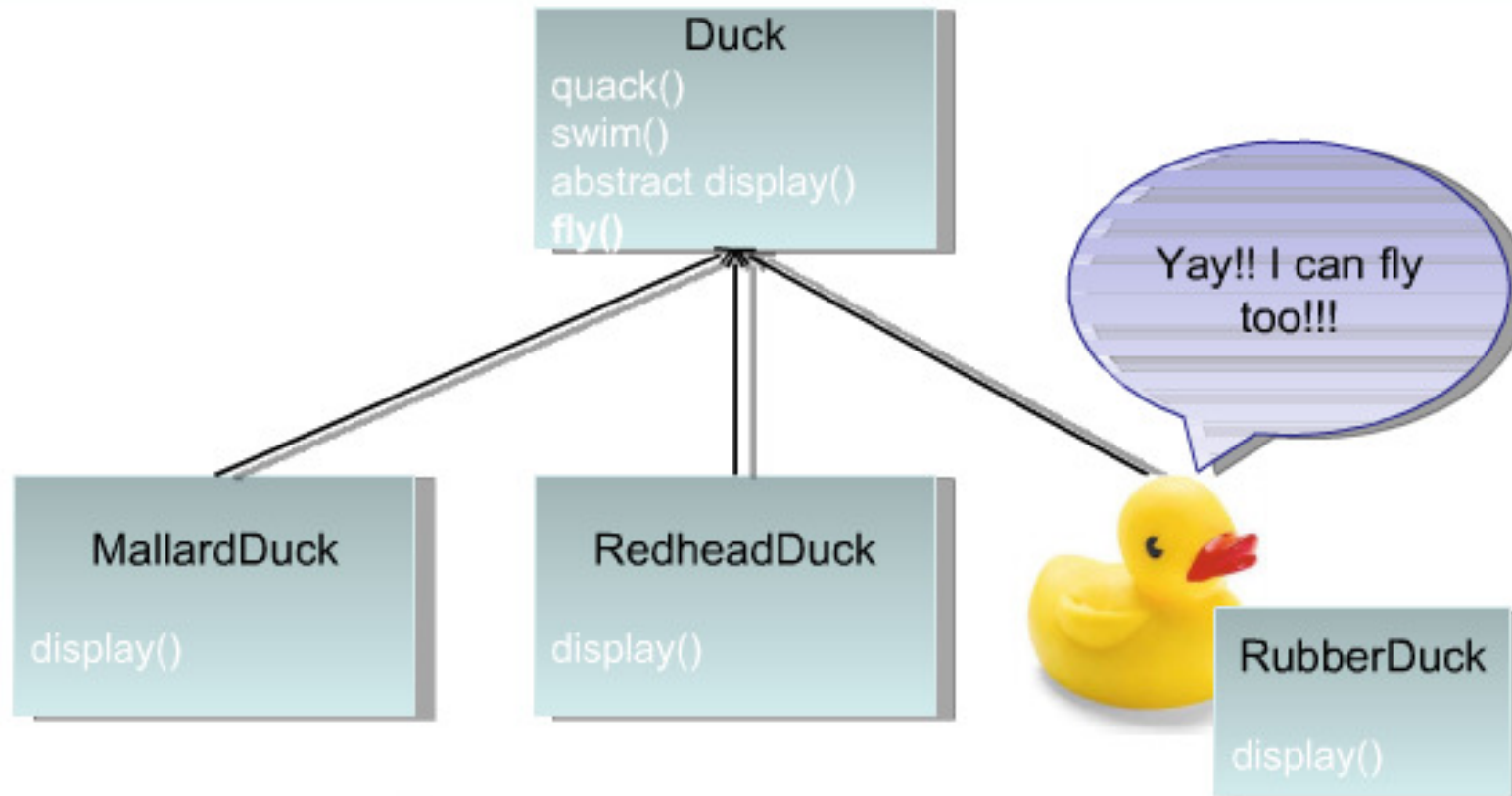
Strategy pattern: the duck



Strategy pattern: the duck



The rubber duck



First solution

- ▶ Override fly()
- ▶ Class Rubberduck{

```
    fly() {  
        \\ do nothing  
    }  
    quack(){  
        \\ override to squeak  
    }  
}
```
- ▶ **PROBLEM:** subclassing when only part of the behaviour is inherited
 - ▶ All time a new duck is added, the designer has to check if methods fly and quack have to be overridden

Second solution


<<Interfaces>> !!!

Yes!!! That's it! I make an IFlyable interface and RubberDuck doesn't get to implement it...

```
MallardDuck
<<IFlyable>>
display()
```

```
RedheadDuck
<<IFlyable>>
display()
```

```
RubberDuck
//You can't fly!
display()
```



They can't see me happy 😞

I... I... I...

I have a Question!

SimCorp simulates 50 ducks... are you saying you are going to write 50 fly methods? What if there is a change in flying style and it effects 20 ducks... will all 20 ducks change?

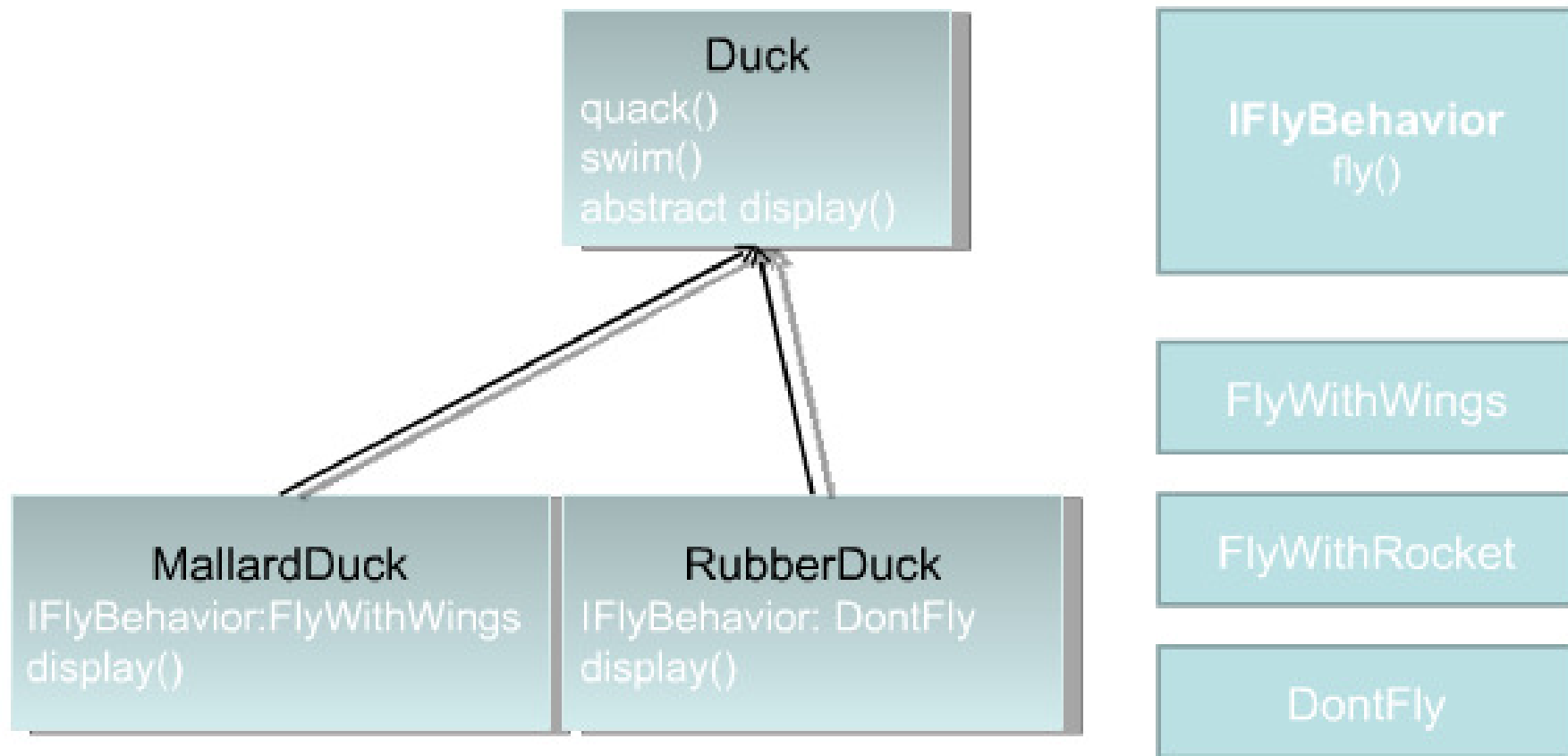
I am losing money you know...



I thought she was non-technical...

- Well here is my situation
- I can't put the fly() method in the base class
- If I use interface, I can't reuse code
- Alright, so this calls for a dependency split
- Flying is a behavior and should be separate from the Duck object
- Flying behaviors could be reused on different objects
- Different ducks could fly in different ways

Strategy



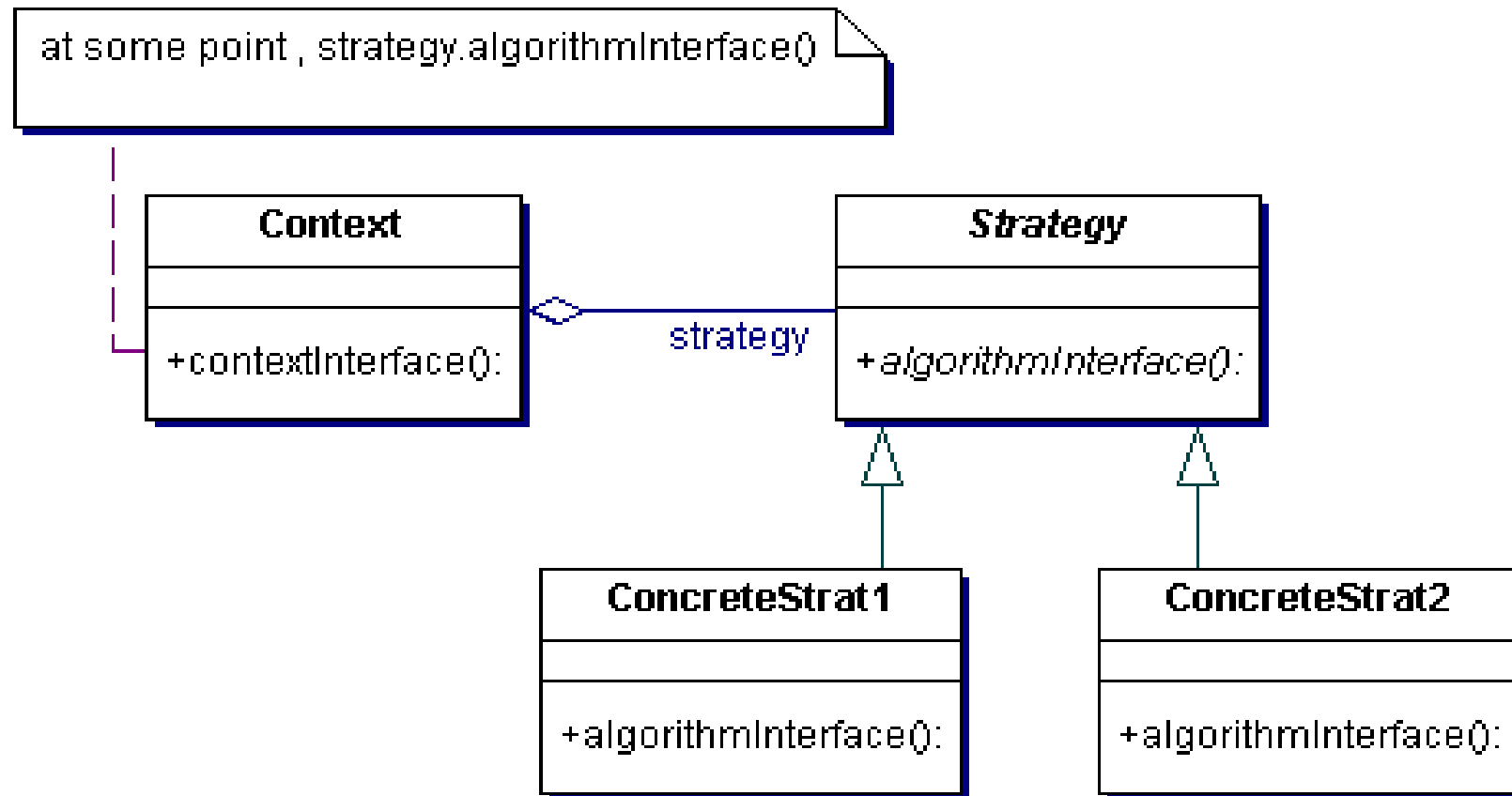
Recall some OO design principles

- ▶ “Identify what vary and encapsulate them, so that later you can alter or extend the parts that vary without affecting those that don’t”;
- ▶ “Program to an interface, not an implementation”;
- ▶ “Favor composition over inheritance”.

Strategy

- ▶ Define a family of algorithms, encapsulate each one, and make them interchangeable. Strategy lets the algorithm vary independently from clients that use it.
- ▶ A program may have to supply several variations of an algorithm or of a behaviour.
- ▶ Solution:
 - ▶ These variations are encapsulated in separate classes
 - ▶ There is a uniform access to them

Strategy: structure



Strategy: participants

- ▶ **Strategy**

- ▶ Defines an interface common to all supported algorithms

- ▶ **ConcreteStrategy**

- ▶ Each concrete strategy implements an algorithm

- ▶ **Context**

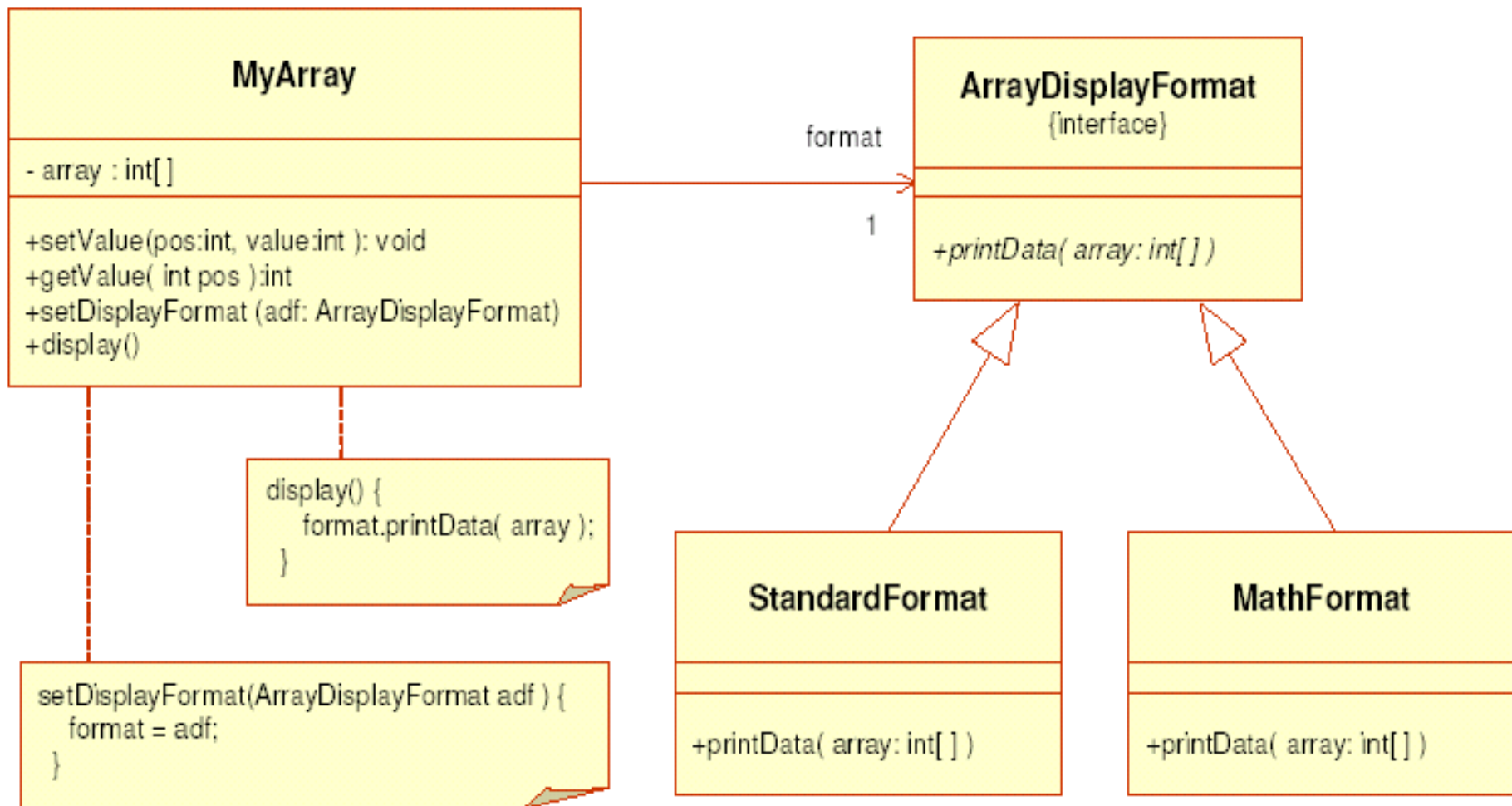
- ▶ Contains a reference to a strategy object (with type Strategy)
- ▶ May define an interface that lets strategy accessing its data. (Instead of passing them as arguments)

Example

- ▶ The MyArray class represents vectors of numbers
- ▶ One of its methods print the array, in two formats:
 - ▶ MathFormat (es. {12, -7, 3, ...})
 - ▶ StandardFormat (es. ar[0]_12, ar[1]_-7, ar[2]_3, ...)
- ▶ In the future these formats may be substituted by different ones....

- ▶ Problem:
 - ▶ How to isolate the algorithm used to format the array contents, so that it can vary independently of the other methods of the class?

Solution



Context

```
public class MyArray {  
    private int[] array;  
    private int size;  
    ArrayDisplayFormat format;  
  
    public MyArray( int size ) {  
        array = new int[ size ];  
    }  
  
    public void setValue( int pos, int value ) {  
        array[pos] = value;  
    }  
  
    public int getValue( int pos ) {  
        return array[pos];  
    }  
  
    public int getLength( int pos ) {  
        return array.length;  
    }  
  
    public void setDisplayFormat( ArrayDisplayFormat adf ) {  
        format = adf;  
    }  
  
    public void display() {  
        format.printData( array );  
    }  
}
```


The interface (strategy)

```
public interface ArrayDisplayFormat {  
    public void printData( int[] arr );  
  
}
```

First concrete strategy

```
public class StandardFormat implements ArrayDisplayFormat {  
  
    public void printData( int[] arr ) {  
        System.out.print( "{ " );  
        for(int i=0; i < arr.length-1 ; i++ )  
            System.out.print( arr[i] + ", " );  
        System.out.println( arr[arr.length-1] + " }" );  
  
    }  
}
```

Second concrete strategy

```
public class MathFormat implements ArrayDisplayFormat {  
  
    public void printData( int[] arr ) {  
        for(int i=0; i < arr.length ; i++ )  
            System.out.println( "Arr[ " + i + " ] = " + arr[i] );  
    }  
}
```

The client

```
public class StrategyExample {  
  
    public static void main (String[] arg) {  
  
        MyArray m = new MyArray( 10 );  
        m.setValue( 1 , 6 );  
        m.setValue( 0 , 8 );  
        m.setValue( 4 , 1 );  
        m.setValue( 9 , 7 );  
        System.out.println("This is the array in 'standard' format");  
        m.setDisplayFormat( new StandardFormat() );  
        m.display();  
        System.out.println("This is the array in 'math' format:");  
        m.setDisplayFormat( new MathFormat() );  
        m.display();  
    }  
}
```

- ▶ È il cliente che crea e passa un oggetto ConcreteStrategy al Context
- ▶ Da quel momento interagisce solo con Context

The result

```
C: \Design Patterns\Behavioral\Strategy>java StrategyExample
```

```
This is the array in 'standard' format :
```

```
{ 8, 6, 0, 0, 1, 0, 0, 0, 0, 7 }
```

```
This is the array in 'math' format:
```

```
Arr[ 0 ] = 8
```

```
Arr[ 1 ] = 6
```

```
Arr[ 2 ] = 0
```

```
Arr[ 3 ] = 0
```

```
Arr[ 4 ] = 1
```

```
Arr[ 5 ] = 0
```

```
Arr[ 6 ] = 0
```

```
Arr[ 7 ] = 0
```

```
Arr[ 8 ] = 0
```

```
Arr[ 9 ] = 7
```

Applicability

- ▶ **Use the Strategy pattern whenever:**
 - ▶ Many related classes differ only in their behavior
 - ▶ You need different variants of an algorithm
 - ▶ An algorithm uses data that clients shouldn't know about. Use the Strategy pattern to avoid exposing complex, algorithm-specific data structures.
 - ▶ A class defines many behaviors, and these appear as multiple conditional statements in its operations. Instead of many conditionals, move related conditional branches into their own Strategy class.

Discussion

▶ **Benefits**

- ▶ Provides an alternative to subclassing the Context class to get a variety of algorithms or behaviors
- ▶ Eliminates large conditional statements
- ▶ Provides a choice of implementations for the same behavior

▶ **Liabilities**

- ▶ Increases the number of objects
- ▶ All algorithms must use the same Strategy interface

Discussion (cont'd)

- ▶ Different ConcreteStrategy may need different data.
- ▶ Most probably some ConcreteStrategy will not use all the data passed through the generic interface
 - ▶ Hence: the context create and initializes parameters that will never be used by anybody
 - ▶ When this is a problem: stronger coupling between ConcreteStrategy and Context (the former accessing the latter)

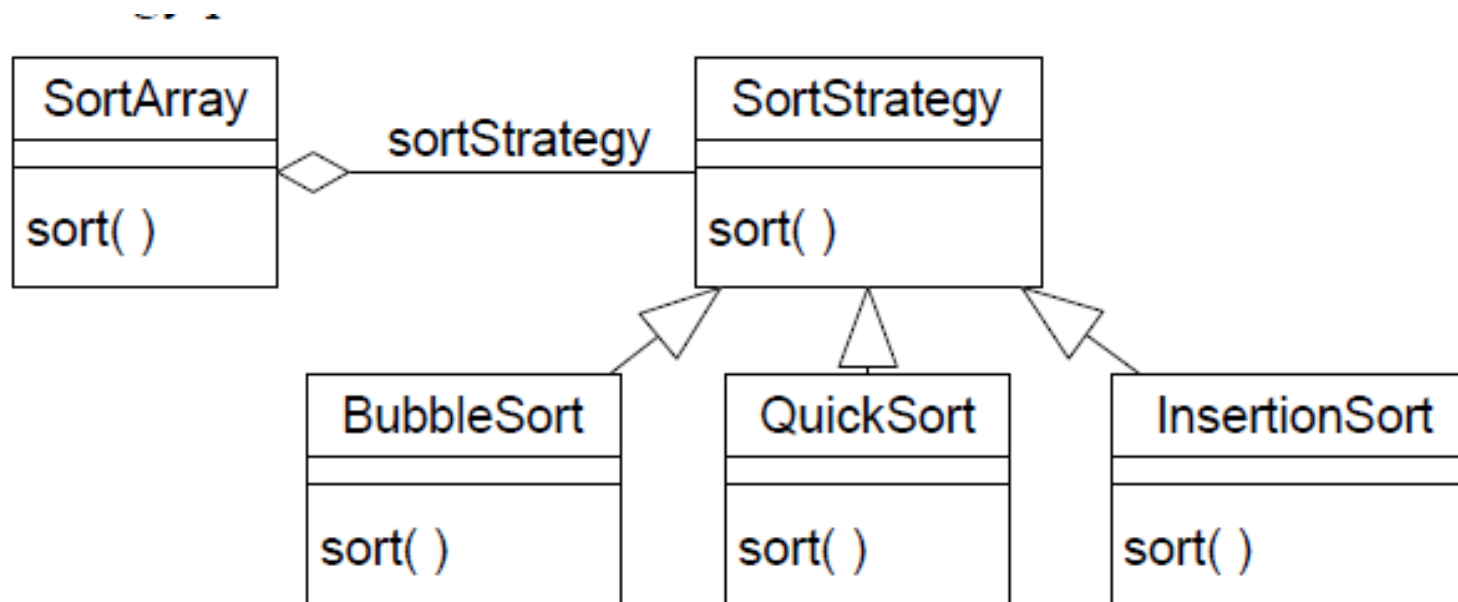
Strategy Pattern Example: SORT

- ▶ **Problem:**

- ▶ A class wants to decide at run-time what algorithm it should use to sort an array. Many different sort algorithms are already available.

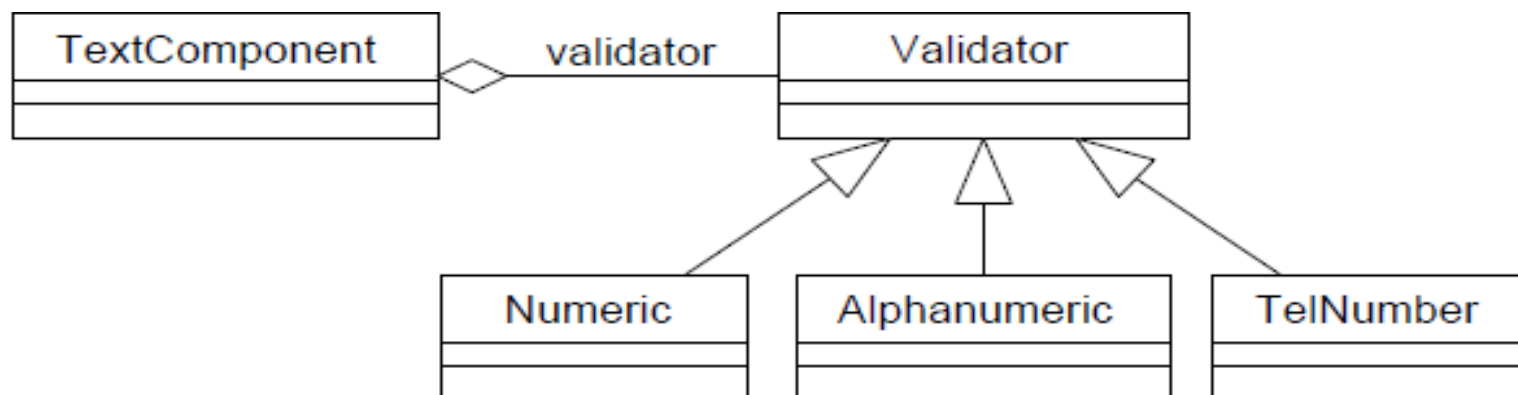
- ▶ **Solution**

- ▶ Encapsulate the different sort algorithms using the Strategy pattern



Strategy Pattern Example: GUI

- ▶ A GUI text component object wants to decide at runtime what strategy it should use to validate user input. Many different validation strategies are possible: numeric fields, alphanumeric fields, telephone-number fields, etc.
- ▶ Solution
 - ▶ Encapsulate the different input validation strategies using the Strategy pattern
- ▶ This is the technique used by the Java Swing GUI text components. Every text component has a reference to a document model which provides the required user input validation strategy.



Homework: design and code

- ▶ Fox Machine is a company that sells printers and gives discounts to clients.
- ▶ But there are many kinds of discount calculation methods such as: 5% off, reduce a fixed amount, no discount at all, etc.
- ▶ Now Fox Machine asks you to develop a sales management system, they want you to design a schema to calculate the discount when selling printers. Your design should be capable of selecting the discount calculation methods flexibly (even selling the same kind of printer).
- ▶ Furthermore, when they need new discount calculation methods or want to modify old methods, it should be very easy and will not affect the existing system.

