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Introduction to Software Engineering

The Strategy Design Pattern

For details see Gamma et al. in “Design Patterns”

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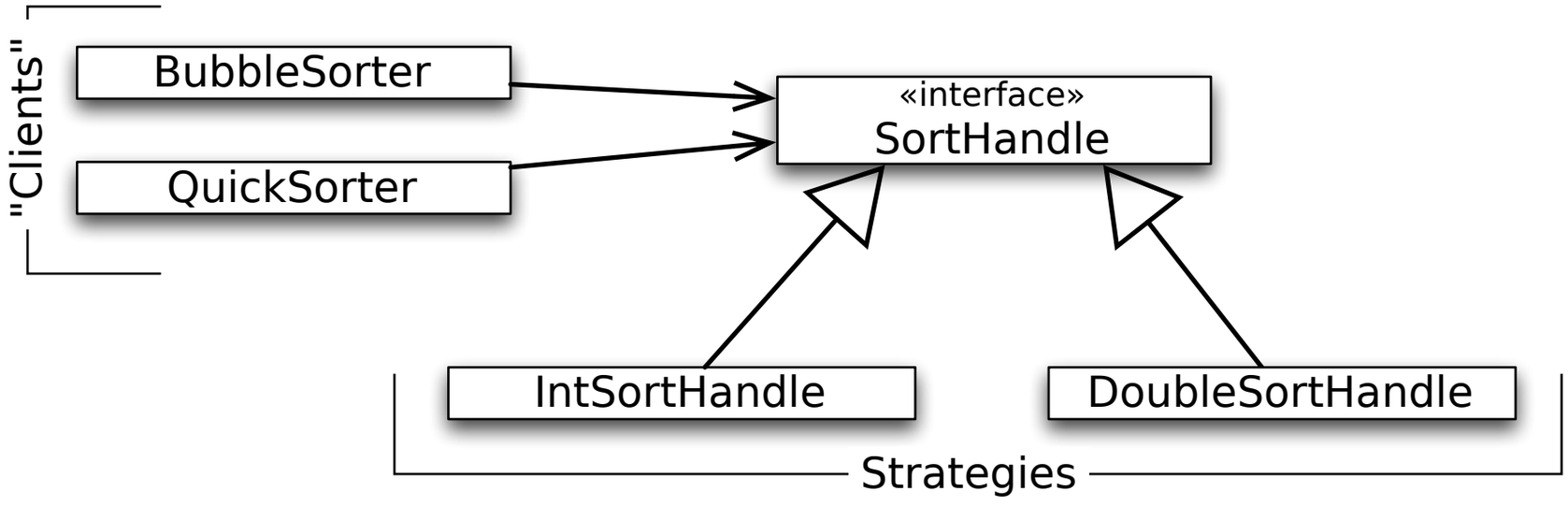
The Strategy Design Pattern
Using Strategy

- ...many related classes differ only in their behavior rather than implementing different related abstractions
  Strategies allow to configure a class with one of many behaviors.
- ...you need different variants of an algorithm
  Strategies can be used when variants of algorithms are implemented as a class hierarchy.
- ...a class defines many behaviors that appear as multiple conditional statements in its operations
  Move related conditional branches into a strategy.

The Strategy Design Pattern

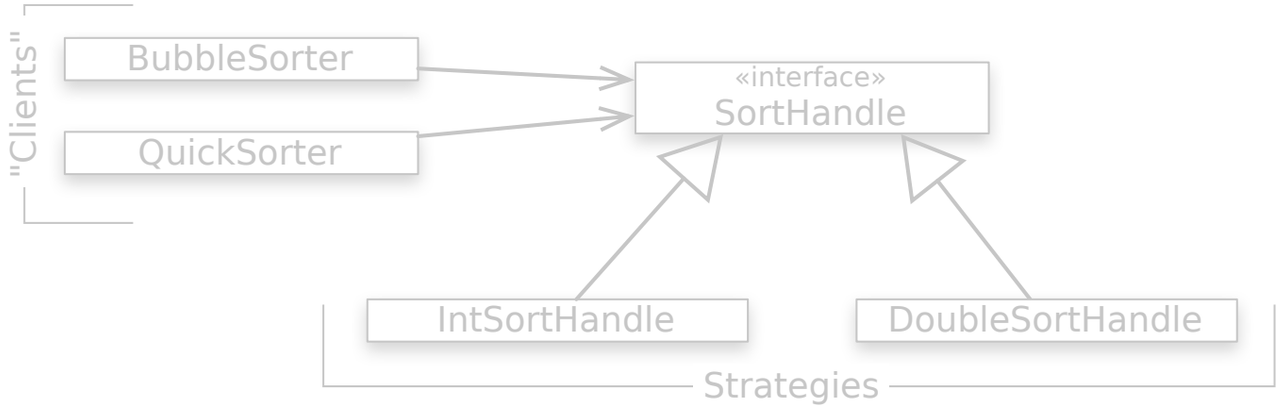
Intent & Example

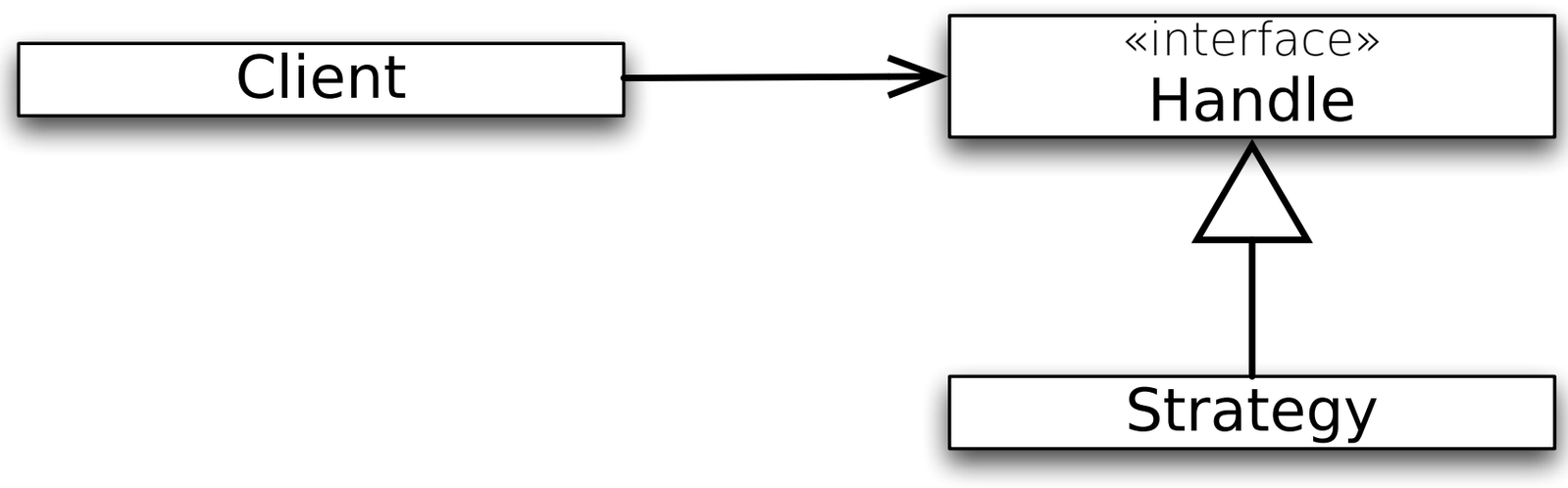
> Define a family of algorithms, encapsulate each one, and make them interchangeable. Strategy lets the algorithm vary independently from clients that use it.



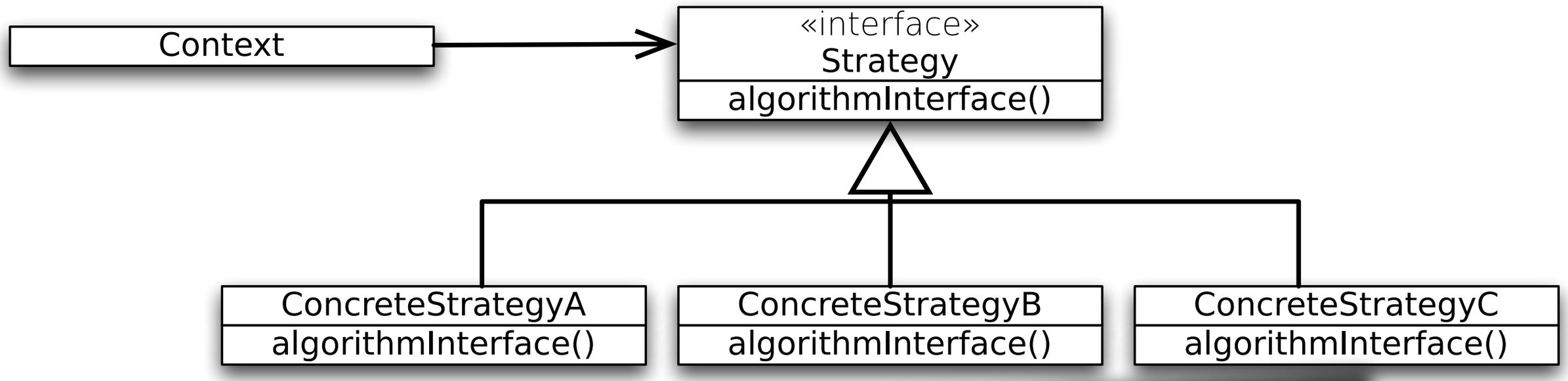
The Strategy Design Pattern
Excerpt of the Structure

> Define a family of algorithms, encapsulate each one, and make them interchangeable. Strategy lets the algorithm vary independently from clients that use it.





The Strategy Design Pattern
General Structure



Define a family of algorithms, encapsulate each one, and make them interchangeable.

The Strategy Design Pattern
Strategy - An Alternative to Subclassing

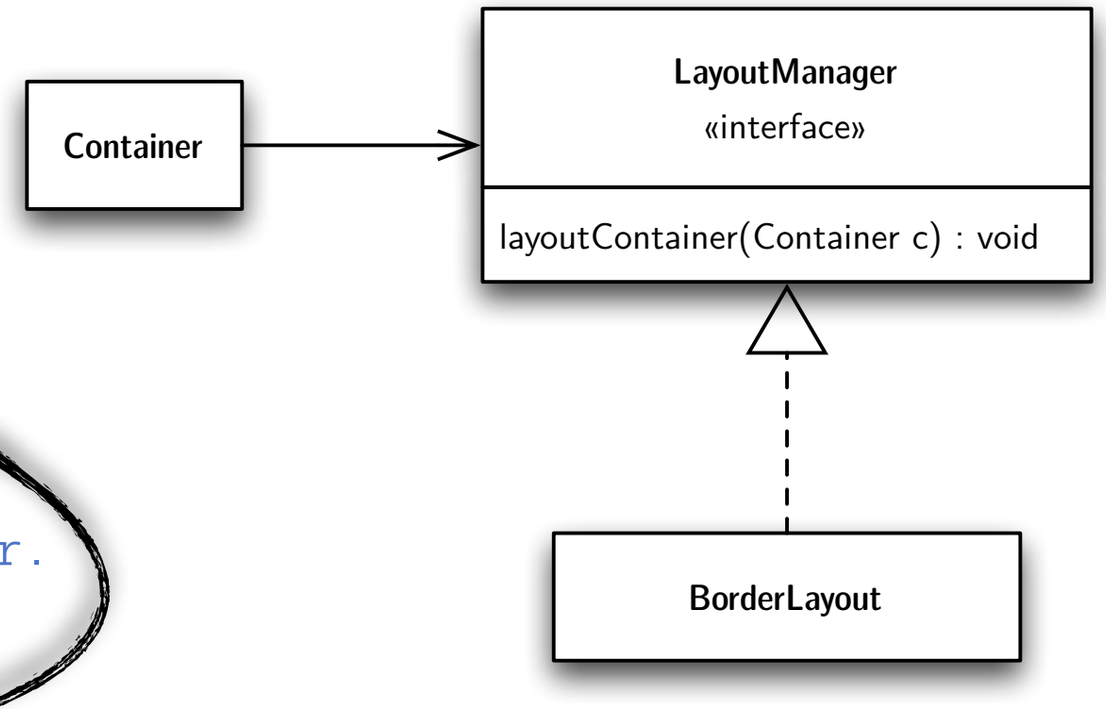
- Subclassing `Context` mixes algorithm's implementation with that of `Context`
  Context harder to understand, maintain, extend.
- When using subclassing we can't vary the algorithm dynamically
- Subclassing results in many related classes
  Only differ in the algorithm or behavior they employ.
- Encapsulating the algorithm in Strategy...
  - lets you vary the algorithm independently of its context
  - makes it easier to switch, understand, and extend the algorithm

If you would use subclassing instead of the Strategy Design Pattern.

Example - “The Strategy Pattern” in Java AWT/Swing

Client Code

```
java.awt.Container c = ...;
c.setLayout(new java.awt.BorderLayout())
```




```
public class Container extends Component {
    ...
     /**
      * Sets the layout manager for this container.
      * @param mgr the specified layout manager
      */
    public void setLayout(LayoutManager mgr) {
        layoutMgr = mgr;
        invalidateIfValid();
    }

    /**
     * Causes this container to lay out its components. ...
     */
    public void doLayout() {
        LayoutManager layoutMgr = this.layoutMgr;
        if (layoutMgr != null) {
            layoutMgr.layoutContainer(this);
        }
    }
}
```

The Strategy Design Pattern
Things to Consider

- Clients must be aware of different strategies and how they differ, in order to select the appropriate one
- Clients might be exposed to implementation issues
- Use Strategy only when the behavior variation is relevant to clients

The Strategy Design Pattern
Things to Consider

- Optional Strategy objects
  - Context checks if it has a Strategy before accessing it...
    - If yes, Context uses it normally
    - If no, Context carries out default behavior
- Benefit: clients don't have to deal with Strategy objects unless they don't like the default behavior

The Strategy Design Pattern
Things to Consider

- Increased number of (strategy) objects
- Sometimes can be reduced by stateless strategies that Contexts can share
- Any state is maintained by Context, passes it in for each request to the Strategy object
  (No / less coupling between Strategy implementations and Context.)
- Shared strategies should not maintain state across invocations
  (→Services)

The Strategy Design Pattern
Implementation

Communication Overhead

- The Strategy interface is shared by all Concrete Strategy classes whether the algorithms they implement are trivial or complex
- Some ConcreteStrategies won't use all the information passed to them
  (Simple ConcreteStrategies may use none of it.)
  (Context creates/initializes parameters that never get used.)
  If this is an issue use a tighter coupling between Strategy and Context; let Strategy know about Context.

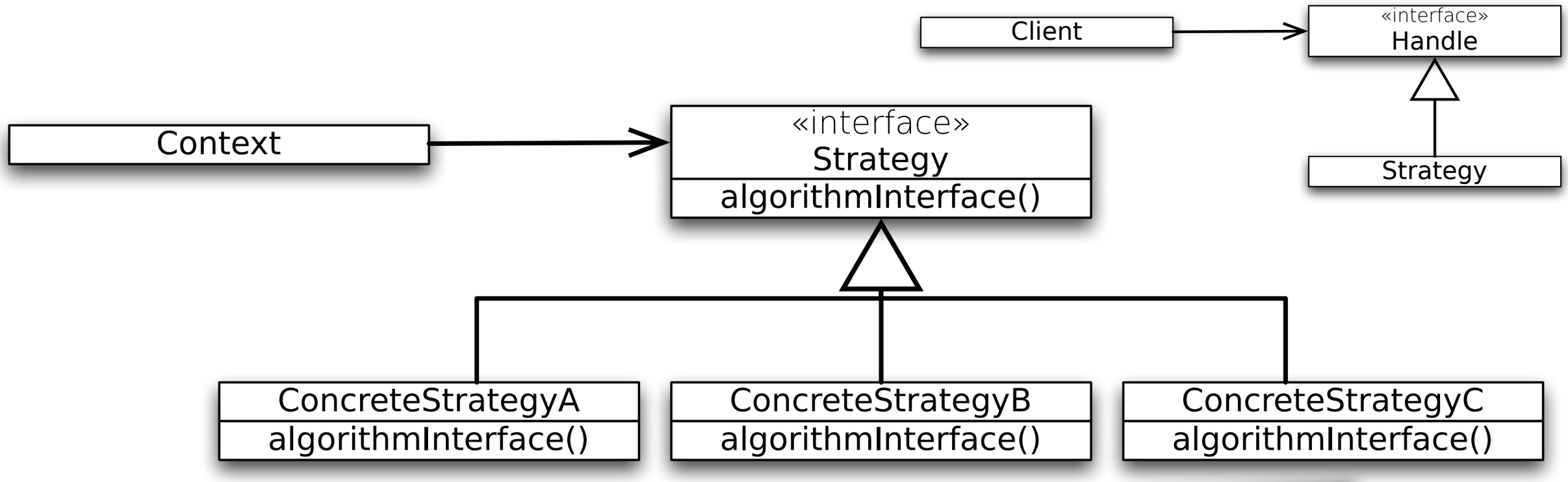
The Strategy Design Pattern
Implementation

Giving Strategy Visibility for the Context Information the Strategy needs

Two possible strategies:

- Pass the needed information as a parameter…
  - Context and Strategy decoupled
  - Communication overhead
  - Algorithm can’t be adapted to specific needs of context
- Context passes itself as a parameter or Strategy has a reference to its Context…
  - Reduced communication overhead
  - Context must define a more elaborate interface to its data
  - Closer coupling of Strategy and Context

Comparison of the Strategy Design Pattern and the Template Design Pattern



Using the strategy pattern, both - the template and the detailed implementations - depend on abstractions (interfaces).