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Introduction to Software Engineering

The Strategy Design Pattern

For details see Gamma et al. in "Design Patterns"

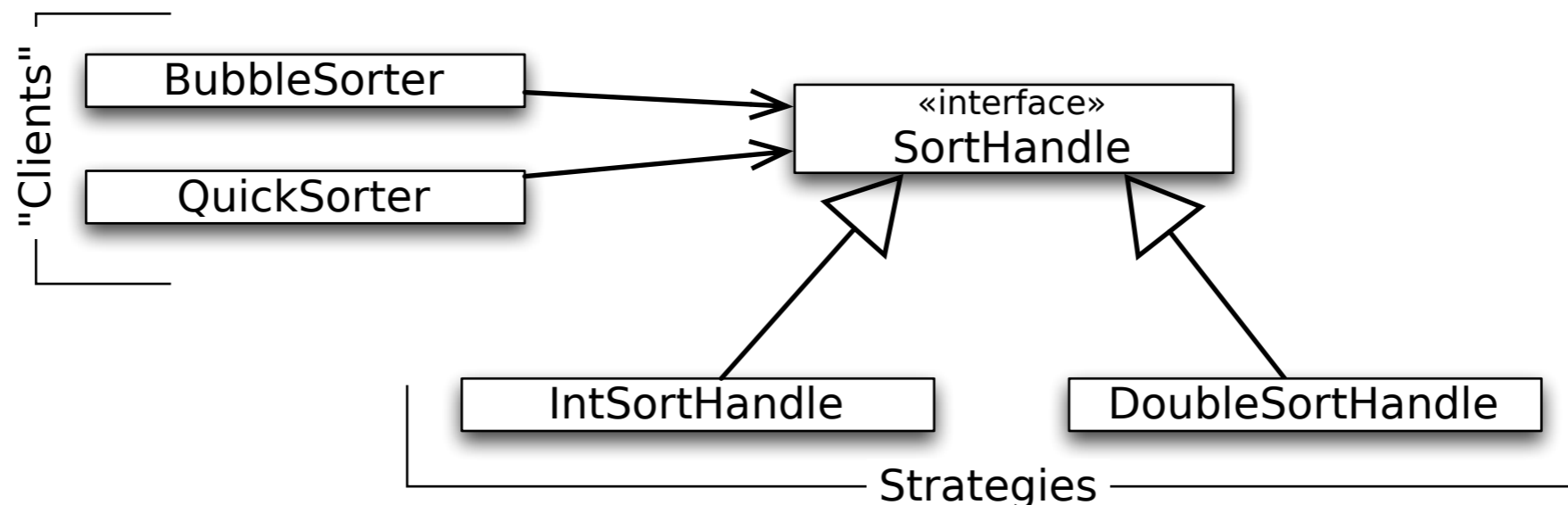


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The Strategy Design Pattern

Intent & Example

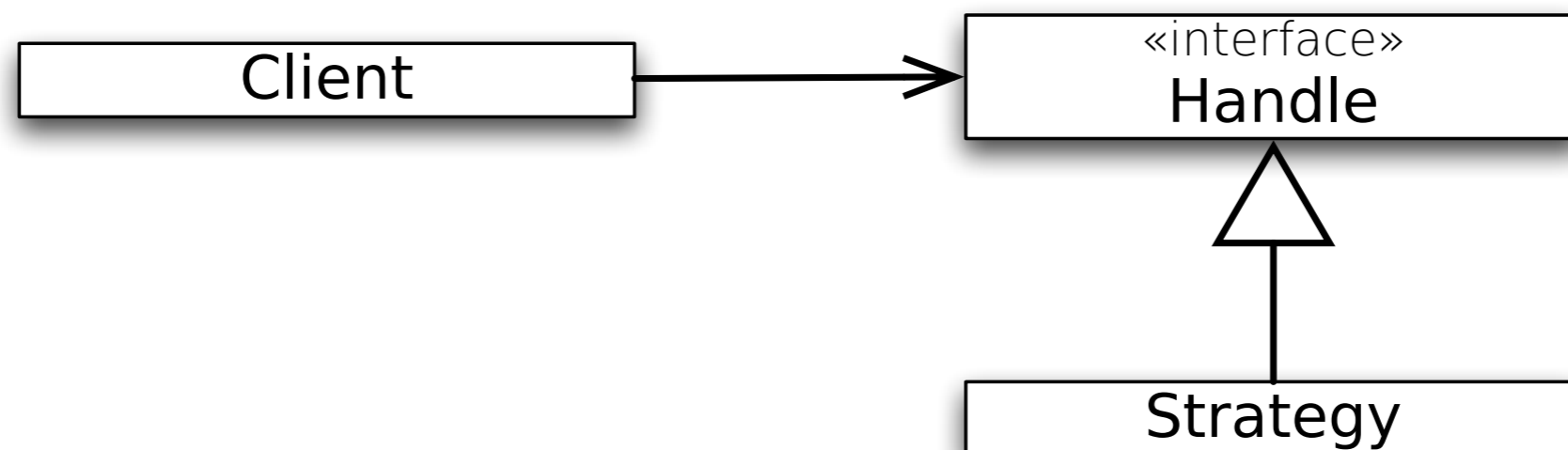
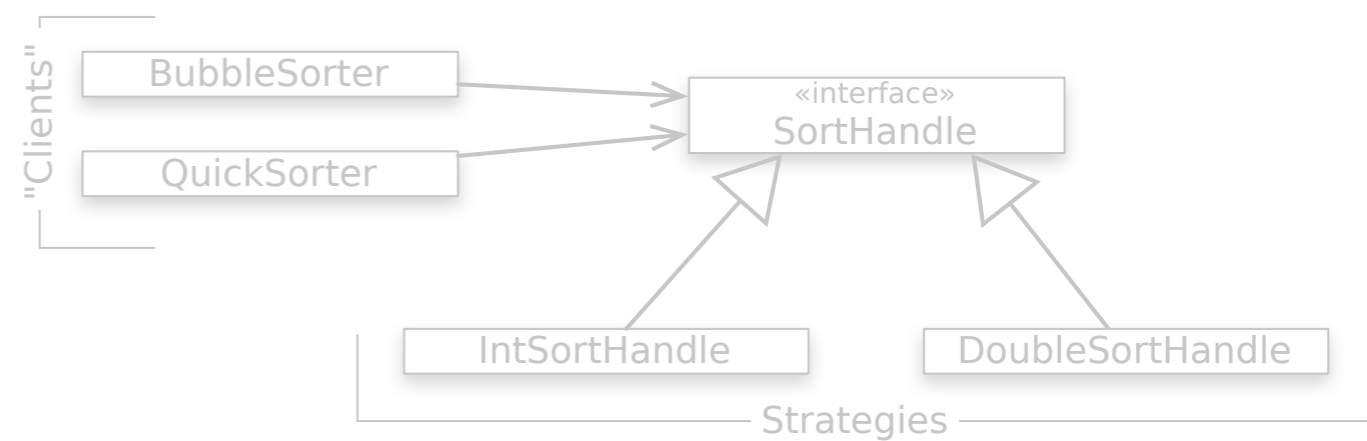
Define a family of algorithms, encapsulate each one, and make them interchangeable. Strategy lets the algorithm vary independently from clients that use it.



The Strategy Design Pattern

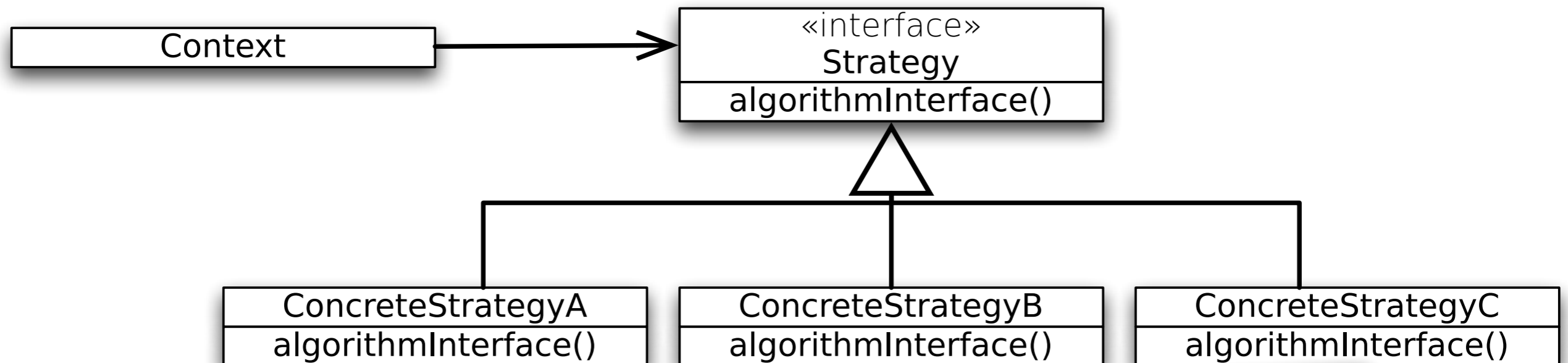
Excerpt of the Structure

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.

few 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, reuse and extend the algorithm

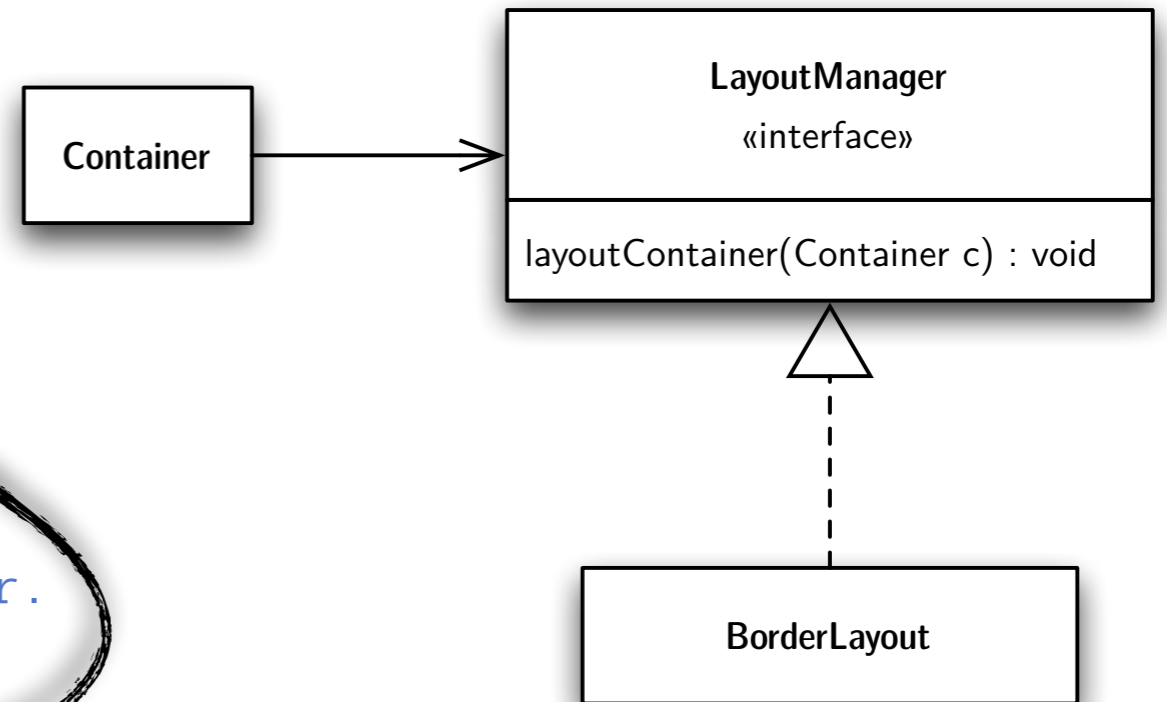
If you would use subclassing instead of the Strategy Design Pattern.

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

When to use 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

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

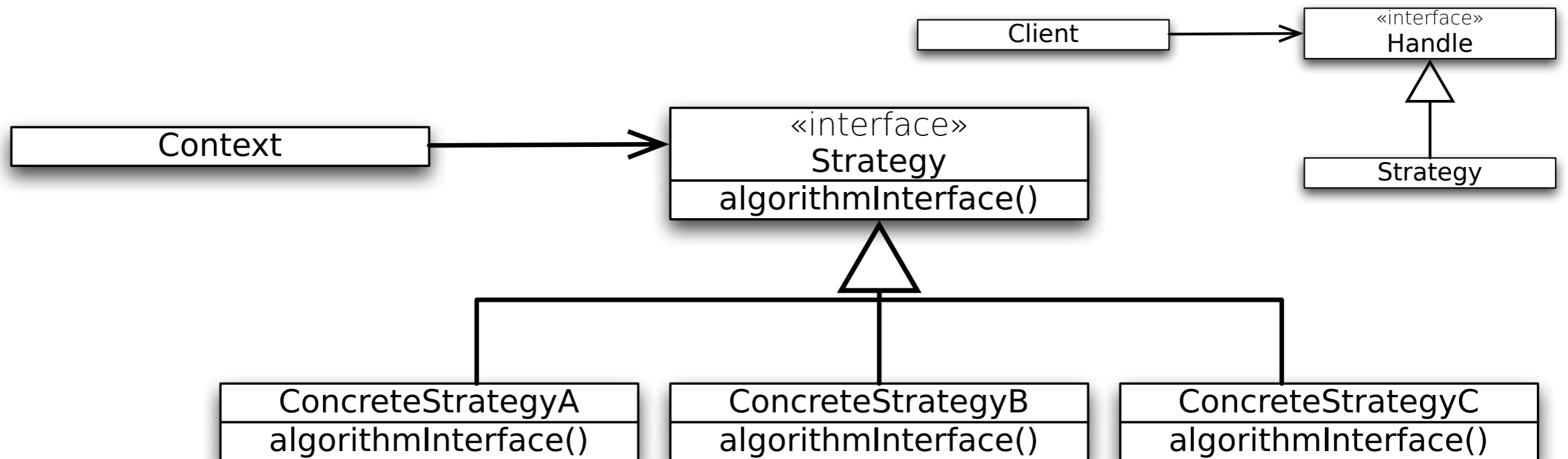
Implementation

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).