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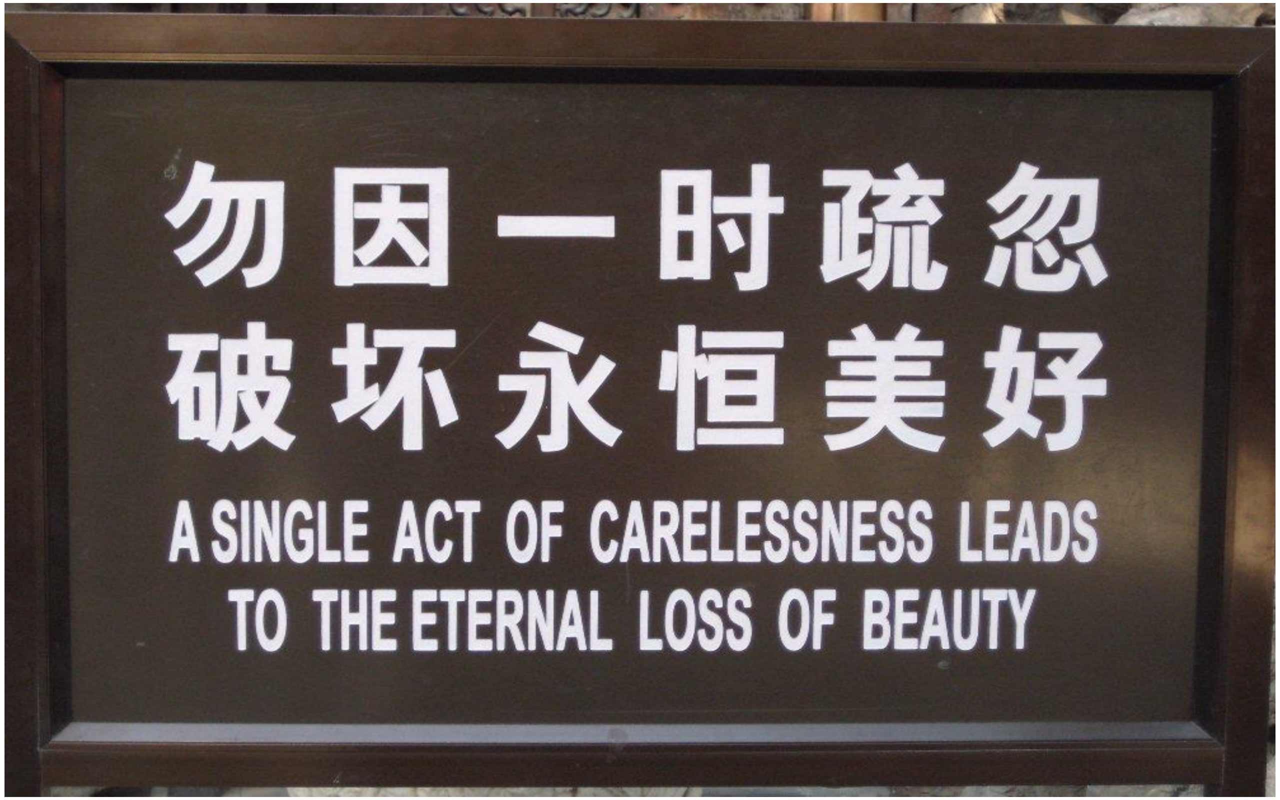
Software Engineering and Architecture

Pattern Fragility

Advice

- Forbidden city, Beijing.



勿因一时疏忽
破坏永恒美好

A SINGLE ACT OF CARELESSNESS LEADS
TO THE ETERNAL LOSS OF BEAUTY

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Why Patterns?

- Design patterns organize and structure code in a particular way.
  - Static: Arrangement of classes/interfaces
  - Dynamic: Assignment of responsibility, interaction patterns
- Why:
  - Because I get some benefits from doing so…
- Bottom line:
  - Patterns are *means to a goal, not the goal itself*

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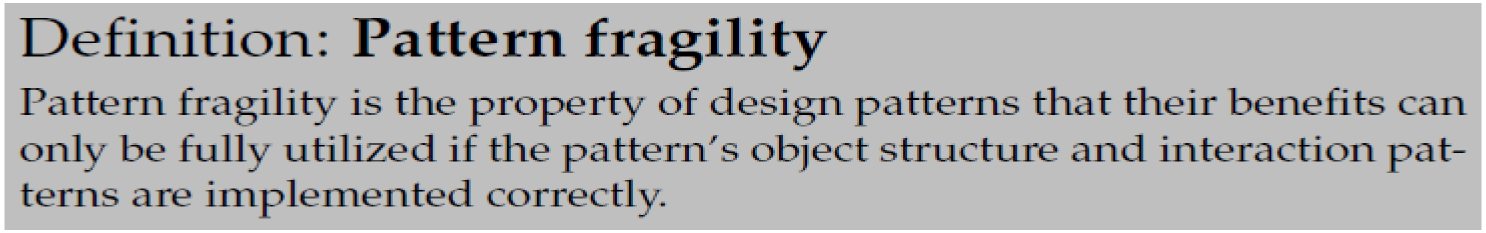
Patterns Are Code

- However, patterns are defined in code, and if I code wrong I “amputate” the pattern. I get all the liabilities and none of the advantages.



Definition: Pattern fragility

Pattern fragility is the property of design patterns that their benefits can only be fully utilized if the pattern’s object structure and interaction patterns are implemented correctly.

- Warstory:
  – COT case: Reusable search component’s deadline was forced. Additional staff added. A design pattern based, highly decoupled, design was utterly destroyed in a week.

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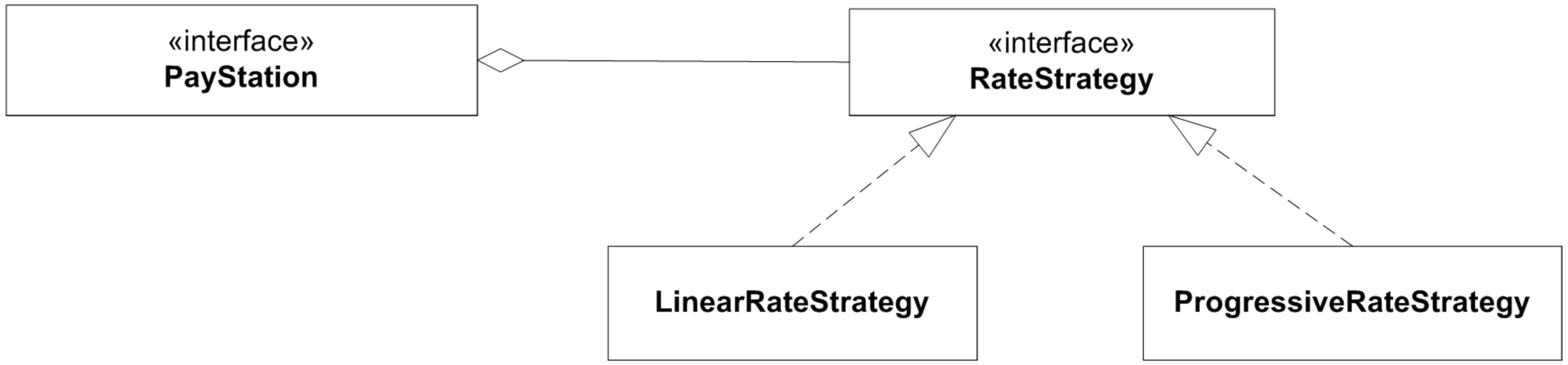
Example: Strategy

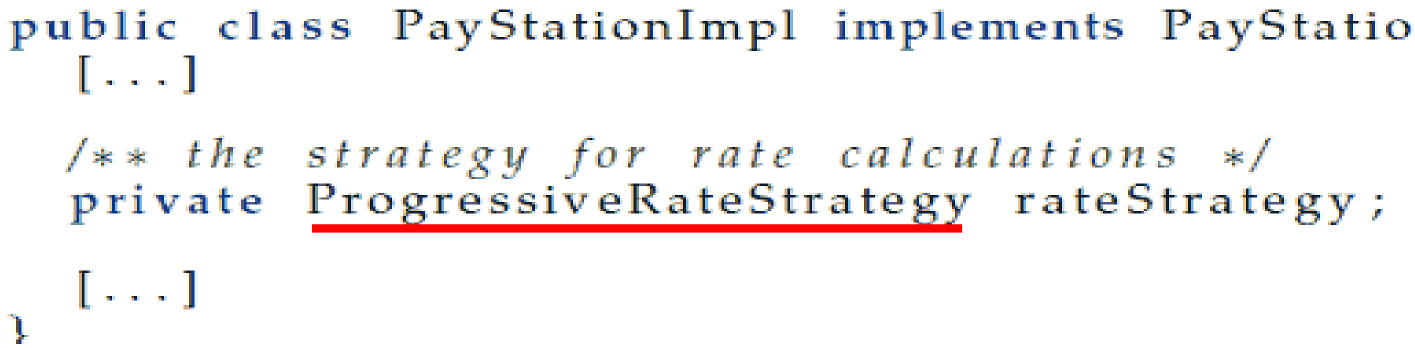
Strategy

- Responsibilities must be served by concrete behaviour in objects...



Pitfall 1: Declaration of Delegates

- ***1. Do not even think of using class names in declarations!***
- Why is the following change a disaster

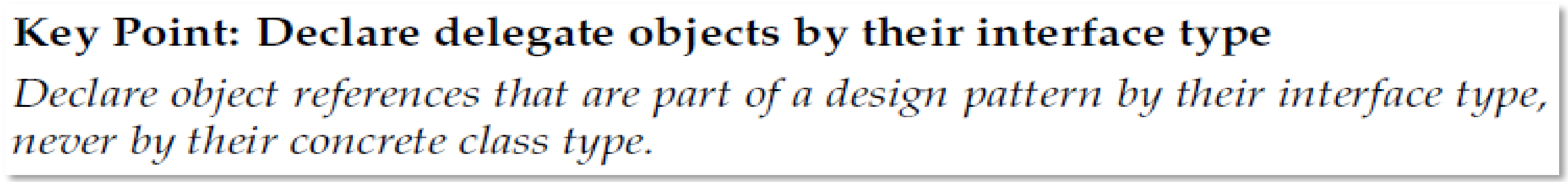


```
public class PayStationImpl implements PayStation {
  [...]

  /** the strategy for rate calculations */
  private ProgressiveRateStrategy rateStrategy;

  [...]
}
```

Keypoint 1



Key Point: Declare delegate objects by their interface type

Declare object references that are part of a design pattern by their interface type, never by their concrete class type.

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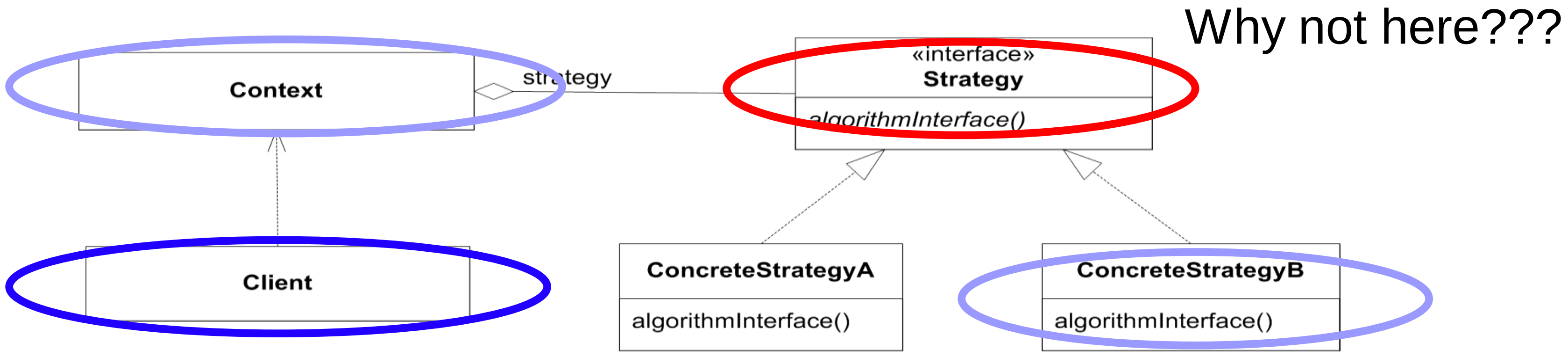
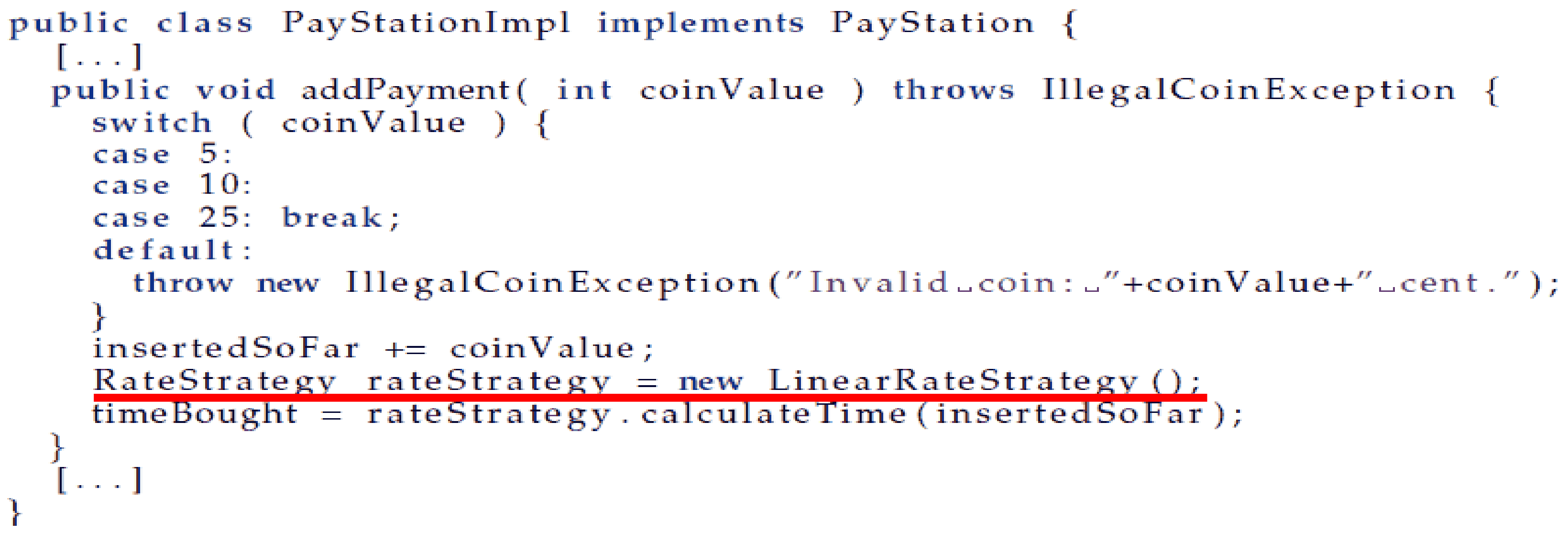
Pitfall 2: Binding in the Right Place

- Loose coupling is fine, but we have to couple the objects together eventually.
- It is important that the binding is made
  - *in the right place*
  - *as few places as possible (optimally 1!)*
- Many possibilities for Strategy:



Binding in the Wrong Place

- Binding in the Context object:



```
public class PayStationImpl implements PayStation {
  [...]
  public void addPayment( int coinValue ) throws IllegalCoinException {
    switch ( coinValue ) {
    case 5:
    case 10:
    case 25: break;
    default:
      throw new IllegalCoinException("Invalid␣coin:␣"+coinValue+"␣cent.");
    }
    insertedSoFar += coinValue;
    RateStrategy rateStrategy = new LinearRateStrategy();
    timeBought = rateStrategy.calculateTime(insertedSoFar);
  }
  [...]
}
```

- Will *not* break any tests for Alphatown!

Consequence

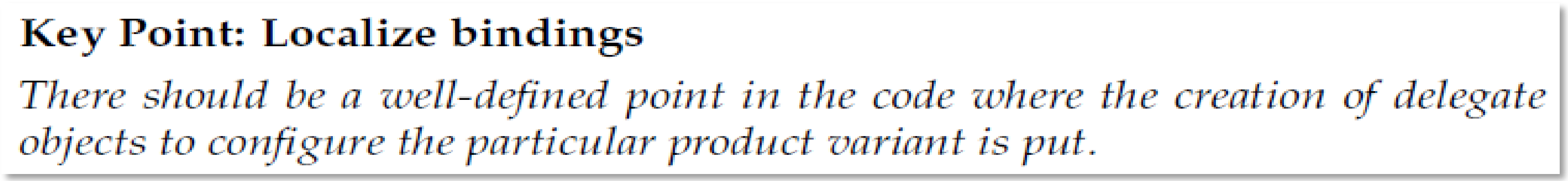
- What is the consequence?

- I got *all* the pattern’s liabilities
  - more interfaces and classes and objects to overview

- And *none* of the pattern’s benefits
  - high coupling
  - no variability at all!

Advice

- Keypoint



Key Point: Localize bindings

There should be a well-defined point in the code where the creation of delegate objects to configure the particular product variant is put.

- In Strategy, this is normally the Client role.
- Note again:
  - Automated tests that test the *full suite* of products *will* detect this defect.
  - A manual testing effort much focused on a specific product variant will probably not...

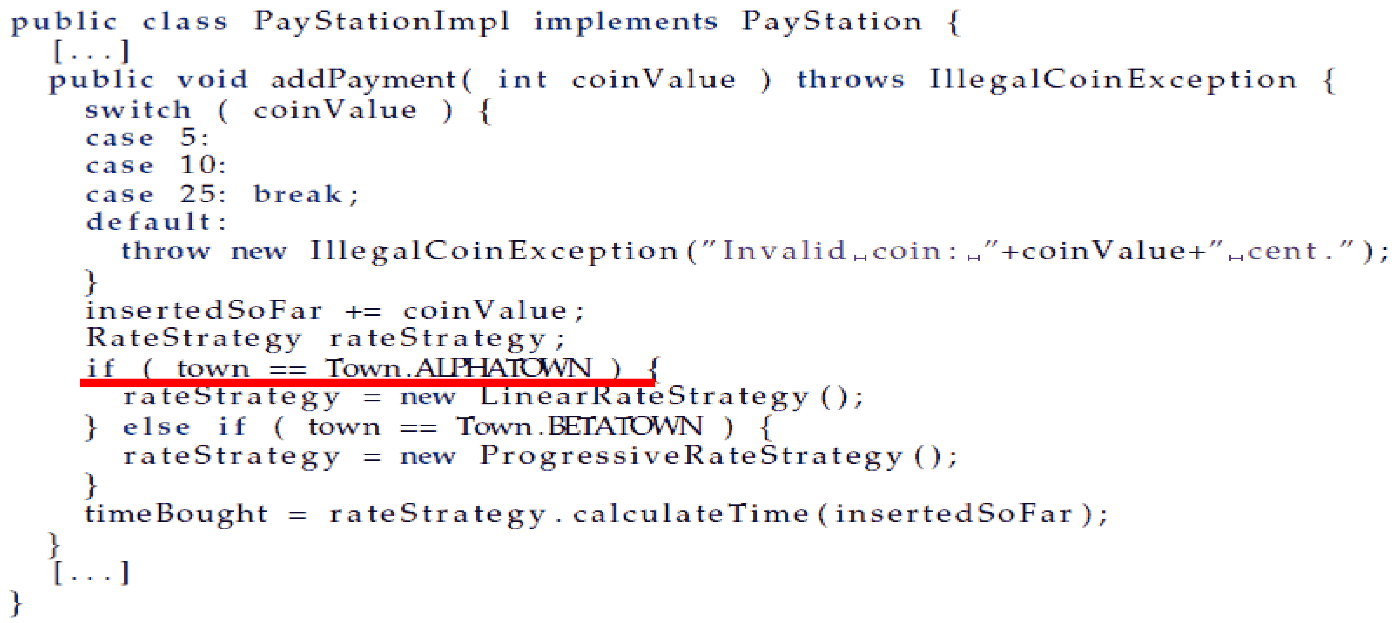
Relation to Other Patterns

- Abstract Factory is a *creational pattern*. Its purpose in life is to define bindings. Thus, the factory is often *the right place* to make bindings.

- In State it is actually often the ConcreteState objects that define the ‘next state’ of the state machine. Thus it is more common that ConcreteState objects directly create state objects.

Concealed Parameterization

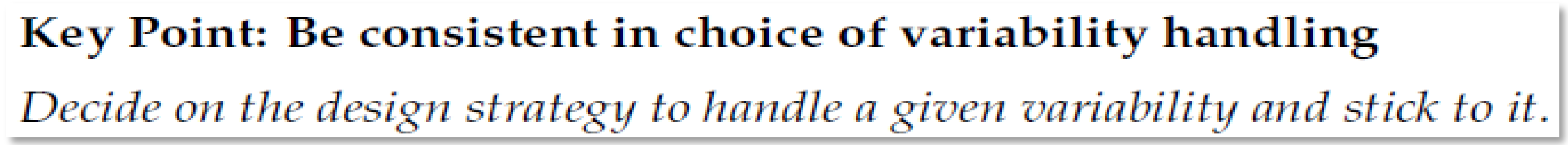
- Assume: Previous binding survived.
- Later: *"Why does Betatown not work any more?*
- *I need to fix it, and fix it fast!"*



```
public class PayStationImpl implements PayStation {
  [...]
  public void addPayment( int coinValue ) throws IllegalCoinException {
    switch ( coinValue ) {
    case 5:
    case 10:
    case 25: break;
    default:
      throw new IllegalCoinException("Invalid␣coin:␣"+coinValue+"␣cent.");
    }
    insertedSoFar += coinValue;
    RateStrategy rateStrategy;
    if ( town == Town.ALPHATOWN ) {
      rateStrategy = new LinearRateStrategy();
    } else if ( town == Town.BETATOWN ) {
      rateStrategy = new ProgressiveRateStrategy();
    }
    timeBought = rateStrategy.calculateTime(insertedSoFar);
  }
  [...]
}
```

Advice

- Keypoint

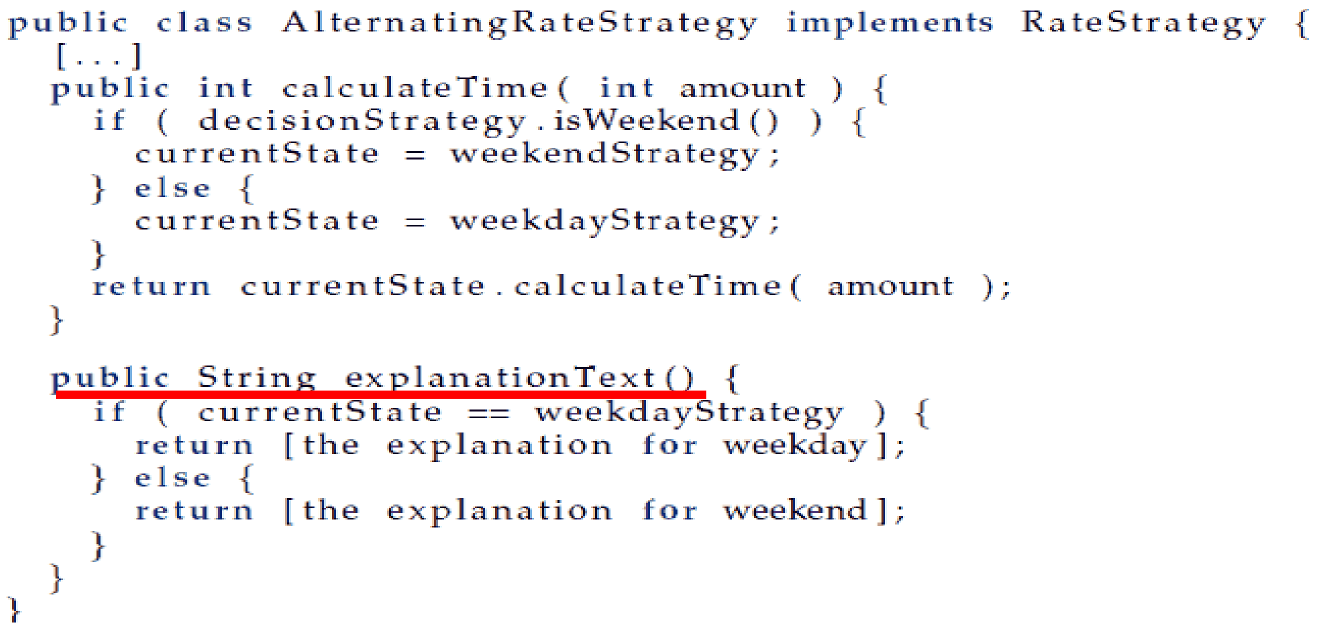


Key Point: Be consistent in choice of variability handling

Decide on the design strategy to handle a given variability and stick to it.

Responsibility Erosion

- *Software changes its own requirement.*
- New (weird) request
  - Gammatown: Explain rate policy.



```
public class AlternatingRateStrategy implements RateStrategy {
  [...]
  public int calculateTime( int amount ) {
    if ( decisionStrategy.isWeekend() ) {
      currentState = weekendStrategy;
    } else {
      currentState = weekdayStrategy;
    }
    return currentState.calculateTime( amount );
  }

  public String explanationText() {
    if ( currentState == weekdayStrategy ) {
      return [the explanation for weekday];
    } else {
      return [the explanation for weekend];
    }
  }
}
```

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Consequences

- Now, however, this strategy does not conform to the contract by the interface.

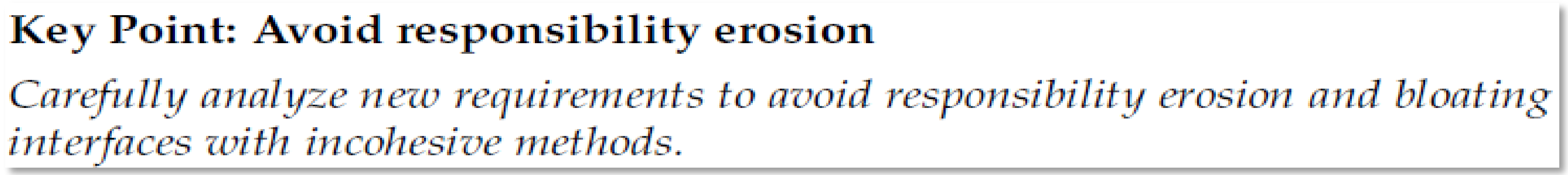
```
if ( rateStrategy instanceof AlternatingRateStrategy ) {
  AlternatingRateStrategy rs =
    (AlternatingRateStrategy) rateStrategy;
  String theExplanation = rs.explanationText();
  [use it somehow]
}
```

- Solution: Move the method up into the RateStrategy interface.

- **But**: I have now added a new responsibility. One that *may* not be cohesive.

Advice

- Keypoint:



Key Point: Avoid responsibility erosion

Carefully analyze new requirements to avoid responsibility erosion and bloating interfaces with incohesive methods.

- However, sometimes you do need to add more methods to the interface…
  - Strategy: some complex algorithms require methods, that the simpler variants do not have any use for

The polymorphic wrapping trap

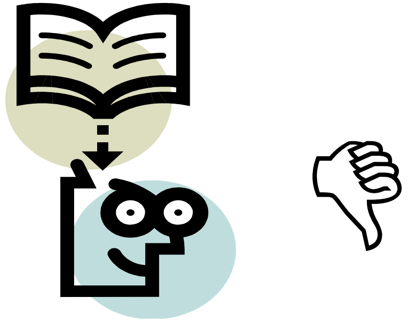
- From a mandatory hand-in

```
public class AlphaCivGame implements Game {...}

public class BetaCivGame extends AlphaCivGame{

    public BetaCivGame(){
        super();
    }

    @Override
    public Player getWinner() {
        return new BetaWinnerStrategy().getWinner(this);
    }

}
```

Summary

- **Take care at the implementation level!!!**
- It only takes a few “slip-ups” to completely destroy the intended benefits of a pattern!

- **Corollary: You do not learn patterns by reading a book or listening to me!**
- **CODE! AND REFLECT!**



Summary

- ***All your programmers must deeply understand the roles and protocols embodied in design patterns in order to keep the design intact.***