Adapting interfaces

The INFDEV team

Hogeschool Rotterdam
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INFSEN02-2

Introduction

Introduction

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Lecture topics

- Issues arising from connecting domains
- The adapter design pattern
- Examples and considerations
- Conclusions

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Issues:

- Independent domains based each its interface(s)
- They share no code, so we cannot make them communicate
- Sometimes the logics of one might still be compatible with the other

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Examples:

- Legacy systems
- Different frameworks
- Closed libraries
- Etc..

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Introduction

- Today we are going to study code adapters
- In particular, we are going to study how to make existing classes work within other domains without modifying their code
- How? By means of a design pattern: the adapter (a behavioral design pattern)
- A clean and general mechanism that allows an instance of an interface to be used where another interface is expected

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Adapting existing classes

- A further constraint is that we cannot change the original implementation
- Why?

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Adapting existing classes

- A further constraint is that we cannot change the original implementation
- Why?
- *We might break other programs depending on such implementation*

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Examples:

- An option as an iterator,
- A traditional iterator as a safe iterator,
- A class belonging to a closed library with the interface required by our application,
- A shape in another drawing library,
- Etc.

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An example of similar but incompatible classes

- Consider the following two classes `LegacyLine` and `LegacyRectangle`
- Both implementing a draw method

```
1  class LegacyLine {
2    public void Draw(int x1,int y1,int x2,int y2) {
3      Console.WriteLine("line␣from␣(" + x1 + ',' + y1 + ")␣to␣(" + x2 + ',' +
           y2 + ')'");
4  ␣␣}
5  }
6  class␣LegacyRectangle␣{
7  ␣␣public␣void␣Draw(int␣x,int␣y,int␣w,int␣h)␣{
8  ␣␣␣␣Console.WriteLine("rectangle at ("␣+␣x␣+␣',’␣+␣y␣+␣") with width "␣+␣w␣+
       ␣" and height "␣+␣h);
9  ␣␣}
10 }
```

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Consuming our LegacyLine and LegacyRectangle

- Suppose we wished to build a drawing system
- We need to group lines and rectangles together
- Cast to `Object`?

```
1  List<Object> shapes = new List<Object>();
2  shapes.Add(new LegacyLine());
3  shapes.Add(new LegacyRectangle());
4  foreach(Object shape in shapes){
5    if(shape is LegacyLine) {
6      (LegacyLine)shape.Draw(...);
7    }
8    if(shape is LegacyRectangle) {
9      (LegacyRectangle)shape.Draw(...);
10   }
11  }
```

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Issues with consuming LegacyLine and LegacyRectangle

- As we can see from the example consuming instances of such classes is complex and error-prone
- We could of course apply a visitor, but in this case it is not possible, since we cannot touch the implementation
- We wish now to reduce such complexity and to achieve safety

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Consuming "safely" LegacyLine and LegacyRectangle: idea

- A solution would be to define an intermediate mediating layer that abstracts instances of both `LegacyLine` and `LegacyRectangle`
- For this implementation we first define an interface `Shape` with one method signature `Draw`
- This interface defines the entry of our own domain

```
1 interface Shape {
2   void Draw(int x1,int y1,int x2,int y2);
3 }
```

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An adapter for our LegacyLine

- We declare a class `Line` that takes as input a `LegacyLine` object
- Whenever the `Draw` method is called also the `Draw` of the `LegacyLine` object is called
- `Line` exists both in the legacy and our new domain

```
1  class Line : Shape {
2    private LegacyLine underlyingLine;
3    public Line(LegacyLine line) {
4      this.underlyingLine = line;
5    }
6    public void Draw(int x1,int y1,int x2,int y2) {
7      underlyingLine.Draw(...);
8    }
9  }
```

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An adapter for our LegacyRectangle

- We apply the same mechanism to our LegacyRectangle

```
1  class Rectangle : Shape {
2    private LegacyRectangle underlyingRectangle;
3    public Rectangle(LegacyRectangle rectangle) {
4      this.underlyingRectangle = rectangle;
5    }
6    public void Draw(int x1,int y1,int x2,int y2) {
7      underlyingRectangle.Draw(...);
8    }
9  }
```

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Consuming "safely" LegacyLine and LegacyRectangle

- Our drawing system can now define a list of shapes

```
1  List<Shape> shapes = new List<Shape>();
2  shapes.Add(new Line(new LegacyLine()));
3  shapes.Add(new Rectangle(new LegacyRectangle()));
4  foreach(Shape shape in Shapes){
5    shape.Value.Draw(...);
6   }
```

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Consuming "safely" LegacyLine and LegacyRectangle

- We could even extend our Shape with a visitor

```
1 interface Shape {
2   void Draw(int x1,int y1,int x2,int y2);
3   U Visit<U>(Func<U> onLegacyLine,Func<U> onLegacyRectangle);
4 }
```

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Considerations

- As we can see our program now manages instances of both `LegacyLine` and `LegacyRectangle` without requiring to manually deal with their details
- This makes the code not only more maintainable but also safer, since the original implementation remains the same
- In this way our program deals with objects of type `Rectangle` and `Line` as if they are concrete `LegacyLine` and `LegacyRectangle` objects without changing concrete functionalities

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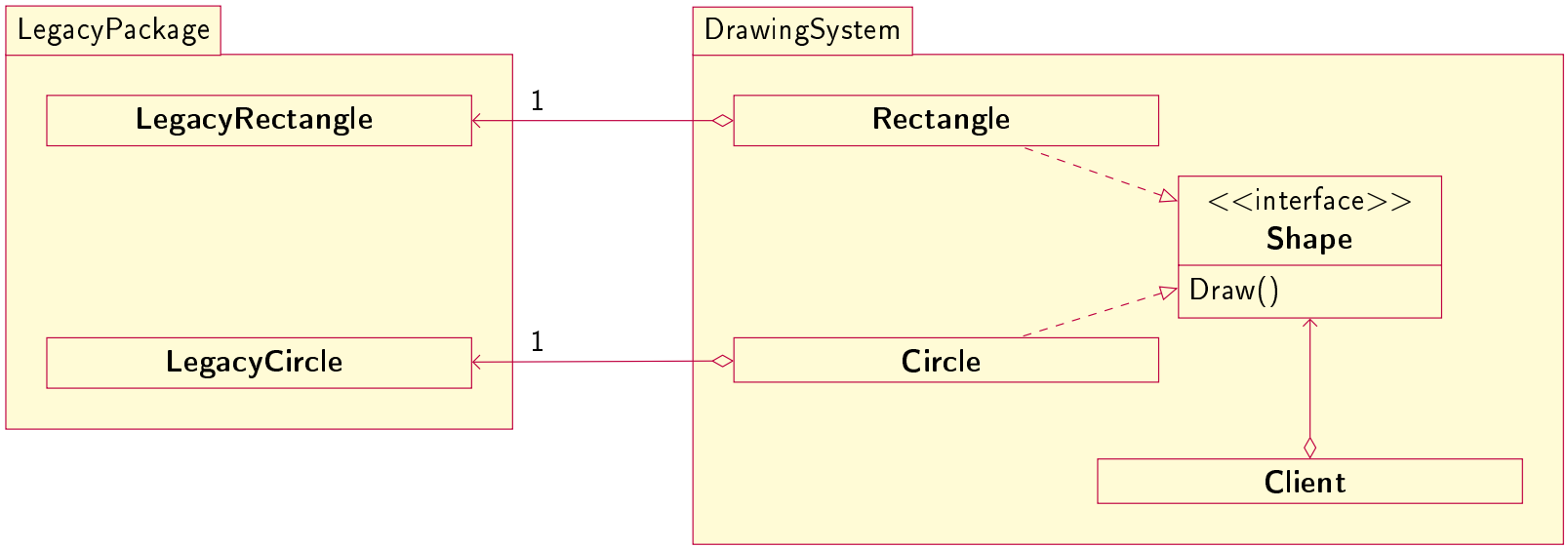
LegacyPackage
LegacyRectangle
LegacyCircle
1
1
DrawingSystem
Rectangle
<<interface>>
Shape
Draw()
Circle
Client

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The adapter design pattern

- By means of adapters, we "convert" the interface of a class into another, without touching the class sources
- In what follows we will study such design pattern and provide a general formalization

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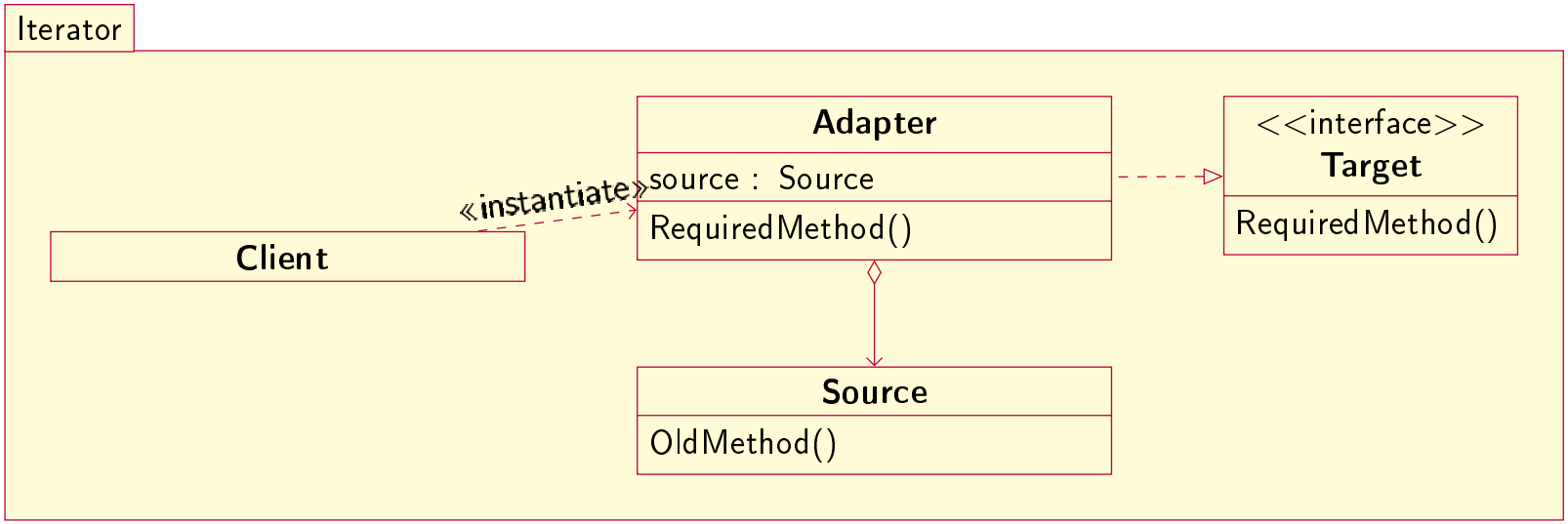
The adapter design pattern structure

- Given two different interfaces `Source` and `Target`
- An `Adapter` is built to adapt `Source` to `Target`
- The `Adapter` implements `Target` and contains a reference to texttttSource
- A `Client` interacts with the `Adapter` whenever it a `Target`, but we have a `Some`
- In the following we provide a UML for such structure

Adapter


Iterator
Adapter
source : Source
RequiredMethod()
<<interface>>
Target
RequiredMethod()
«instantiate»
Client
Source
OldMethod()

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Example:

- Consider the `Option` data type
- It is a collection of sorts
- It could be iterated, but it does not implement an interator!

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Iterating an Option<T>

- In this case Target is Iterator<T>, Source is Option<T>, and Adapter is IOptionIterator<T>
- Now, GetNext returns Some only the at the first iteration
- Note, if we iterate a None entity we return None

```
1  class IOptionIterator<T> : Iterator<T> {
2    private Option<T> option;
3    private bool visited = false;
4    public IOptionIterator(Option<T> option) {
5      this.option = option;
6    }
7    Option<T> GetNext() {
8      if(visited) {
9        return new None<T>();
10     }
11     else{
12       visited = true;
13       if(option.IsSome()) {
14         return new Some<T>(option.GetValue());
15       }
16       else{
17         return new None<T>();
18       }
19     }
```

Adapter

Iterating an Option<T>

- Which with visitor becomes:

```
1  class IOptionIterator<T> : Iterator<T> {
2    private Option<T> option;
3    private bool visited = false;
4    public IOptionIterator(Option<T> option) {
5      this.option = option;
6    }
7    Option<T> GetNext() {
8      if(visited) {
9        return new None<T>();
10     }
11     else{
12       visited = true;
13       return option.Visit<Option<T>>(() => new None<T>(),t => new Some<T>(t)
               );
14     }
15   }
16 }
```

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Considerations about bijectivity

- Adapters map behaviors across domains
- Adapting may not change or add behaviors

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Considerations about bijectivity

- Consider the `TraditionalIterator` and `Iterator` example
- We can adapt in both directions!

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```
1  class MakeSafe<T> : Iterator<T> {
2    private TraditionalIterator<T> iterator;
3    public MakeSafe(TraditionalIterator<T> iterator) {
4      this.iterator = iterator;
5    }
6    Option<T> GetNext() {
7      if(iterator.MoveNext()) {
8        return new Some<T>(iterator.GetCurrent());
9      }
10     else{
11       return new None<T>();
12     }
13   }
14 }
```

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Which in Java then becomes:

```
1  class MakeSafe<T> implements Iterator<T> {
2    private TraditionalIterator<T> iterator;
3    public MakeSafe(TraditionalIterator<T> iterator) {
4      this.iterator = iterator;
5    }
6    Option<T> GetNext() {
7      if(iterator.MoveNext()) {
8        return new Some<T>(iterator.GetCurrent());
9      }
10     else{
11       return new None<T>();
12     }
13   }
14 }
```

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```
1  class MakeUnsafe<T> : TraditionalIterator<T> {
2    private _current T;
3    private Iterator<T> iterator;
4    public MakeUnsafe(Iterator<T> iterator) {
5      this.iterator = iterator;
6    }
7    T GetCurrent() {
8      return _current;
9    }
10   bool MoveNext() {
11     Option<T> opt = iterator.GetNext();
12     if(opt.IsSome()) {
13       _current = iterator.GetValue();
14       return true;
15     }
16     else{
17       return false;
18     }
19   }
20 }
```

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Which in Java then becomes:

```
1  class MakeUnsafe<T> implements TraditionalIterator<T> {
2    private _current T;
3    private Iterator<T> iterator;
4    public MakeUnsafe(Iterator<T> iterator) {
5      this.iterator = iterator;
6    }
7    T GetCurrent() {
8      return _current;
9    }
10   bool MoveNext() {
11     Option<T> opt = iterator.GetNext();
12     if(opt.IsSome()) {
13       _current = iterator.GetValue();
14       return true;
15     }
16     else{
17       return false;
18     }
19   }
20 }
```

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Considerations about bijectivity

- What is the behavior of `new MakeSafe(new MakeUnsafe(it))` for a generic iterator it?

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Considerations about bijectivity

- What is the behavior of `new MakeSafe(new MakeUnsafe(it))` for a generic iterator it?
- No change! The two behave exactly the same!

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Considerations about bijectivity

- What is the behavior of `new MakeUnsafe(new MakeSafe(it))` for a generic iterator it?

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Considerations about bijectivity

- What is the behavior of `new MakeUnsafe(new MakeSafe(it))` for a generic iterator it?
- No change! The two behave exactly the same!

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Considerations about bijectivity

- An adapter does not add or remove information, in order to preserve the correctness of the involved interface adapters
- Adapters are simply “bridges” to let abstractions vary independently, and contain no domain logic

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Conclusion

- Code comes in different forms
- Sometimes code cannot be changed: a library, a framework, etc..
- Sometimes it is hard to make existing code work in a specific target application (for example because it is written with other conventions or is simply legacy)
- The adapter pattern allows the adaptation of such code in a way that makes the resulting solution flexible and safe
- How? By providing an custom adapter that mediates between the targeted client and the code to adapt

This is it!

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The best of luck, and thanks for the attention!