Adapting interfaces

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INFDEV02-4

Introduction

Introduction

Lecture topics

- Issues arising from importing and using entities
- The adapter design pattern
- Examples and considerations
- Conclusions

The adapter design pattern

Introduction

- Today we are going to study code adapters
- In particular, we are going to study how to make existing classes work with others without modifying their code
- How? By means of a design pattern: the adapter (a behavioral design pattern)
- We will see the adapter provides a clean and general mechanism that allows an interface of an existing class to be used as another interface

The adapter design pattern

Adapting existing classes

- It is often the case where we need to adapt existing entities to other
- For example we wish to treat an option by means of an iterator, traditional iterator as a safe iterator, or a class belonging to a closed library with the interface required by our application
- With the only constraint that we cannot change the original implementation and the original functionalities
- Why?

The adapter design pattern

Adapting existing classes

- It is often the case where we need to adapt existing entities to other
- For example we wish to treat an option by means of an iterator, traditional iterator as a safe iterator, or a class belonging to a closed library with the interface required by our application
- With the only constraint that we cannot change the original implementation and the original functionalities
- Why?
- Otherwise we might break other programs depending on such implementation

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An example of similar but incompatible classes

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

```
class LegacyLine {
  public void Draw(int x1,int y1,int x2,int y2) {
    Console.WriteLine("line␣from␣(" + x1 + ',' + y1 + ")␣to␣(" + x2 + ',' +
        y2 + ')'");
␣␣}
}
class␣LegacyRectangle␣{
␣␣public␣void␣Draw(int␣x,int␣y,int␣w,int␣h)␣{
␣␣␣␣Console.WriteLine("rectangle at ("␣+␣x␣+␣','␣+␣y␣+␣") with width "␣+␣w␣+
     ␣" and height "␣+␣h);
␣␣}
}
```

Consuming our LegacyLine and LegacyRectangle

- We now wish to consume instances of `LegacyLine` and `LegacyRectangle` in our application
- We group such instances within the same collection, so to deal with them all at once, thus to avoid duplication
- The collection is of type `Object`. Why? Because `LegacyLine` and `LegacyRectangle` do not share a same type

```
LinkedList<Object> shapes = new LinkedList<Object>();
shapes.Add(new LegacyLine());
shapes.Add(new LegacyRectangle());
while (shapes.Tail != null) {
  if shapes.Head.getClass().getName().equals("LegacyLine") {
    (LegacyLine)shapes.Head.Value.Draw(...);
  }
  if shapes.Head.getClass().getName().equals("LegacyRectangle") {
    (LegacyRectangle)shapes.Head.Value.Draw(...);
  }
  shapes = shapes.Tail;
}
```

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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 their implementation
- We wish now to reduce such complexity and to achieve safeness

Consuming "safely" LegacyLine and LegacyRectangle: idea

- A solution would be to define an intermediate layer that mediates for us with instances of both `LegacyLine` and `LegacyRectangle`
- For this implementation we need first to define an interface `Shape` with one method signature `Draw`

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

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

```
class Line : Shape {
  private LegacyLine underlyingLine;
  public Line(LegacyLine line) {
    this.underlyingLine = line;
  }
  public void Draw(int x1,int y1,int x2,int y2) {
    underlyingLine.Draw(...);
  }
}
```

An adapter for our LegacyRectangle

- We apply the same mechanism to our `LegacyRectangle`

```
class Rectangle : Shape {
  private LegacyRectangle underlyingRectangle;
  public Rectangle(LegacyRectangle rectangle) {
    this.underlyingRectangle = rectangle;
  }
  public void Draw(int x1,int y1,int x2,int y2) {
    underlyingRectangle.Draw(...);
  }
}
```

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Consuming "safely" LegacyLine and LegacyRectangle

- The main program will now define a list of shapes containing instances of shapes each referencing an instance of either `LegacyLine` or `LegacyRectangle`

```
LinkedList<Shape> shapes = new LinkedList<Shape>();
shapes.Add(new Line(new LegacyLine()));
shapes.Add(new Rectangle(new LegacyRectangle()));
while (shapes.Tail != null) {
  shapes.Head.Value.Draw(...);
  shapes = shapes.Tail;
 }
```

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
- This example
- In this way our program deals with objects of type `Rectangle` and `Line` as if they are concrete `LegacyLine` and `LegacyRectangle` objects without changing its concrete functionalities

The adapter design pattern

The adapter design pattern

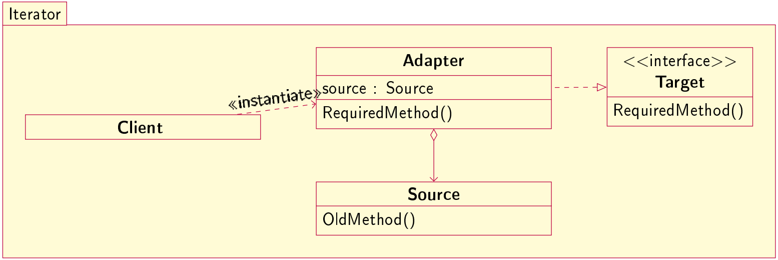
- Is a design pattern that abstracts the just described mechanism
- By means of adapters, it allows to convert the interface of a class into another one that a client expects without changing its functionalities
- In what follows we will study such design pattern and provide a general formalization

The adapter design pattern

The adapter design pattern structure

- Given two different interfaces Source and texttt Target
- An texttt Adapter is built to, carefully, adapt texttt Source to texttt Target
- The texttt Adapter implements texttt Target and contains a reference to texttt Source
- A texttt Client interacts with the texttt Adapter whenever it needs to interact with texttt Source as if it is an instance of texttt Target
- In the following we provide a UML for such structure

The adapter design pattern



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The adapter design pattern

Iterating an IOption<T>

- Adapters successfully achieve the task of making an source interface “behaving” as another
- It is the case of the option introduced in the previously
- As an option can be seen as a collection that might contains at most one element
- We can treat such option as an iterator
- How? By means of an adapter

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Iterating an IOption<T>

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

```
class IOptionIterator<T> : Iterator<T> {
  private IOption<T> option;
  private bool visited = false;
  public IOptionIterator(IOption<T> option) {
    this.option = option;
  }
  IOption<int> GetNext() {
    if visited {
      return new None<T>();
    }
    else{
      visited = true;
      return option.Visit<IOption<T>>(() => new None<T>(),t => new Some<T>(t
           ));
    }
  }
}
```

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Considerations about reversibility

- Adapters as we can see successfully achieve the task of adapting imported and custom client interfaces without changing the imported interface
- However, it is important that adapting does not change the intended behavior of the imported interface

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Considerations about reversibility

- Consider the `TraditionalIterator` and `Iterator` example
- Adapting a `TraditionalIterator` to an `Iterator` does not change the order of iteration (see previous class)
- But, adapting an `Iterator` to `TraditionalIterator` changes the order of iteration

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Considerations about reversibility

- An adapter does not add or remove information, in order to preserve the correctness of the involved interface adapters
- Adapting interface should not affect their intended logical mechanisms
- Adapters are simply “bridges” to let abstractions vary independently
- Thus, **Safe(Unsafe(list))** = **list** and **Unsafe(Safe(list))** = **list**

Conclusion

- Code comes in different forms
- For many cases code cannot be changed: like a library, a toolkit, etc..
- Sometimes it is hard to make such code work in a specific target application (for example because it is written at a different time)
- The adapter pattern allows the adaptation of such code in a way that makes the resulting solution safe and maintainable
- How? By providing an custom adapter that mediated between the targeted client and the code to adapt

This is it!

The best of luck, and thanks for the attention!