COMP2511

Visitor Pattern

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Design Patterns

Creational Patterns

- Factory Method
- Abstract Factory
- Builder
- Singleton

Structural Patterns

- Adapter
- Composite
- Decorator

Behavioral Patterns

- Iterator
- Observer
- State
- Strategy
- Template
- Visitor

Visitor Pattern

Some of the material is from the websites https://refactoring.guru/design-patterns/ and the wikipedia pages.

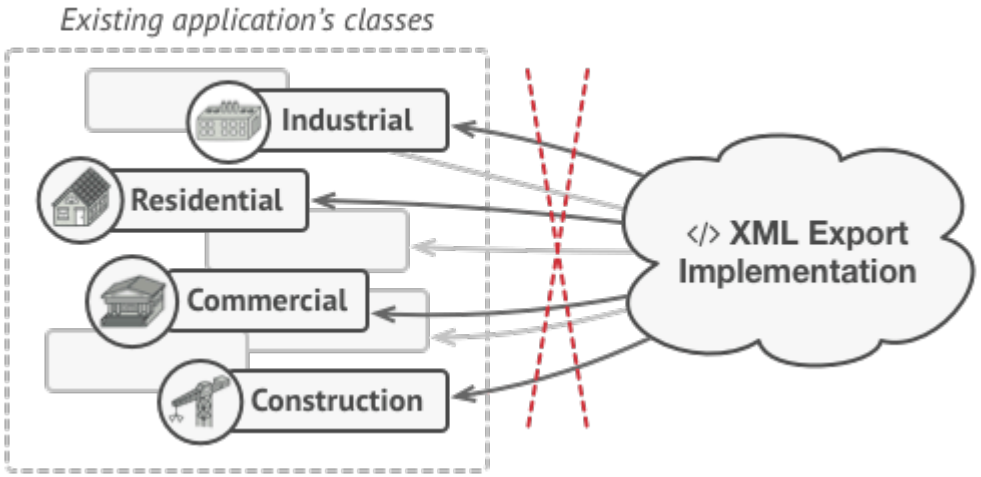
Visitor Pattern

- Visitor is a behavioral design pattern that adds new operations/behaviors to the existing objects, without modifying them.
- The visitor design pattern is a way of separating an algorithm from an object structure on which it operates.
- A practical result of this separation is the ability to add new operations to existing object structures without modifying the structures.
- It is one way to follow the open/closed principle.
- A visitor class is created that implements all of the appropriate specializations of the virtual operation/method.
- The visitor takes the instance reference as input, and implements the goal (additional behavior).
- Visitor pattern can be added to public APIs, allowing its clients to perform operations on a class without having to modify the source.

Visitor Pattern

Problem:

- A geographic information structured as one colossal graph.
- Each node of the graph may represent a city, an industry, a sightseeing area, etc.
- Each node type is represented by its own class, while each specific node is an object.
- *Task*: you want to export the graph into XML format.



The XML export method had to be added into all node classes, which bore the risk of breaking the whole application if any bugs slipped through along with the change.

Visitor Pattern

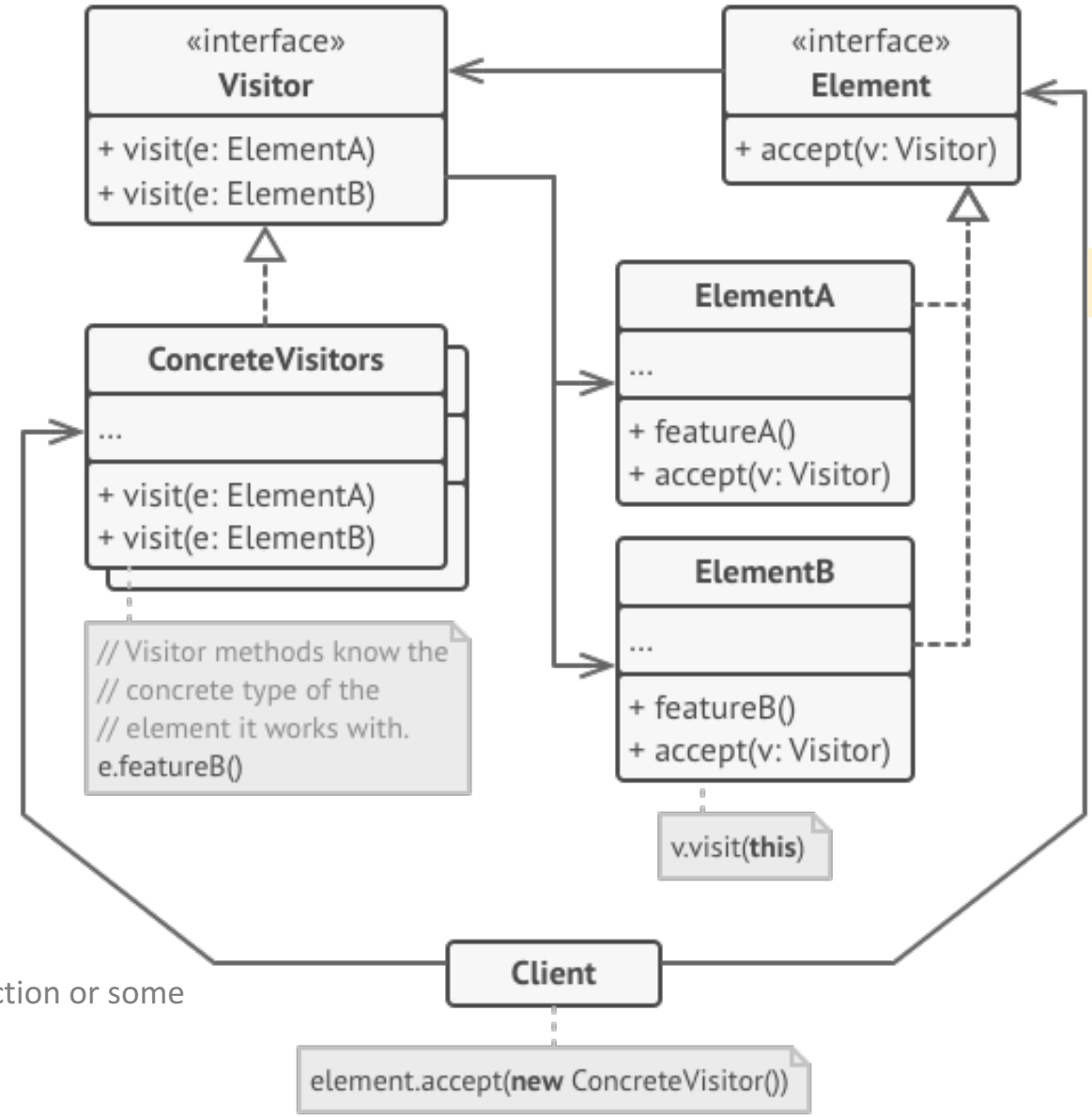
Solution:

- The Visitor pattern suggests that you place the new behavior into a separate class called visitor, instead of trying to integrate it into existing classes.
- The original object that had to perform the behavior is now passed to one of the visitor's methods as an argument, providing the method access to all necessary data contained within the object (see the example for more clarification).
- The visitor class need to define **a set of methods**, one for each type.
  For example, a city, a sightseeing place, an industry, etc.
- The visitor pattern uses a technique called "Double Dispatch" to execute a suitable method on a given object (of different types).
  - An object "**accept**s" a *visitor* and tells it what visiting method should be executed. See the example for more clarifications.
  - One additional method allows us to add further behaviors without further altering the code.

Visitor Pattern: Structure

1 The **Visitor** interface declares a set of visiting methods that can take concrete elements of an object structure as arguments.

2 Each **Concrete Visitor** implements several versions of the same behaviors, tailored for different concrete element classes.



3 The **Element** interface declares a method for "accepting" visitors. This method should have one parameter declared with the type of the visitor interface.

4 Each **Concrete Element** must implement the acceptance method. The purpose of this method is to **redirect the call to the proper visitor's method corresponding to the current element class.** Be aware that even if a base element class implements this method, all subclasses must still override this method in their own classes and call the appropriate method on the visitor object.

5 The Client usually represents a collection or some other complex object (for example, a Composite tree).

Visitor Pattern: Example-1

```java
public interface CarElementVisitable {

    void accept(CarElementVisitor visitor);
}
```

Read the **example code** discussed in the lectures, and also **provided** for this week

```java
public class Wheel implements CarElementVisitable {

    private final String name;
    private double cost = 210;

    public Wheel(final String name) {
        this.name = name;
    }

    public String getName() {
        return name;
    }

    @Override
    public void accept(CarElementVisitor visitor) {

        visitor.visit(this);
    }
```

"**accept**" method for Simple Object

```java
public class Car implements CarElementVisitable {

    private ArrayList<CarElementVisitable> elements =
            new ArrayList<CarElementVisitable>();

    private double cost = 6000;

    public Car() {
        this.elements.add( new Wheels() );
        this.elements.add( new Body() );
        this.elements.add( new Engine() );
    }

    @Override
    public void accept(CarElementVisitor visitor) {

        for (CarElementVisitable element : elements) {
            element.accept(visitor);
        }

        visitor.visit(this);
    }
```

"**accept**" method for Composite Object

Visitor Pattern: Example-1

```java
public interface CarElementVisitor {

    void visit(Body body);
    void visit(BodyPart1 bodyPart1);
    void visit(BodyPart2 bodyPart2);

    void visit(Wheels wheels);
    void visit(Wheel wheel);

    void visit(Car car);
    void visit(Engine engine);

}
```

The visitor class need to define a set of **visit** methods, each of which could take arguments of different types. For example, "Body", "Engine", "Car", "Wheel", etc. Need to implement **visit** methods for each type.

```java
public class CarElementPrintVisitor implements CarElementVisitor {

    @Override
    public void visit(Body body) {
        System.out.println("Visiting body");
    }

    @Override
    public void visit(Car car) {
        System.out.println("Visiting car");
    }

    @Override
    public void visit(Engine engine) {
        System.out.println("Visiting engine");
    }

    @Override
    public void visit(Wheel wheel) {
        System.out.println("Visiting " + wheel.getName() + " wheel");
    }

    @Override
    public void visit(BodyPart1 bodyPart1) {
        System.out.println("Visiting bodyPart1");

    }
```

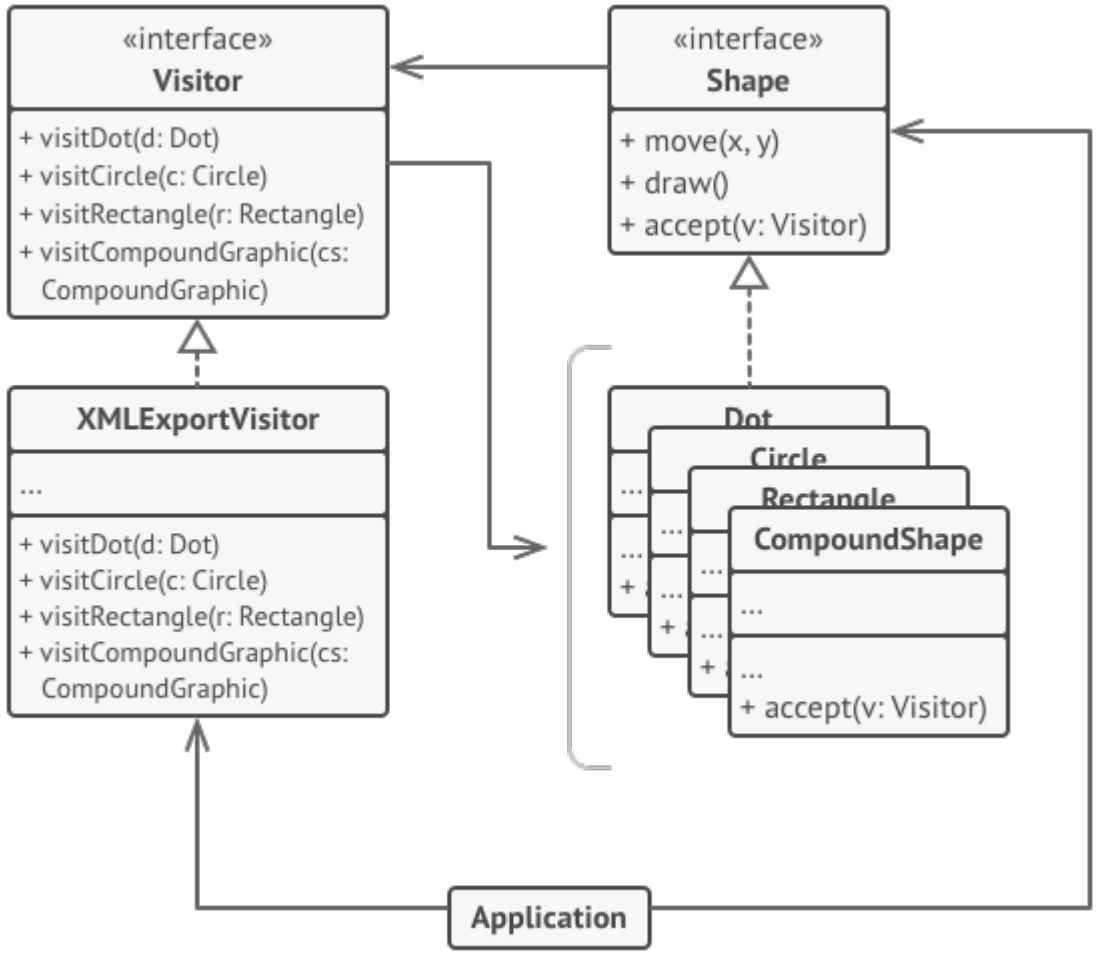
```java
public static void main(final String[] args) {

    Car car = new Car();

    System.out.println("\n ------ From CarElemen
    car.accept(new CarElementPrintVisitor());
```

Read the **example code** discussed in the lectures, and also **provided** for this week

Visitor Pattern: Example-2



For more see: https://refactoring.guru/design-patterns/visitor/java/example

Visitor Pattern: Applicability and Limitation

Applicability:

Moving operations into visitor classes is beneficial when,

- many unrelated operations on an object structure are required,
- the classes that make up the object structure are known and not expected to change,
- new operations need to be added frequently,
- an algorithm involves several classes of the object structure, but it is desired to manage it in one single location,
- an algorithm needs to work across several independent class hierarchies.

Limitation:

- extensions to the class hierarchy more difficult,
  as a new class typically require a new **visit** method to be added to each visitor.

End