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Visitor pattern

In object-oriented programming and software engineering, 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 existent object structures without modifying the structures. It is one way to follow the open/closed principle.

In essence, the visitor allows adding new virtual functions to a family of classes, without modifying the classes. Instead, a visitor class is created that implements all of the appropriate specializations of the virtual function. The visitor takes the instance reference as input, and implements the goal through double dispatch.

Contents

Overview

The Visitor [1] design pattern is one of the twenty-three well-known *GoF design patterns* that describe how to solve recurring design problems to design flexible and reusable object-oriented software, that is, objects that are easier to implement, change, test, and reuse.

What problems can the Visitor design pattern solve? [2]

- It should be possible to define a new operation for (some) classes of an object structure without changing the classes.

When new operations are needed frequently and the object structure consists of many unrelated classes, it's inflexible to add new subclasses each time a new operation is required because "[..] distributing all these operations across the various node classes leads to a system that's hard to understand, maintain, and change." [1]

What solution does the Visitor design pattern describe?

- Define a separate (visitor) object that implements an operation to be performed on elements of an object structure.
- Clients traverse the object structure and call a *dispatching operation accept(visitor)* on an element — that "dispatches" (delegates) the request to the "accepted visitor object". The visitor object then performs the operation on the element ("visits the element").

This makes it possible to create new operations independently from the classes of an object structure by adding new visitor objects.

See also the UML class and sequence diagram below.

Definition

The Gang of Four defines the Visitor as:

> Represent an operation to be performed on elements of an object structure. Visitor lets you define a new operation without changing the classes of the elements on which it operates.

The nature of the Visitor makes it an ideal pattern to plug into public APIs thus allowing its clients to perform operations on a class using a "visiting" class without having to modify the source.[3]

Uses

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.

A drawback to this pattern, however, is that it makes extensions to the class hierarchy more difficult, as new classes typically require a new `visit` method to be added to each visitor.

Use Case Example

Consider the design of a 2D computer-aided design (CAD) system. At its core there are several types to represent basic geometric shapes like circles, lines, and arcs. The entities are ordered into layers, and at the top of the type hierarchy is the drawing, which is simply a list of layers, plus some added properties.

A fundamental operation on this type hierarchy is saving a drawing to the system's native file format. At first glance it may seem acceptable to add local save methods to all types in the hierarchy. But it is also useful to be able to save drawings to other file formats. Adding ever more methods for saving into many different file formats soon clutters the relatively pure original geometric data structure.

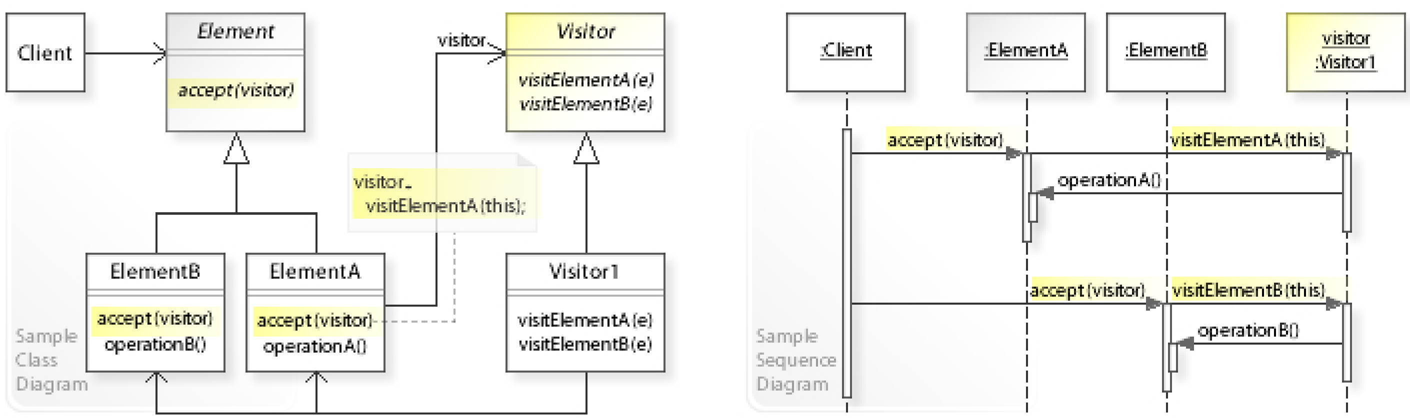
A naive way to solve this would be to maintain separate functions for each file format. Such a save function would take a drawing as input, traverse it, and encode into that specific file format. As this is done for each added different format, duplication between the functions accumulates. For example, saving a circle shape in a raster format requires very similar code no matter what specific raster form is used, and is different from other primitive shapes. The case for other primitive shapes like lines and polygons is similar. Thus, the code becomes a large outer loop traversing through the objects, with a large decision tree inside the loop querying the type of the object. Another problem with this approach is that it is very easy to miss a shape in one or more savers, or a new primitive shape is introduced, but the save routine is implemented only for one file type and not others, leading to code extension and maintenance problems.

Instead, the Visitor pattern can be applied. It encodes a logical operation on the whole hierarchy into one class containing one method per type. In the CAD example, each save function would be implemented as a separate Visitor subclass. This would remove all duplication of type checks and traversal steps. It would also make the compiler complain if a shape is omitted.

Another motive is to reuse iteration code. For example, iterating over a directory structure could be implemented with a visitor pattern. This would allow creating file searches, file backups, directory removal, etc., by implementing a visitor for each function while reusing the iteration code.

Structure

UML class and sequence diagram

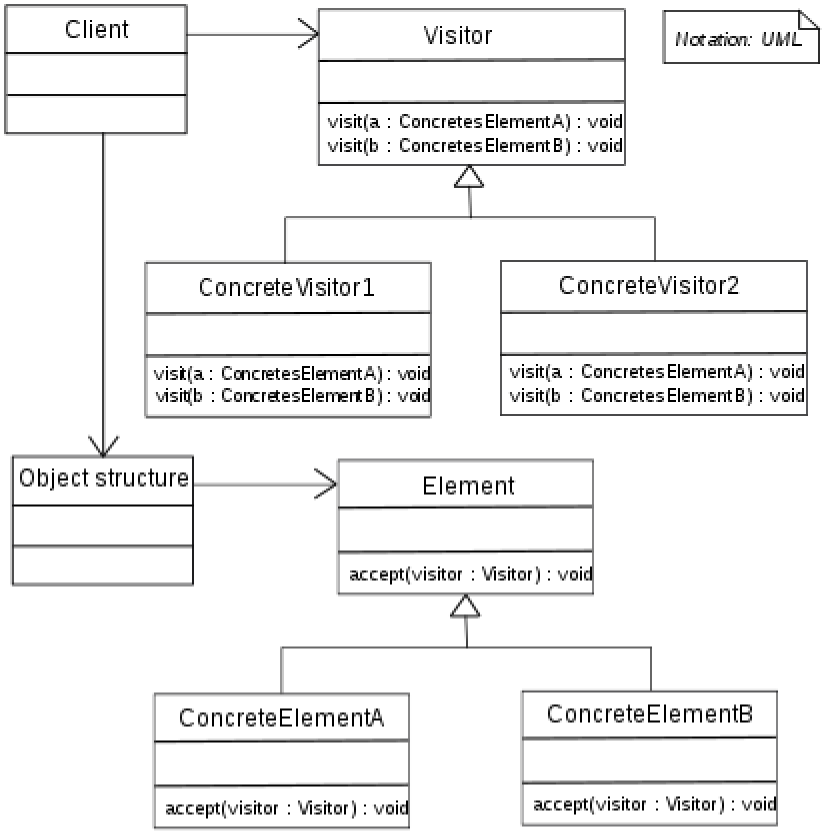


A sample UML class and sequence diagram for the Visitor design pattern. [4]

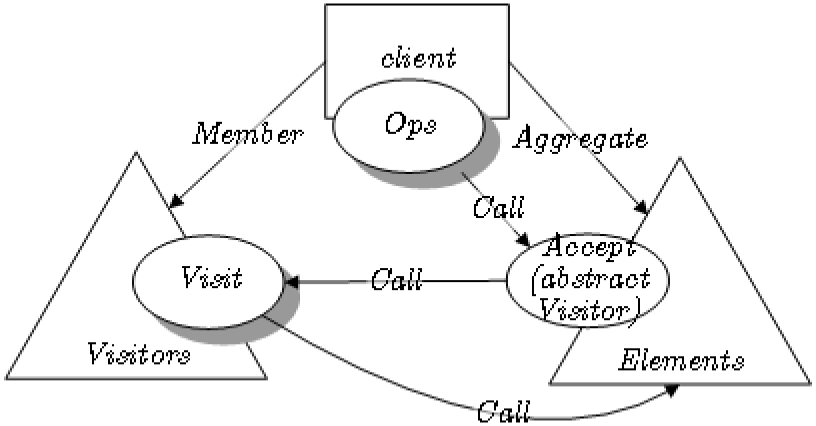
In the above UML class diagram, the `ElementA` class doesn't implement a new operation directly. Instead, `ElementA` implements a *dispatching operation* `accept(visitor)` that "dispatches" (delegates) a request to the "accepted visitor object" (`visitor.visitElementA(this)`). The `Visitor1` class implements the operation (`visitElementA(e:ElementA)`).
`ElementB` then implements `accept(visitor)` by dispatching to `visitor.visitElementB(this)`. The `Visitor1` class implements the operation (`visitElementB(e:ElementB)`).

The UML sequence diagram shows the run-time interactions: The `Client` object traverses the elements of an object structure (`ElementA,ElementB`) and calls `accept(visitor)` on each element.
First, the `Client` calls `accept(visitor)` on `ElementA`, which calls `visitElementA(this)` on the accepted `visitor` object. The element itself (`this`) is passed to the `visitor` so that it can "visit" `ElementA` (call `operationA()`).
Thereafter, the `Client` calls `accept(visitor)` on `ElementB`, which calls `visitElementB(this)` on the `visitor` that "visits" `ElementB` (calls `operationB()`).

Class diagram



Visitor in Unified Modeling Language (UML)



Visitor in LePUS3 (legend (http://lepus.org.uk/ref/legend/legend.xml))

Details

The visitor pattern requires a programming language that supports single dispatch, as common object-oriented languages (such as C++, Java, Smalltalk, Objective-C, Swift, JavaScript, Python and C#) do. Under this condition, consider two objects, each of some class type; one is termed the *element*, and the other is *visitor*.

The *visitor* declares a `visit` method, which takes the element as an argument, for each class of element. *Concrete visitors* are derived from the visitor class and implement these `visit` methods, each of which implements part of the algorithm operating on the object structure. The state of the algorithm is maintained locally by the concrete visitor class.

The *element* declares an `accept` method to accept a visitor, taking the visitor as an argument. *Concrete elements*, derived from the element class, implement the `accept` method. In its simplest form, this is no more than a call to the visitor's `visit` method. Composite elements, which maintain a list of child objects, typically iterate over these, calling each child's `accept` method.

The *client* creates the object structure, directly or indirectly, and instantiates the concrete visitors. When an operation is to be performed which is implemented using the Visitor pattern, it calls the `accept` method of the top-level element(s).

When the `accept` method is called in the program, its implementation is chosen based on both the dynamic type of the element and the static type of the visitor. When the associated `visit` method is called, its implementation is chosen based on both the dynamic type of the visitor and the static type of the element, as known from within the implementation of the `accept` method, which is the same as the dynamic type of the element. (As a bonus, if the visitor can't handle an argument of the given element's type, then the compiler will catch the error.)

Thus, the implementation of the `visit` method is chosen based on both the dynamic type of the element and the dynamic type of the visitor. This effectively implements double dispatch. For languages whose object systems support multiple dispatch, not only single dispatch, such as Common Lisp or C# via the Dynamic Language Runtime (DLR), implementation of the visitor pattern is greatly simplified (a.k.a. Dynamic Visitor) by allowing use of simple function overloading to cover all the cases being visited. A dynamic visitor, provided it operates on public data only, conforms to the open/closed principle (since it does not modify extant structures) and to the single responsibility principle (since it implements the Visitor pattern in a separate component).

In this way, one algorithm can be written to traverse a graph of elements, and many different kinds of operations can be performed during that traversal by supplying different kinds of visitors to interact with the elements based on the dynamic types of both the elements and the visitors.

C# example

This example shows how to print a tree representing a numeric expression involving literals and their addition. The same example is presented using both classic and Dynamic Language Runtime implementations.

Classic visitor

A classic visitor where the Print operations for each type are implemented in one ExpressionPrinter class as a number of overloads of the Visit method.

```
namespace Wikipedia
{
  using System;
  using System.Text;

  interface IExpressionVisitor
  {
    void Visit(Literal literal);
    void Visit(Addition addition);
  }

  interface IExpression
  {
    void Accept(IExpressionVisitor visitor);
  }

  class Literal : IExpression
  {
    internal double Value { get; set; }

    public Literal(double value)
    {
      this.Value = value;
    }
    public void Accept(IExpressionVisitor visitor)
    {
      visitor.Visit(this);
    }
```

```
}

class Addition : IExpression
{
  internal IExpression Left { get; set; }
  internal IExpression Right { get; set; }

  public Addition(IExpression left, IExpression right)
  {
    this.Left = left;
    this.Right = right;
  }

  public void Accept(IExpressionVisitor visitor)
  {
    visitor.Visit(this);
  }
}

class ExpressionPrinter : IExpressionVisitor
{
  StringBuilder sb;

  public ExpressionPrinter(StringBuilder sb)
  {
      this.sb = sb;
  }

  public void Visit(Literal literal)
  {
    sb.Append(literal.Value);
  }

  public void Visit(Addition addition)
  {
    sb.Append("(");
    addition.Left.Accept(this);
    sb.Append("+");
    addition.Right.Accept(this);
    sb.Append(")");
  }
}

public class Program
{
  public static void Main(string[] args)
  {
    // emulate 1+2+3
    var e = new Addition(
      new Addition(
        new Literal(1),
        new Literal(2)
      ),
      new Literal(3)
    );
    var sb = new StringBuilder();
```

```
      var expressionPrinter = new ExpressionPrinter(sb);
      e.Accept(expressionPrinter);
      Console.WriteLine(sb);
    }
  }
}
```

Dynamic Visitor

This example declares a separate `ExpressionPrinter` class that takes care of the printing. The expression classes must expose their members to make this possible.

```
namespace Wikipedia
{
  using System;
  using System.Text;

  abstract class Expression
  {
  }

  class Literal : Expression
  {
    public double Value { get; set; }

    public Literal(double value)
    {
      this.Value = value;
    }
  }

  class Addition : Expression
  {
    public Expression Left { get; set; }
    public Expression Right { get; set; }

    public Addition(Expression left, Expression right)
    {
      Left = left;
      Right = right;
    }
  }

  class ExpressionPrinter
  {
    public static void Print(Literal literal, StringBuilder sb)
    {
      sb.Append(literal.Value);
    }

    public static void Print(Addition addition, StringBuilder sb)
    {
```

```
      sb.Append("(");
      Print((dynamic) addition.Left, sb);
      sb.Append("+");
      Print((dynamic) addition.Right, sb);
      sb.Append(")");
    }
  }

  class Program
  {
    static void Main(string[] args)
    {
      // emulate 1+2+3
      var e = new Addition(
        new Addition(
          new Literal(1),
          new Literal(2)
        ),
        new Literal(3)
      );
      var sb = new StringBuilder();
      ExpressionPrinter.Print((dynamic) e, sb);
      Console.WriteLine(sb);
    }
  }
}
```

Smalltalk example

In this case, it is the object's responsibility to know how to print itself on a stream. The visitor here is then the object, not the stream.

```
"There's no syntax for creating a class. Classes are created by sending messages to other classes."
WriteStream subclass: #ExpressionPrinter
    instanceVariableNames: ''
    classVariableNames: ''
    package: 'Wikipedia'.

ExpressionPrinter>>write: anObject
    "Delegates the action to the object. The object doesn't need to be of any special
    class; it only needs to be able to understand the message #putOn:"
    anObject putOn: self.
    ^ anObject.

Object subclass: #Expression
    instanceVariableNames: ''
    classVariableNames: ''
    package: 'Wikipedia'.

Expression subclass: #Literal
    instanceVariableNames: 'value'
    classVariableNames: ''
    package: 'Wikipedia'.
```

```
Literal class>>with: aValue
    "Class method for building an instance of the Literal class"
    ^ self new
        value: aValue;
        yourself.

Literal>>value: aValue
  "Setter for value"
  value := aValue.

Literal>>putOn: aStream
    "A Literal object knows how to print itself"
    aStream nextPutAll: value asString.

Expression subclass: #Addition
    instanceVariableNames: 'left right'
    classVariableNames: ''
    package: 'Wikipedia'.

Addition class>>left: a right: b
    "Class method for building an instance of the Addition class"
    ^ self new
        left: a;
        right: b;
        yourself.

Addition>>left: anExpression
    "Setter for left"
    left := anExpression.

Addition>>right: anExpression
    "Setter for right"
    right := anExpression.

Addition>>putOn: aStream
    "An Addition object knows how to print itself"
    aStream nextPut: $(.
    left putOn: aStream.
    aStream nextPut: $+.
    right putOn: aStream.
    aStream nextPut: $).

Object subclass: #Program
    instanceVariableNames: ''
    classVariableNames: ''
    package: 'Wikipedia'.

Program>>main
    | expression stream |
    expression := Addition
                    left: (Addition
                            left: (Literal with: 1)
                            right: (Literal with: 2))
                    right: (Literal with: 3).
    stream := ExpressionPrinter on: (String new: 100).
```

```
    stream write: expression.
    Transcript show: stream contents.
    Transcript flush.
```

C++ example

Sources

```
#include <iostream>
#include <vector>

class AbstractDispatcher;   // Forward declare AbstractDispatcher

class File {    // Parent class for the elements (ArchivedFile, SplitFile and ExtractedFile)
public:
    // This function accepts an object of any class derived from AbstractDispatcher and must be implemented in all derived classes
    virtual void accept(AbstractDispatcher &dispatcher) = 0;
};

// Forward declare specific elements (files) to be dispatched
class ArchivedFile;
class SplitFile;
class ExtractedFile;

class AbstractDispatcher {   // Declares the interface for the dispatcher
public:
    // Declare overloads for each kind of a file to dispatch
    virtual void dispatch(ArchivedFile &file) = 0;
    virtual void dispatch(SplitFile &file) = 0;
    virtual void dispatch(ExtractedFile &file) = 0;
};

class ArchivedFile: public File {    // Specific element class #1
public:
    // Resolved at runtime, it calls the dispatcher's overloaded function, corresponding to ArchivedFile.
    void accept(AbstractDispatcher &dispatcher) override {
        dispatcher.dispatch(*this);
    }
};

class SplitFile: public File {   // Specific element class #2
public:
    // Resolved at runtime, it calls the dispatcher's overloaded function, corresponding to SplitFile.
    void accept(AbstractDispatcher &dispatcher) override {
        dispatcher.dispatch(*this);
    }
};

class ExtractedFile: public File {   // Specific element class #3
public:
```

```
    // Resolved at runtime, it calls the dispatcher's overloaded function, corresponding to ExtractedFile.
    void accept(AbstractDispatcher &dispatcher) override {
        dispatcher.dispatch(*this);
    }
};

class Dispatcher: public AbstractDispatcher {   // Implements dispatching of all kind of elements (files)
public:
    void dispatch(ArchivedFile &) override {
        std::cout << "dispatching ArchivedFile" << std::endl;
    }

    void dispatch(SplitFile &) override {
        std::cout << "dispatching SplitFile" << std::endl;
    }

    void dispatch(ExtractedFile &) override {
        std::cout << "dispatching ExtractedFile" << std::endl;
    }
};

int main() {
    ArchivedFile archivedFile;
    SplitFile splitFile;
    ExtractedFile extractedFile;

    std::vector<File*> files;
    files.push_back(&archivedFile);
    files.push_back(&splitFile);
    files.push_back(&extractedFile);

    Dispatcher dispatcher;

    for (File* file : files) {
        file->accept(dispatcher);
    }
}
```

Output

```
dispatching ArchivedFile
dispatching SplitFile
dispatching ExtractedFile
```

Go example

Sources

```go
package visitor2

import "fmt"

type Visitor interface {
    Visit(element) string
}

type element interface {
    Accept(visitor Visitor) string
}

type Wheel struct {
    name string
}

func (self *Wheel) Accept(visitor Visitor) string {
    return visitor.Visit(self)
}

func (self *Wheel) getName() string {
    return self.name
}

type Engine struct{}

func (self *Engine) Accept(visitor Visitor) string {
    return visitor.Visit(self)
}

type Body struct{}

func (self *Body) Accept(visitor Visitor) string {
    return visitor.Visit(self)
}

type Car struct {
    engine Engine
    body   Body
    wheels [4]Wheel
}

func (self *Car) Accept(visitor Visitor) string {
    res := visitor.Visit(self)
    res += self.engine.Accept(visitor)
    res += self.body.Accept(visitor)
    for _, wheel := range self.wheels {
        res += wheel.Accept(visitor)
    }
    return res
}

type VisitCar struct{}

func (self *VisitCar) Visit(element element) string {
    switch element.(type) {
```

```
    case *Body:
        return fmt.Sprintln("visiting body")
    case *Car:
        return fmt.Sprintln("visiting car")
    case *Engine:
        return fmt.Sprintln("visiting engine")
    case *Wheel:
        return fmt.Sprintln("visiting", element.(*Wheel).getName(), "wheel")
    default:
        return "unsupported type"
    }
}
```

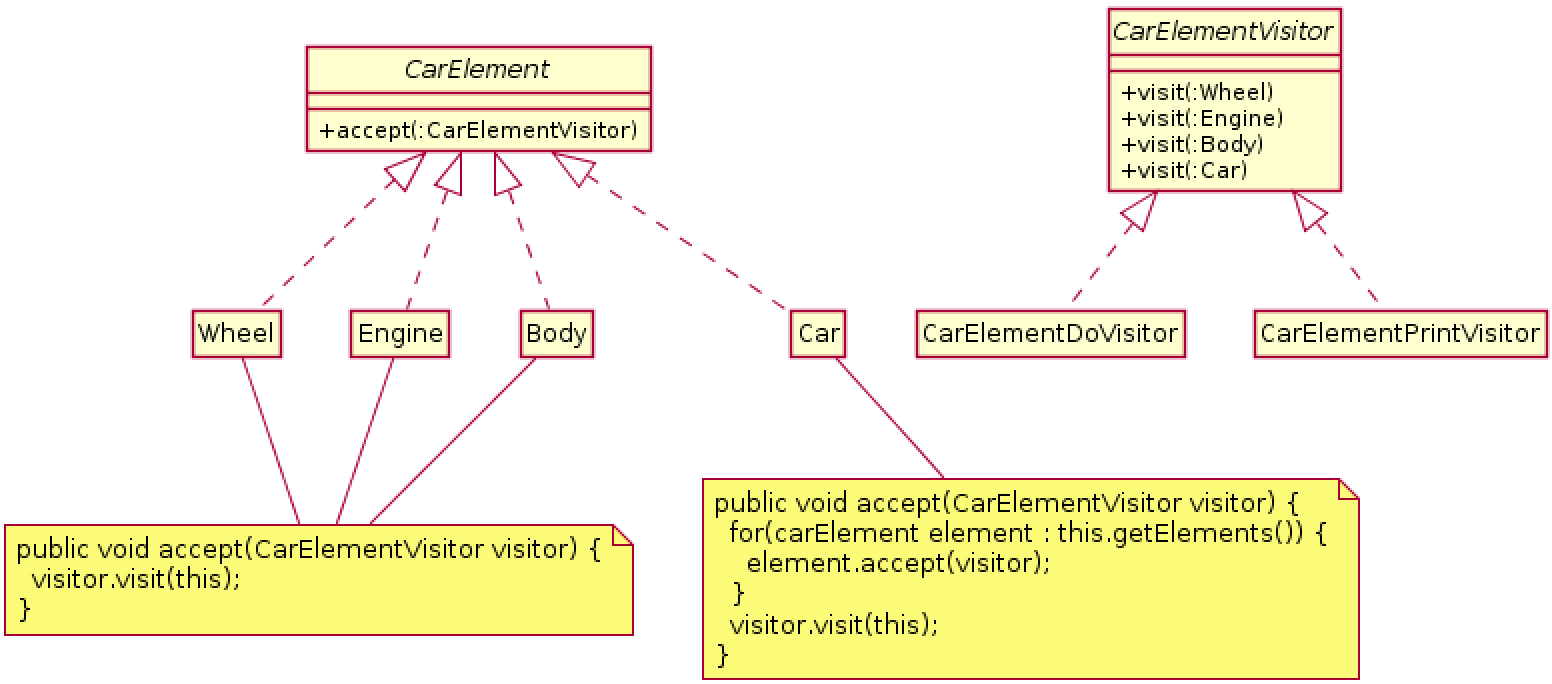
Testcase

```
package visitor

import (
    "testing"
)

func TestVistor(t *testing.T) {
    car := Car{
        engine: Engine{},
        body:   Body{},
    }
    car.wheels[0] = Wheel{"front left"}
    car.wheels[1] = Wheel{"front right"}
    car.wheels[2] = Wheel{"back  left"}
    car.wheels[3] = Wheel{"back right"}

    visitor := VisitCar{}
    res := car.Accept(&visitor)
    exp := `visiting car
visiting engine
visiting body
visiting front left wheel
visiting front right wheel
visiting back  left wheel
visiting back right wheel
`
    if res != exp {
        t.Error(res, exp)
    }
}
```

Java example

The following example is in the language Java, and shows how the contents of a tree of nodes (in this case describing the components of a car) can be printed. Instead of creating `print` methods for each node subclass (`Wheel`, `Engine`, `Body`, and `Car`), one visitor class (`CarElementPrintVisitor`) performs the required printing action. Because different node subclasses require slightly different actions to print properly, `CarElementPrintVisitor` dispatches actions based on the class of the argument passed to its `visit` method. `CarElementDoVisitor`, which is analogous to a save operation for a different file format, does likewise.

Diagram



Sources

```java
import java.util.List;

interface CarElement {
    void accept(CarElementVisitor visitor);
}

interface CarElementVisitor {
    void visit(Body body);
    void visit(Car car);
    void visit(Engine engine);
    void visit(Wheel wheel);
}
```

```
class Wheel implements CarElement {
  private final String name;

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

  public String getName() {
      return name;
  }

  @Override
  public void accept(CarElementVisitor visitor) {
      /*
       * accept(CarElementVisitor) in Wheel implements
       * accept(CarElementVisitor) in CarElement, so the call
       * to accept is bound at run time. This can be considered
       * the *first* dispatch. However, the decision to call
       * visit(Wheel) (as opposed to visit(Engine) etc.) can be
       * made during compile time since 'this' is known at compile
       * time to be a Wheel. Moreover, each implementation of
       * CarElementVisitor implements the visit(Wheel), which is
       * another decision that is made at run time. This can be
       * considered the *second* dispatch.
       */
      visitor.visit(this);
  }
}

class Body implements CarElement {
  @Override
  public void accept(CarElementVisitor visitor) {
      visitor.visit(this);
  }
}

class Engine implements CarElement {
  @Override
  public void accept(CarElementVisitor visitor) {
      visitor.visit(this);
  }
}

class Car implements CarElement {
    private final List<CarElement> elements;

    public Car() {
        this.elements = List.of(
            new Wheel("front left"), new Wheel("front right"),
            new Wheel("back left"), new Wheel("back right"),
            new Body(), new Engine()
        );
    }

    @Override
```

```
    public void accept(CarElementVisitor visitor) {
        for (CarElement element : elements) {
            element.accept(visitor);
        }
        visitor.visit(this);
    }
}

class CarElementDoVisitor implements CarElementVisitor {
    @Override
    public void visit(Body body) {
        System.out.println("Moving my body");
    }

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

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

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

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");
    }
}

public class VisitorDemo {
    public static void main(final String[] args) {
        Car car = new Car();
```

```
        car.accept(new CarElementPrintVisitor());
        car.accept(new CarElementDoVisitor());
    }
}
```

A more flexible approach to this pattern is to create a wrapper class implementing the interface defining the accept method. The wrapper contains a reference pointing to the `CarElement` that could be initialized through the constructor. This approach avoids having to implement an interface on each element. *See article Java Tip 98 article below*

Output

```
Visiting front left wheel
Visiting front right wheel
Visiting back left wheel
Visiting back right wheel
Visiting body
Visiting engine
Visiting car
Kicking my front left wheel
Kicking my front right wheel
Kicking my back left wheel
Kicking my back right wheel
Moving my body
Starting my engine
Starting my car
```

Common Lisp example

Sources

```
(defclass auto ()
  ((elements :initarg :elements)))

(defclass auto-part ()
  ((name :initarg :name :initform "<unnamed-car-part>")))

(defmethod print-object ((p auto-part) stream)
  (print-object (slot-value p 'name) stream))

(defclass wheel (auto-part) ())

(defclass body (auto-part) ())

(defclass engine (auto-part) ())
```

```
(defgeneric traverse (function object other-object))

(defmethod traverse (function (a auto) other-object)
  (with-slots (elements) a
    (dolist (e elements)
      (funcall function e other-object))))

;; do-something visitations

;; catch all
(defmethod do-something (object other-object)
  (format t "don't know how ~s and ~s should interact~%" object other-object))

;; visitation involving wheel and integer
(defmethod do-something ((object wheel) (other-object integer))
  (format t "kicking wheel ~s ~s times~%" object other-object))

;; visitation involving wheel and symbol
(defmethod do-something ((object wheel) (other-object symbol))
  (format t "kicking wheel ~s symbolically using symbol ~s~%" object other-object))

(defmethod do-something ((object engine) (other-object integer))
  (format t "starting engine ~s ~s times~%" object other-object))

(defmethod do-something ((object engine) (other-object symbol))
  (format t "starting engine ~s symbolically using symbol ~s~%" object other-object))

(let ((a (make-instance 'auto
                        :elements `(,(make-instance 'wheel :name "front-left-wheel")
                                    ,(make-instance 'wheel :name "front-right-wheel")
                                    ,(make-instance 'wheel :name "rear-left-wheel")
                                    ,(make-instance 'wheel :name "rear-right-wheel")
                                    ,(make-instance 'body :name "body")
                                    ,(make-instance 'engine :name "engine")))))
  ;; traverse to print elements
  ;; stream *standard-output* plays the role of other-object here
  (traverse #'print a *standard-output*)

  (terpri) ;; print newline

  ;; traverse with arbitrary context from other object
  (traverse #'do-something a 42)

  ;; traverse with arbitrary context from other object
  (traverse #'do-something a 'abc))
```

Output

```
"front-left-wheel"
"front-right-wheel"
"rear-right-wheel"
"rear-right-wheel"
```

```
"body"
"engine"
kicking wheel "front-left-wheel" 42 times
kicking wheel "front-right-wheel" 42 times
kicking wheel "rear-right-wheel" 42 times
kicking wheel "rear-right-wheel" 42 times
don't know how "body" and 42 should interact
starting engine "engine" 42 times
kicking wheel "front-left-wheel" symbolically using symbol ABC
kicking wheel "front-right-wheel" symbolically using symbol ABC
kicking wheel "rear-right-wheel" symbolically using symbol ABC
kicking wheel "rear-right-wheel" symbolically using symbol ABC
don't know how "body" and ABC should interact
starting engine "engine" symbolically using symbol ABC
```

Notes

The `other-object` parameter is superfluous in `traverse`. The reason is that it is possible to use an anonymous function that calls the desired target method with a lexically captured object:

```
(defmethod traverse (function (a auto)) ;; other-object removed
  (with-slots (elements) a
    (dolist (e elements)
      (funcall function e)))) ;; from here too

  ;; ...

  ;; alternative way to print-traverse
  (traverse (lambda (o) (print o *standard-output*)) a)

  ;; alternative way to do-something with
  ;; elements of a and integer 42
  (traverse (lambda (o) (do-something o 42)) a)
```

Now, the multiple dispatch occurs in the call issued from the body of the anonymous function, and so `traverse` is just a mapping function that distributes a function application over the elements of an object. Thus all traces of the Visitor Pattern disappear, except for the mapping function, in which there is no evidence of two objects being involved. All knowledge of there being two objects and a dispatch on their types is in the lambda function.

Python example

Python is a dynamically-typed language and because of this cannot support method overloading. So the "visit" methods for the different model types need to have different names.

Sources

```python
"""
Visitor pattern example.
"""

from abc import ABCMeta, abstractmethod

NOT_IMPLEMENTED = "You should implement this."

class CarElement:
    __metaclass__ = ABCMeta
    @abstractmethod
    def accept(self, visitor):
        raise NotImplementedError(NOT_IMPLEMENTED)

class Body(CarElement):
    def accept(self, visitor):
        visitor.visitBody(self)


class Engine(CarElement):
    def accept(self, visitor):
        visitor.visitEngine(self)


class Wheel(CarElement):
    def __init__(self, name):
        self.name = name
    def accept(self, visitor):
        visitor.visitWheel(self)

class Car(CarElement):
    def __init__(self):
        self.elements = [
            Wheel("front left"), Wheel("front right"),
            Wheel("back left"), Wheel("back right"),
            Body(), Engine()
        ]

    def accept(self, visitor):
        for element in self.elements:
            element.accept(visitor)
        visitor.visitCar(self)

class CarElementVisitor:
    __metaclass__ = ABCMeta
    @abstractmethod
    def visitBody(self, element):
        raise NotImplementedError(NOT_IMPLEMENTED)
    @abstractmethod
    def visitEngine(self, element):
        raise NotImplementedError(NOT_IMPLEMENTED)
    @abstractmethod
    def visitWheel(self, element):
        raise NotImplementedError(NOT_IMPLEMENTED)
    @abstractmethod
    def visitCar(self, element):
```

```
        raise NotImplementedError(NOT_IMPLEMENTED)

class CarElementDoVisitor(CarElementVisitor):
    def visitBody(self, body):
        print("Moving my body.")
    def visitCar(self, car):
        print("Starting my car.")
    def visitWheel(self, wheel):
        print("Kicking my {} wheel.".format(wheel.name))
    def visitEngine(self, engine):
        print("Starting my engine.")


class CarElementPrintVisitor(CarElementVisitor):
    def visitBody(self, body):
        print("Visiting body.")
    def visitCar(self, car):
        print("Visiting car.")
    def visitWheel(self, wheel):
        print("Visiting {} wheel.".format(wheel.name))
    def visitEngine(self, engine):
        print("Visiting engine.")

car = Car()
car.accept(CarElementPrintVisitor())
car.accept(CarElementDoVisitor())
```

Output

```
Visiting front left wheel.
Visiting front right wheel.
Visiting back left wheel.
Visiting back right wheel.
Visiting body.
Visiting engine.
Visiting car.
Kicking my front left wheel.
Kicking my front right wheel.
Kicking my back left wheel.
Kicking my back right wheel.
Moving my body.
Starting my engine.
Starting my car.
```

Related design patterns

- Iterator pattern – defines a traversal principle like the visitor pattern, without making a type differentiation within the traversed objects
- Church encoding – a related concept from functional programming, in which tagged union/sum types may be modeled using the behaviors of "visitors" on such types, and which enables the visitor pattern to emulate variants and patterns.

See also

- Algebraic data type
- Double dispatch
- Multiple dispatch
- Function object

References

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2. "The Visitor design pattern - Problem, Solution, and Applicability" (http://w3sdesign.com/?gr=b11&ugr=proble). *w3sDesign.com*. Retrieved 2017-08-12.
3. Visitor pattern real-world example (https://coreycoogan.wordpress.com/2009/06/16/visitor-pattern-real-world-example/)
4. "The Visitor design pattern - Structure and Collaboration" (http://w3sdesign.com/?gr=b11&ugr=struct). *w3sDesign.com*. Retrieved 2017-08-12.

External links

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- Visitor Patterns (http://goblin.colourcountry.net/apt1002/Visitor%20patterns) as a universal model of terminating computation.
- Visitor Pattern (http://www.oodesign.com/oo_design_patterns/behavioral_patterns/visitor_pattern.html) using reflection(java).
- PerfectJPattern Open Source Project (http://perfectjpattern.sourceforge.net/dp-visitor.html), Provides a context-free and type-safe implementation of the Visitor Pattern in Java based on Delegates.
- Visitor Design Pattern (http://sourcemaking.com/design_patterns/visitor)
- Article Java Tip 98: Reflect on the Visitor design pattern (http://www.javaworld.com/javaworld/javatips/jw-javatip98.html)