CS 410/510 Advanced Programming

# The Visitor Pattern

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## Recap

- Recall the rows and columns diagram

| | | Operations | | |
|---|---|---|---|---|
| | | first | rest | isEmpty |
| Repres-entations | ConsList (e, l) | return e | return l | false |
| | EmptyList | error | error | true |

- Each row is a separate class
  ⇒ adding rows is easy
- Each column is a method in multiple classes
  ⇒ adding columns is hard (or impossible)

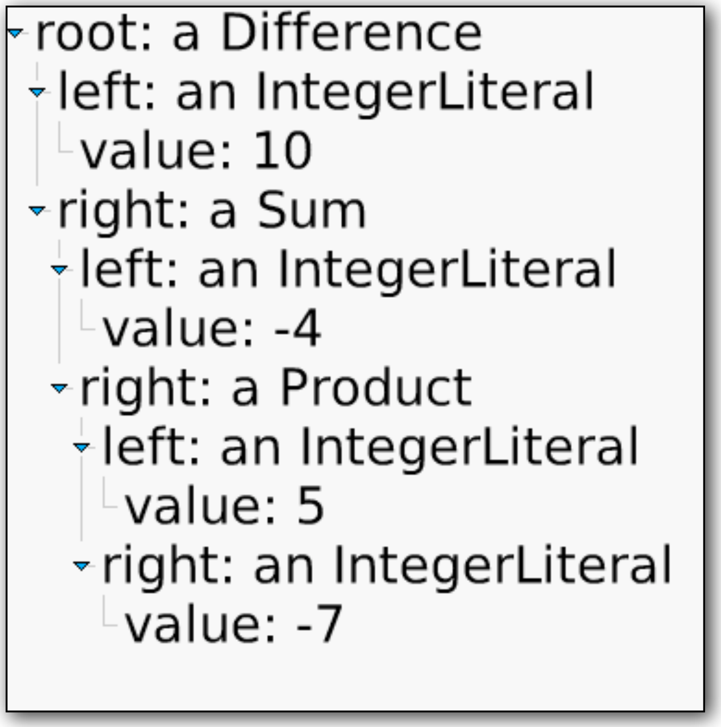
# Visitor: Synopsis

- The Visitor pattern turns columns (hard to add) into rows (easy to add)
  - *i.e.*, it turns columns (methods) into rows (classes)
- operations are represented as *classes*, rather than as *methods*.

## Example: Arithmetic Expressions

- Represent arithmetic expressions like

  10 - (-4 + (5 * -7))



```
root: a Difference
 left: an IntegerLiteral
  value: 10
 right: a Sum
  left: an IntegerLiteral
   value: -4
  right: a Product
   left: an IntegerLiteral
    value: 5
   right: an IntegerLiteral
    value: -7
```

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- Class hierarchy:
  - operations like *numericValue* would normally be implemented by recursive traversal of the expression tree
  - *e.g.*

```
Difference ›› **numericValue**
    ↑ left numericValue –
        right numericValue
```

```
Expression
  BinaryExpression
    Difference
    Product
    Quotient
    Sum
  Primary
    Factor
      Literal
        IntegerLiteral
        RealLiteral
      Negation
```

- Problem: each operation (prettyPrint, typeCheck, etc) is dispersed over a dozen classes

## Solution: turn operation into a class

1. Create *NumericEvaluator* class
   - give it methods called **visitDifference:**, **visitSum:**, that do the appropriate thing on Difference and Sum nodes, *e.g.*:

```
NumericEvaluator ›› visitDifference: diffNode
        ↑ diffNode left numericValue –
              diffNode right numericValue
```

Compare:

```
Difference ›› numericValue
        ↑ left numericValue –
              right numericValue
```

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## Solution (continued)

2. Every concrete class *Foo* in the Expression hierarchy gets a method *accept: aVisitor* defined as follows:

```
Foo ›› accept: aVisitor
        ↑ aVisitor visitFoo: self
```

- Note how the selector of the message tells the visitor what kind of node it is visiting
- Do this for Foo = Difference, Product, Quotient, Sum, *etc*.

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## Solution (continued)

3. At the top of the hierarchy, add a single method that provides a client interface:

```
Expression ›› numericValue
    ↑ self accept: NumericEvaluator new
```

- ✳ all of the code that implements numeric evaluation is now *outside* of the Expression classes
- ✳ It's in the NumericEvaluator class

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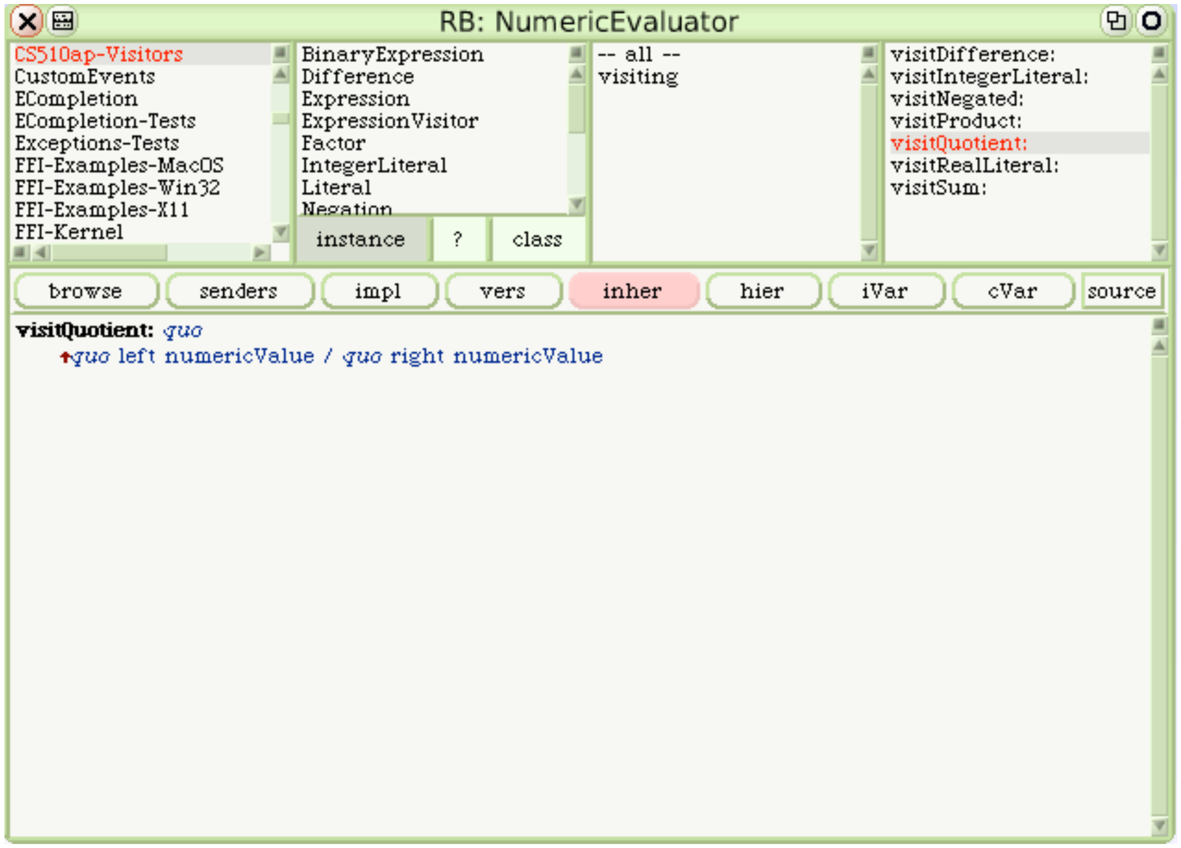
# Let's look …



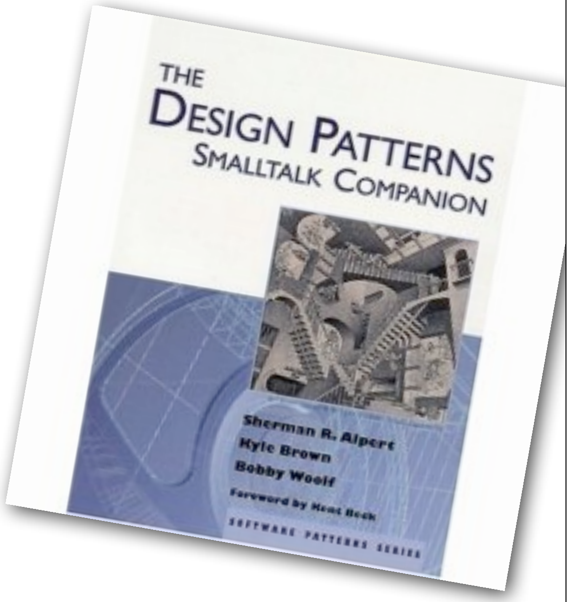
```
visitQuotient: quo
    ↑quo left numericValue / quo right numericValue
```

## Consequences

- External code (in the visitor) must have access to the internals of the visited objects
  - ➡ all significant state must be public
  - Is this object-oriented?
- New operations can be added without changing the Expression classes
  - Why is this a big deal?

A very good resource…
follows format of GoF book

## The Design Patterns Smalltalk Companion



by
Sherman R. Alpert, Kyle Brown, Bobby Woolf
Foreword by Kent Beck

Addison-Wesley, 1998.