CS 410/510 Advanced Programming

The Visitor Pattern

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Recap

- Recall the rows and columns diagram

		Operations		
		first	rest	isEmpty
Representations	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)

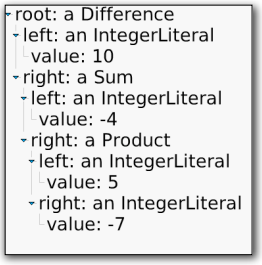
Visitor: Synopsis

- 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))



- 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
```

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*.

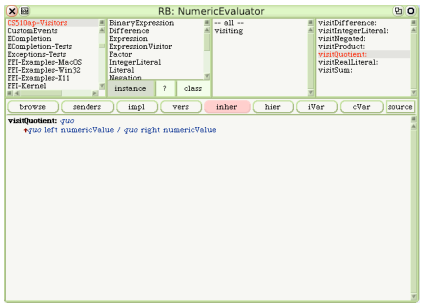
Solution (continued)

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

Let's look …



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.