Visitor

Modular and extensible first class actions

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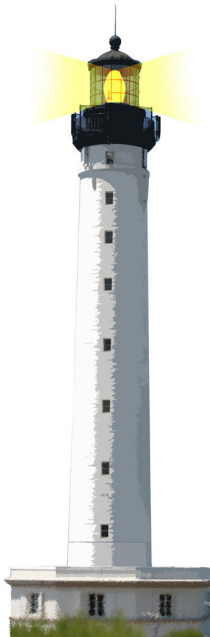


Pharo

http://www.pharo.org

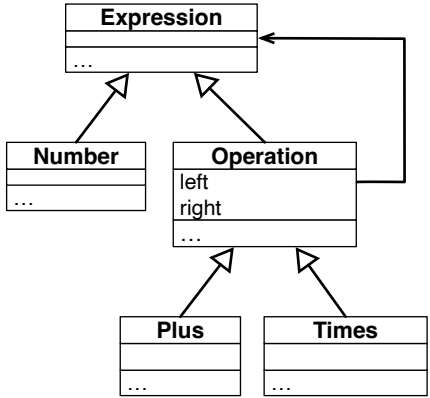
Goal

- Studying examples
- Understanding Visitor
- Pros and Cons

Example: basic arithmetic expressions

Imagine a simple mathematical system

- a Composite
- with number and operation expressions



Some expressions

1

```
ENumber value: 1
```

(3 * 2)

```
Times left: (ENumber value: 3) right: (ENumber value: 2)
```

1 + (3 * 2)

```
Plus
  left: (ENumber value: 1)
  right: (Times left: (ENumber value: 3) right: (ENumber value: 2))
```

In Pharo we can just extend Number so no need of ENumber value: but this is a detail

Operations on the structure

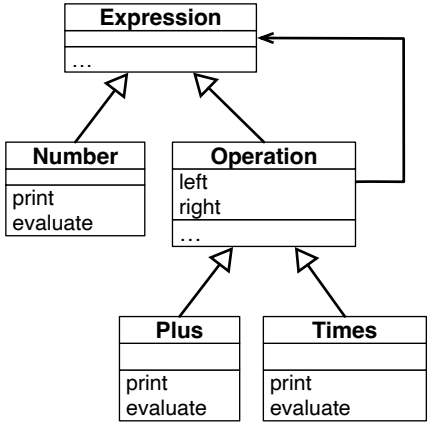
We want to evaluate expressions, and print them
Evaluating

```
1 + (3 * 2)
gives 7
```

Printing

```
+1*32
```

First design: behavior define in the domain



First design analysis

What if we need a stack to print well the expressions?

- Should we define the stack **in** the expression classes even if this is related **only** to print?

Should we **mix** the information about the treatment of items and the items themselves?

- What if we need a table for mathematical expressions **specific** to the LaTeX generation?
- What if we need a table for mathematical expression **specific** to the RDF generation?

Let us see on a real system: Pillar

We have

- the core hierarchy is about 50 classes
- export to LaTeX (two versions)
- export to HTML
- export to Beamer
- export to ASCIIdoc, Markdown, Microdown
- transform trees for expansion

First design conclusion

Putting all the behavior inside the domain objects

- **Blows up** the class API / state / methods
- **Mixes** concerns
- Is **not modular**: we cannot have one operation only
- **Prevents extension**: To add a new behavior I should change the domain

Alternate design: using a visitor

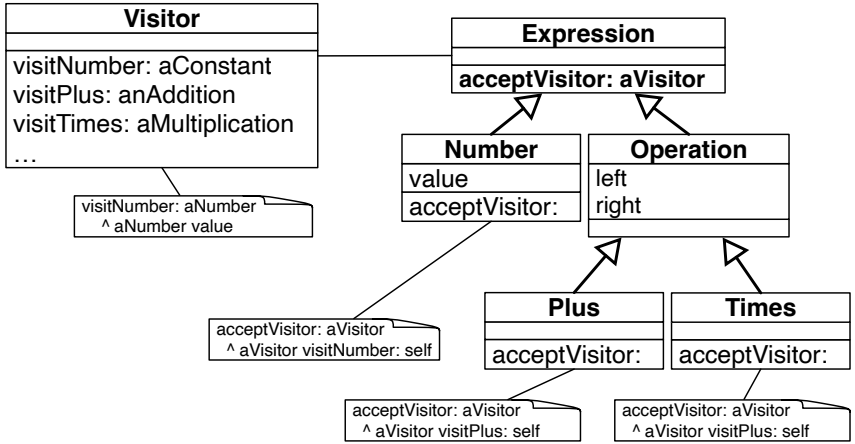
A **Visitor**:

- **decouples** operation from the structure
- **represents** an operation
- Supports **modularity**
  - can package visitors in separate packages
- Supports **extension**
  - defines an extension protocol (set of messages to be defined)
  - new visitors are easy to define

Visitor’s intent

- Represents an **operation** to be performed on the elements of an object structure in a class **separate** from the elements themselves.
- Visitor lets you define a new operation **without changing the classes of the elements** on which it operates.

Visitor's design



Visitor + Composite

A visitor requires a structure to perform different actions based on the kind of element

- **Perfect** match with a composite
- **Uses double dispatch**

A visitor separates a treatment from the data structure (Composite) it applies to.

Based on double dispatch

Each composite element accepts a visitor and tell it how to visit it

```
X >> accept: aVisitor
  aVisitor visitX: self
```

Key to avoid terrible conditional checks

Example: Evaluator Visitor

```
Evaluator >> visitNumber: aNumber
  ^ aNumber value
```

```
Evaluator >> visitPlus: anExpression
  | l r |
  l := anExpression left acceptVisitor: self.
  r := anExpression right acceptVisitor: self.
  ^ l + r
```

```
Evaluator >> visitTimes: anExpression
  | l r |
  l := anExpression left acceptVisitor: self.
  r := anExpression right acceptVisitor: self.
  ^ l * r
```

Invoking the Visitor

```
Evaluator new evaluate:
  (Plus
    left: (ENumber value: 1)
    right: (Times left: (ENumber value: 3) right: (ENumber value: 2)))
> 7
```

```
Evaluator >> evaluate: anExpression
  ^ anExpression acceptVisitor: self
```

Example: Printer

```
Visitor subclass: #Printer
  iv: 'stream level'
```

```
Printer >> visitNumber: aNumber
    stream nextPutAll: aNumber value asString
```

```
Printer >> visitPlus: anExpression
   stream nextPutAll: '+'.
   anExpression left acceptVisitor: self.
   anExpression right acceptVisitor: self.
```

```
Printer >> visitPlus: anExpression
   stream nextPutAll: '*'.
   anExpression left acceptVisitor: self.
   anExpression right acceptVisitor: self.
```

Expression Visitor analysis

- Each visitor **knows** what to do for a number, a plus, and times operation
- Each visitor manages its **own specific** state
- Each visitor is **independent** of other ones
- Double dispatch supports the decoupling

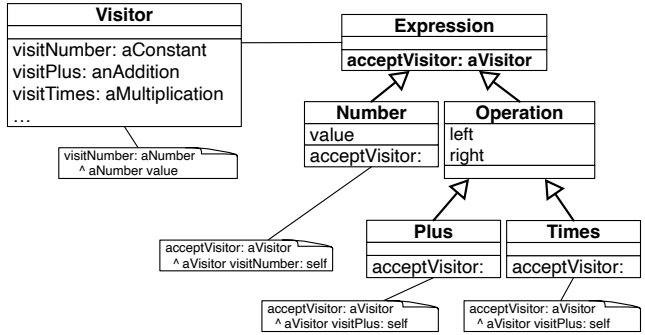
A protocol for extension

To extend a visitor:

- Define a class which has the expected API i.e., visitX methods
- Apply the visitor to the structure

Stepping back: double dispatch is the key point

- The Visitor knows the elementary operations (e.g., evaluating a plus, a minus, and a value)
- The items mentions to the Visitor how **they** want to be visited



Visitor: another look at it

Visitor design provides a **pluggable distributed recursive treatment** of a composite structure

```
Printer >> visitPlus: anExpression
   stream nextPutAll: '*'.
   anExpression left acceptVisitor: self.
   anExpression right acceptVisitor: self.
```

When to use a Visitor

- Whenever you have a number of items on which you have to perform a number of actions

Examples:

- Parse tree (ProgramNode) uses a visitor for
  - the compilation (emitting code on CodeStream),
  - pretty printing, syntax hilighting
  - different analysis pass,
  - rotten green test analysis
- Rendering documents (Document) in different formats
  - nodes expansion, HTML, LaTeX, ...

When using a Visitor is challenging

Changing node elements

- If the elements of the composite **change**, you will have to change **all** your visitors
- Problem known as the expression problems in statically-typed languages

Conclusion

Pros:

- Visitor is a good pattern
- It provides modular and extensible design
- Double dispatch makes it plug and play

Cons:

- Can look more complex
- It is not adapted to changing structures

A course by

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