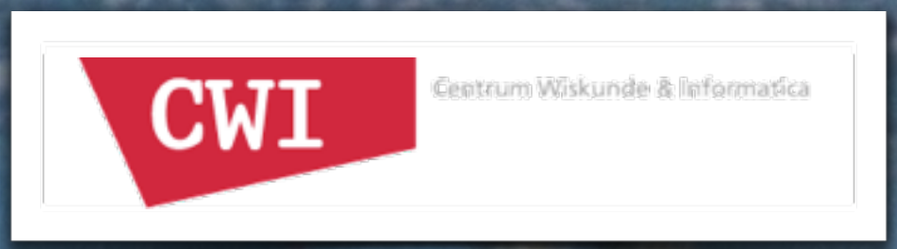


A case of Visitor versus Interpreter Pattern

Paul Klint, Mark Hills, Tijs van der Storm, Jurgen Vinju

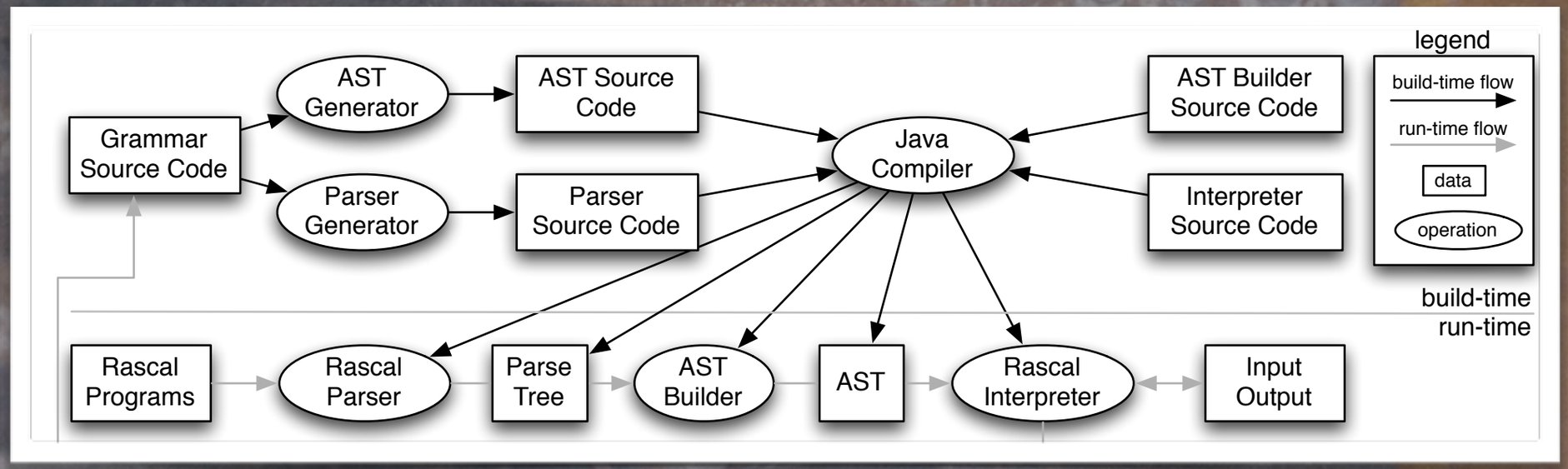
Zürich, June 30th 2011

Why?

- Why this experiment?
- Why this "laboratory" setup?
- Why trust the conclusions?

"Long Live Incremental Research!"

Case:



- Abstract syntax trees (ASTs)
- Operations on ASTs
- 400 concrete classes, 140 abstract classes
- AST classes are generated from a grammar
- Dispatch, dispatch, dispatch
- Evolution of the ± 100 kLOC java code

We compare design (patterns) to learn which is best in which situations

(We scope to "interpreters in Java, based on AST objects")

Composite Pattern

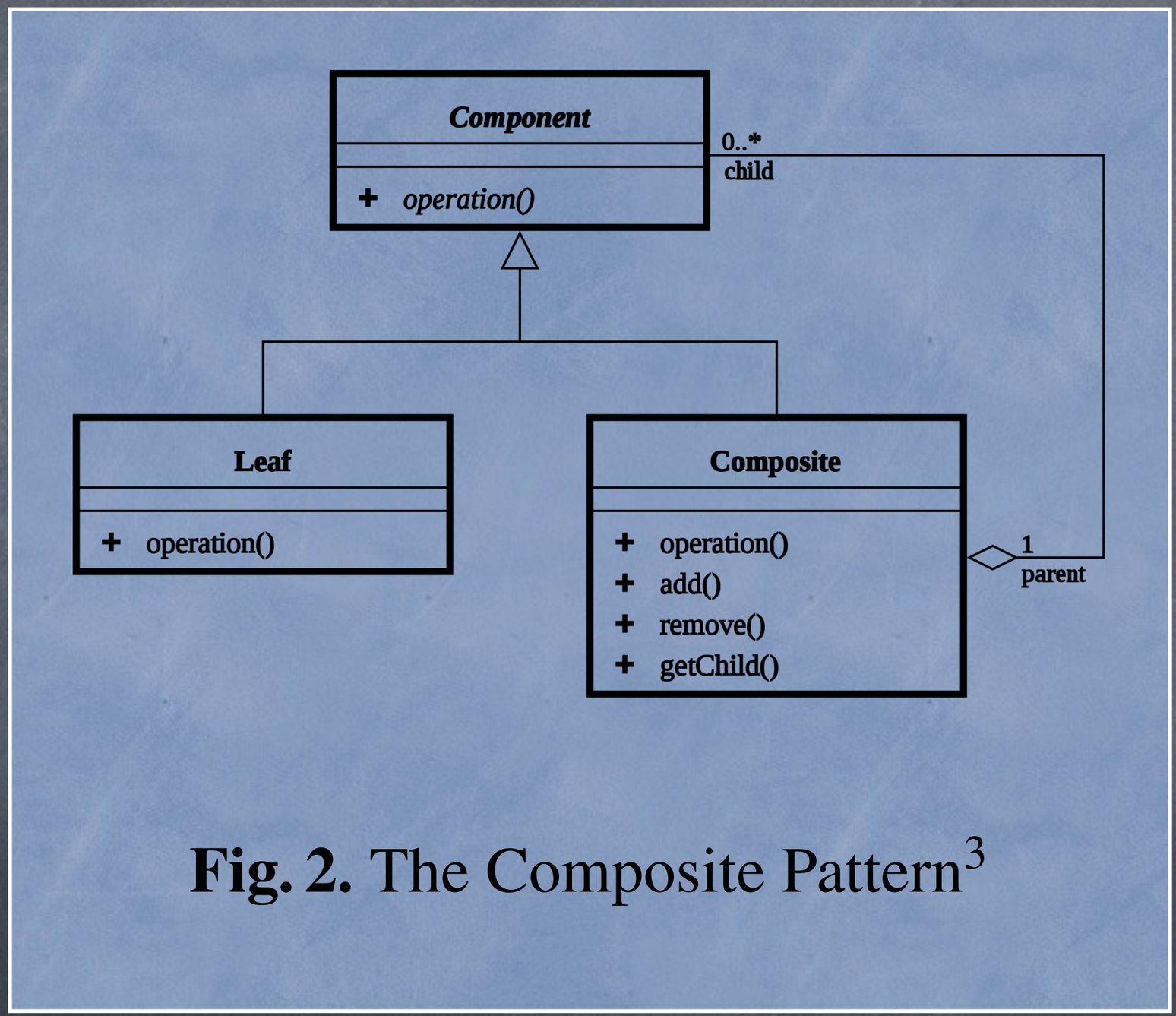
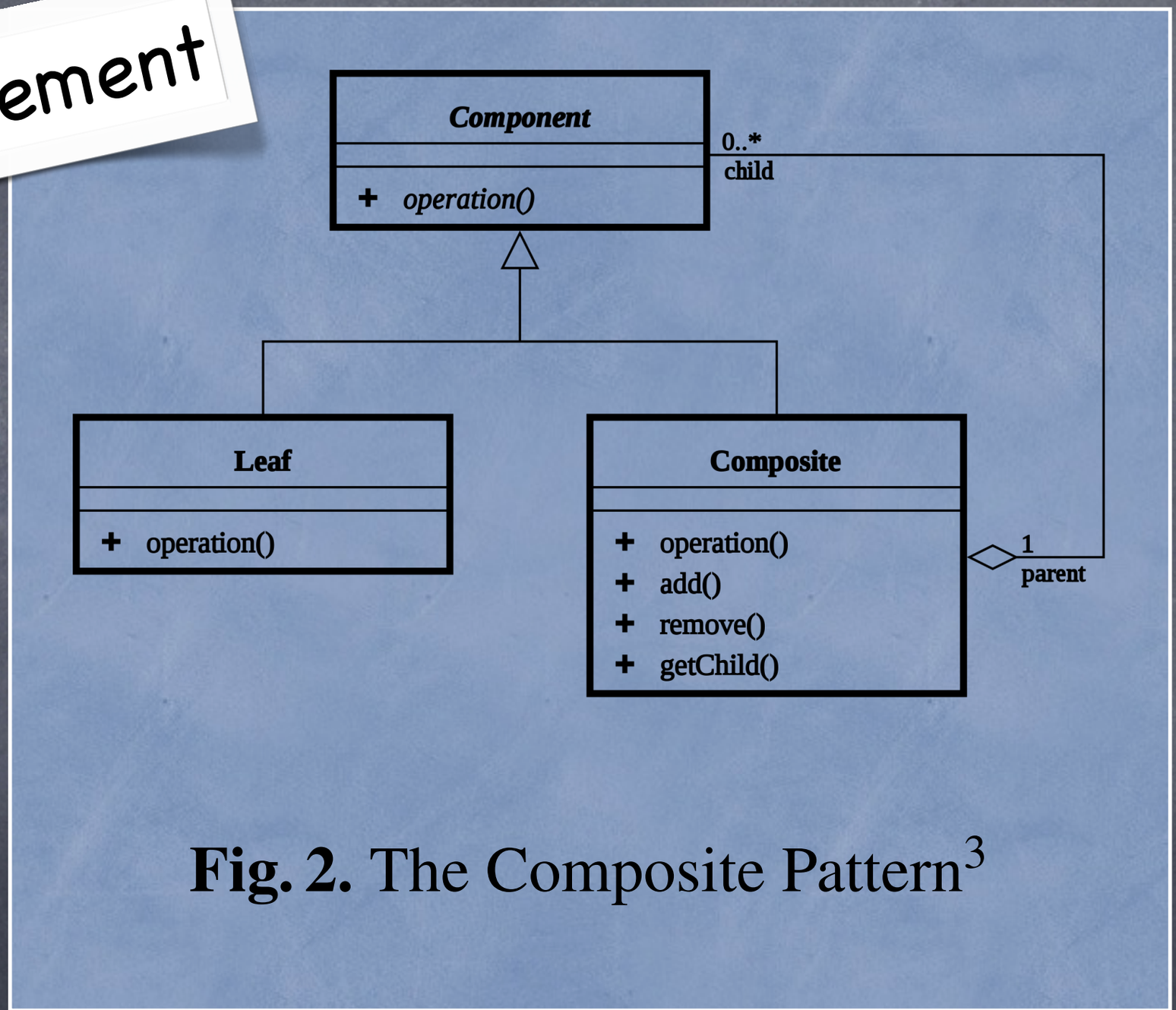


Fig. 2. The Composite Pattern[3]

image from wikipedia.org

Composite Pattern

Statement



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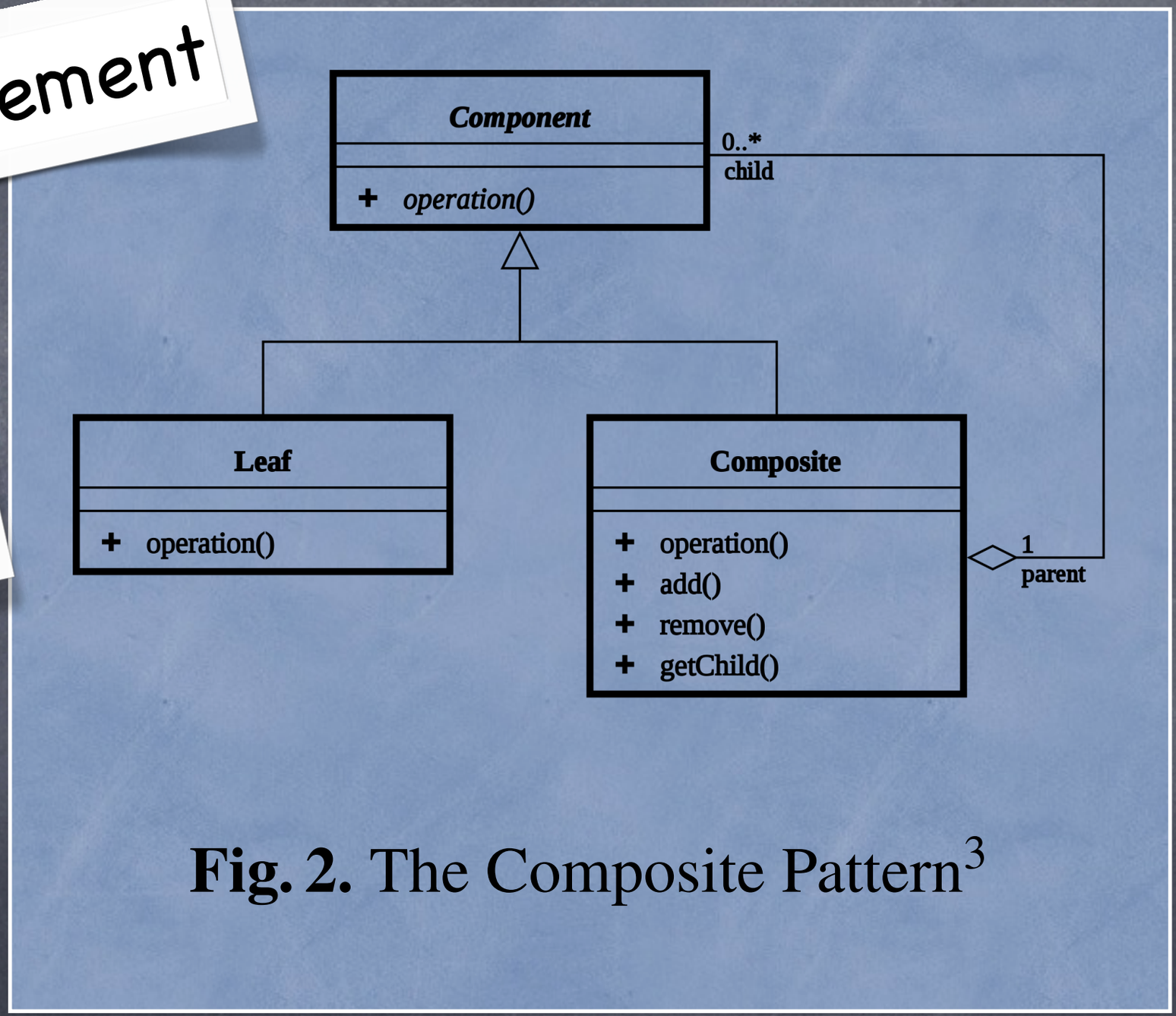
NoOp



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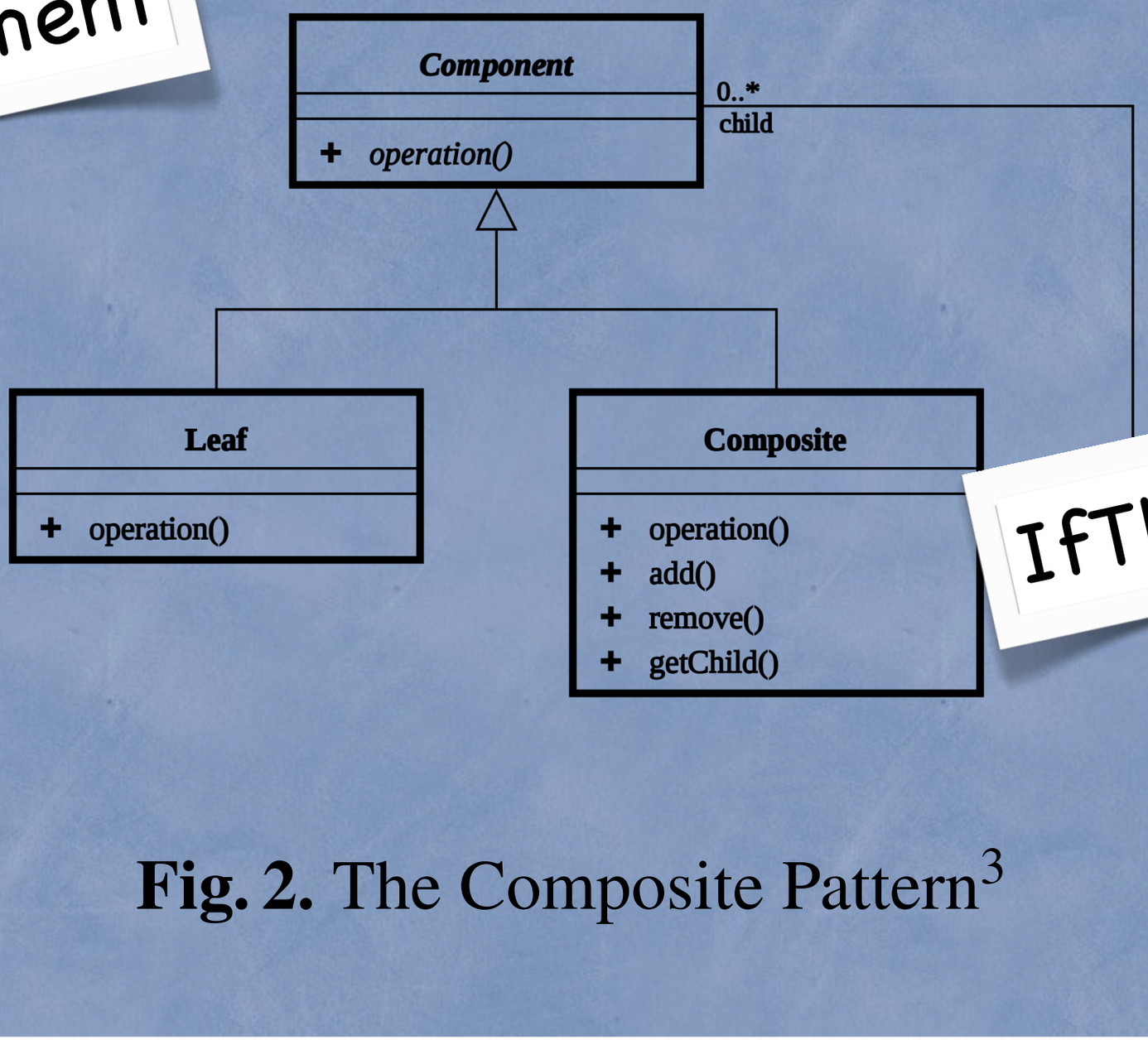
Statement

NoOp

IfThenElse



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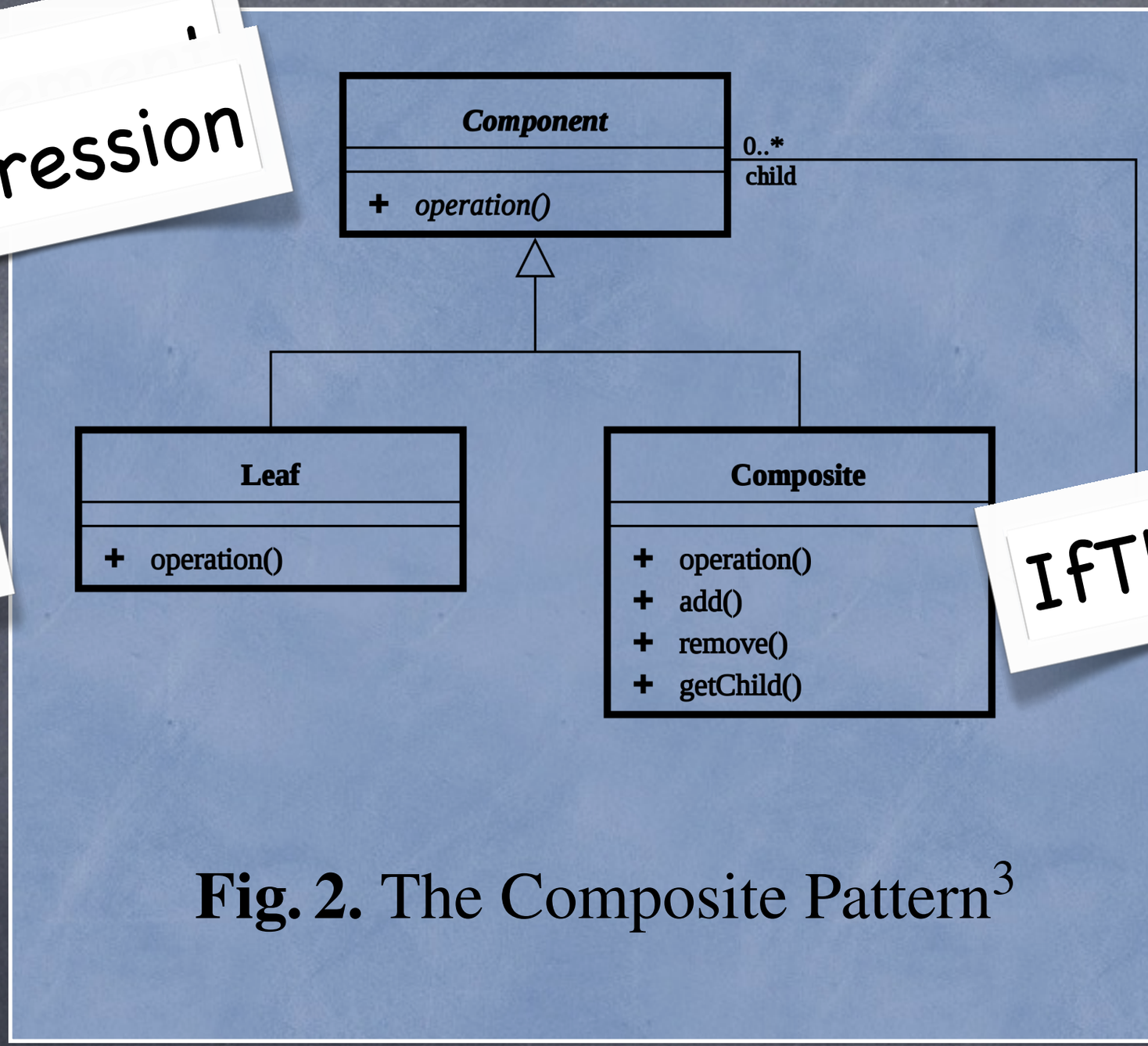

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Composite Pattern

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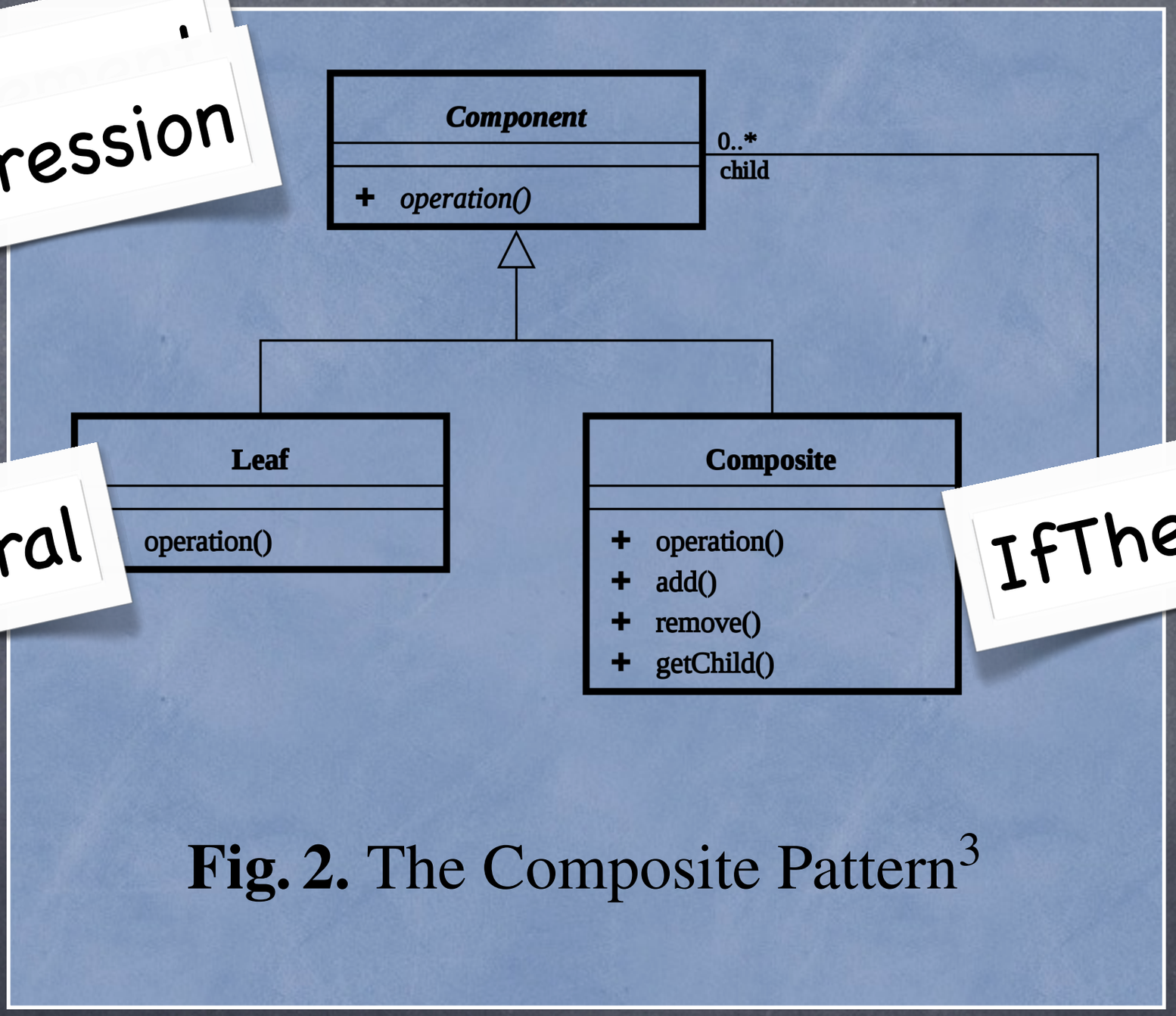

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IntLiteral

IfThenElse

image from wikipedia.org

Composite Pattern

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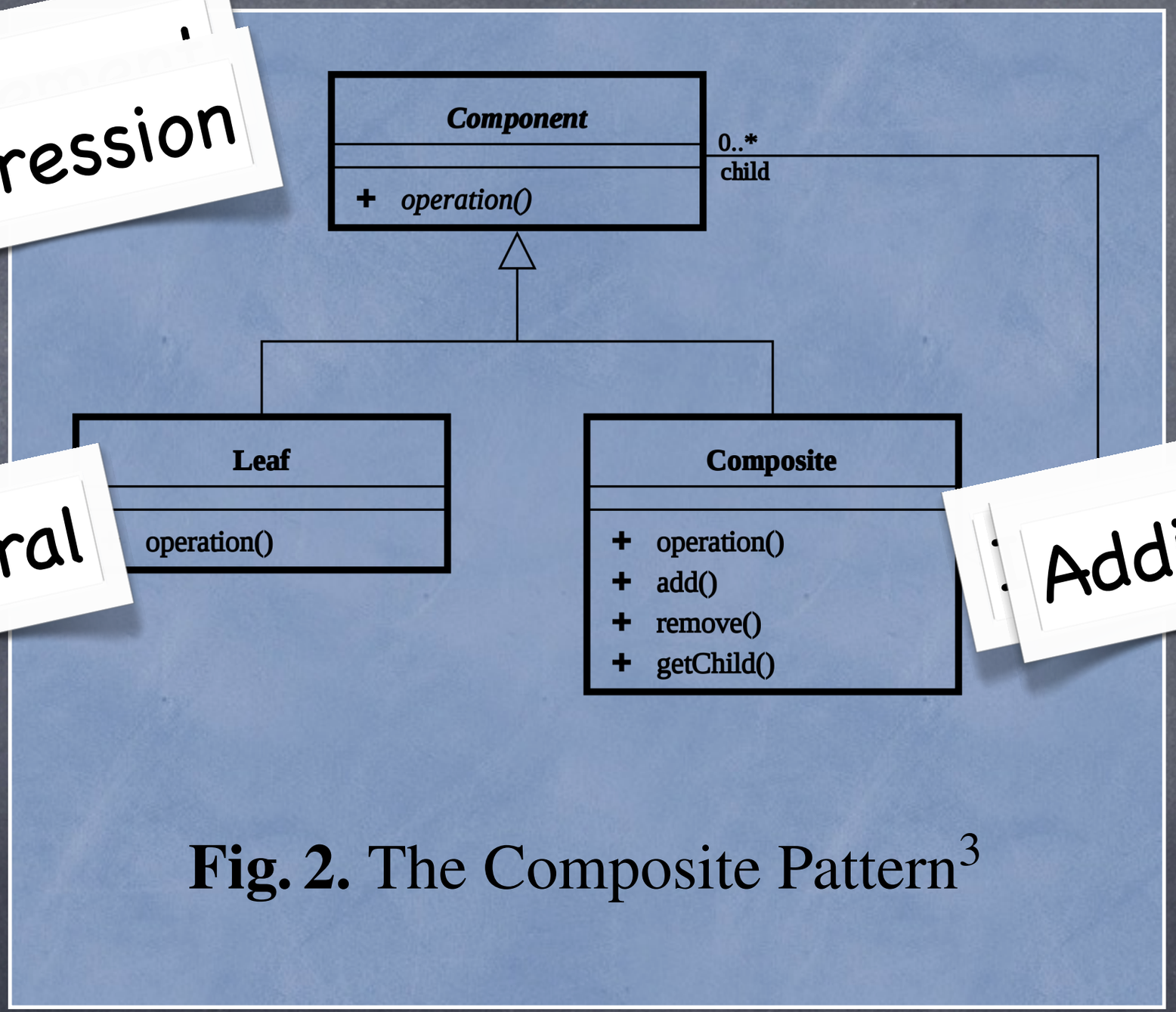


IntLiteral

Addition

Fig. 2. The Composite Pattern[3]

image from wikipedia.org

AST instance

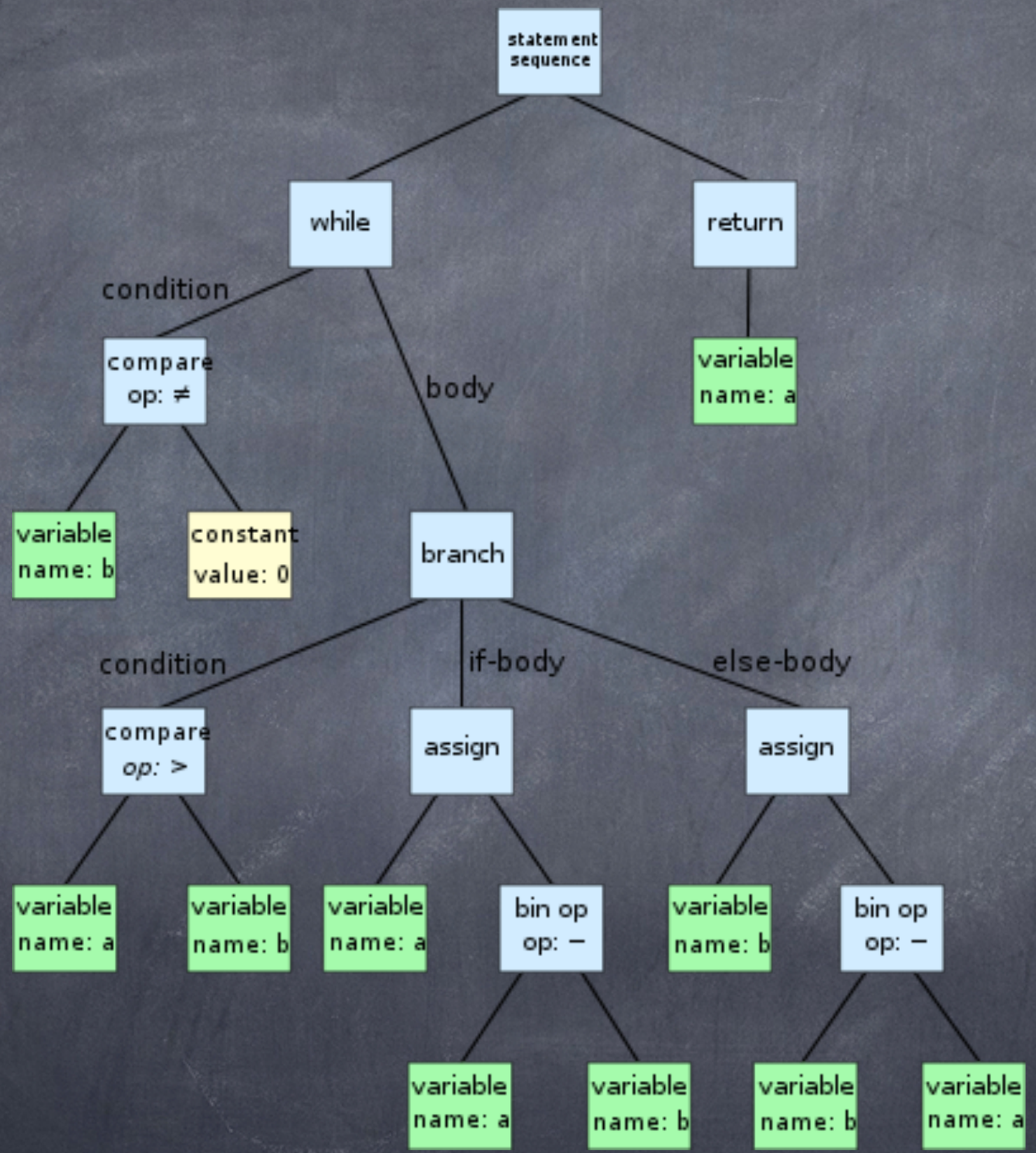


image from wikipedia.org

Interpreter Pattern

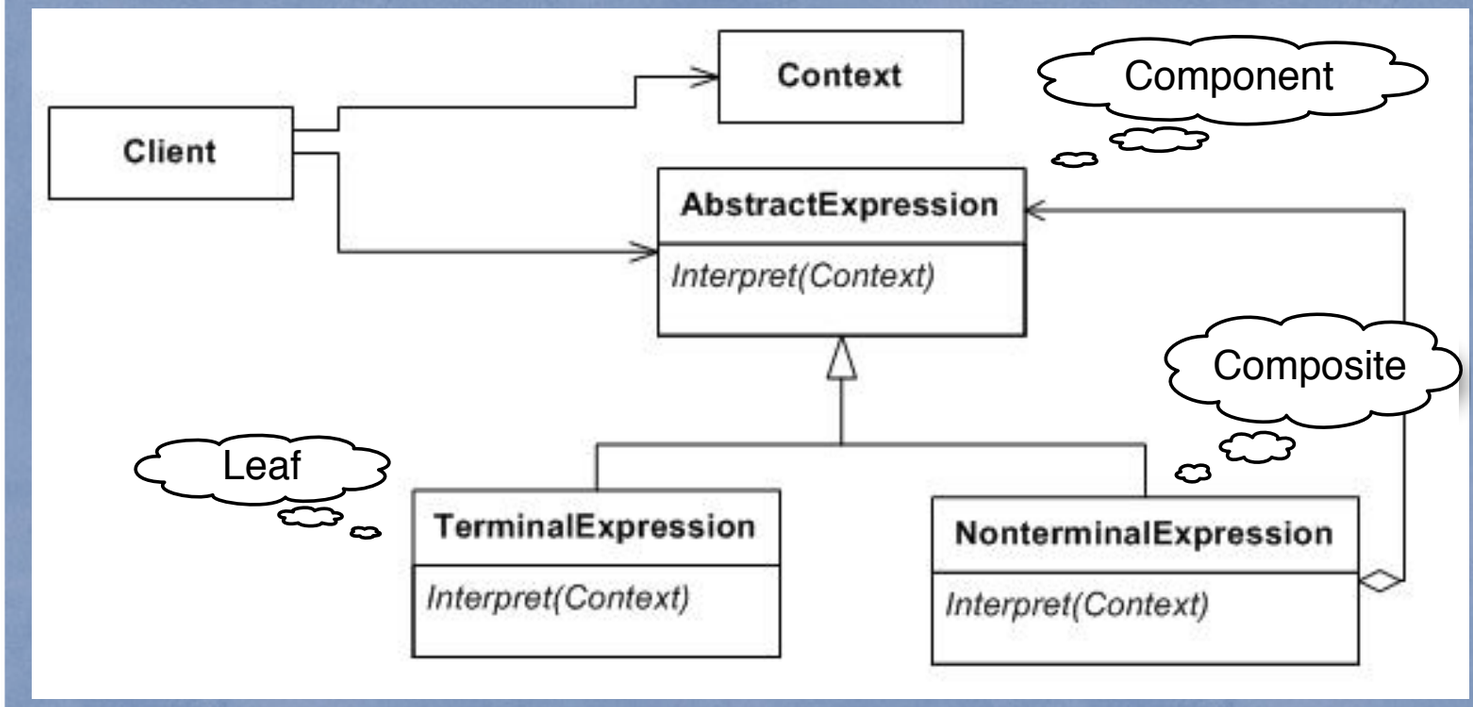
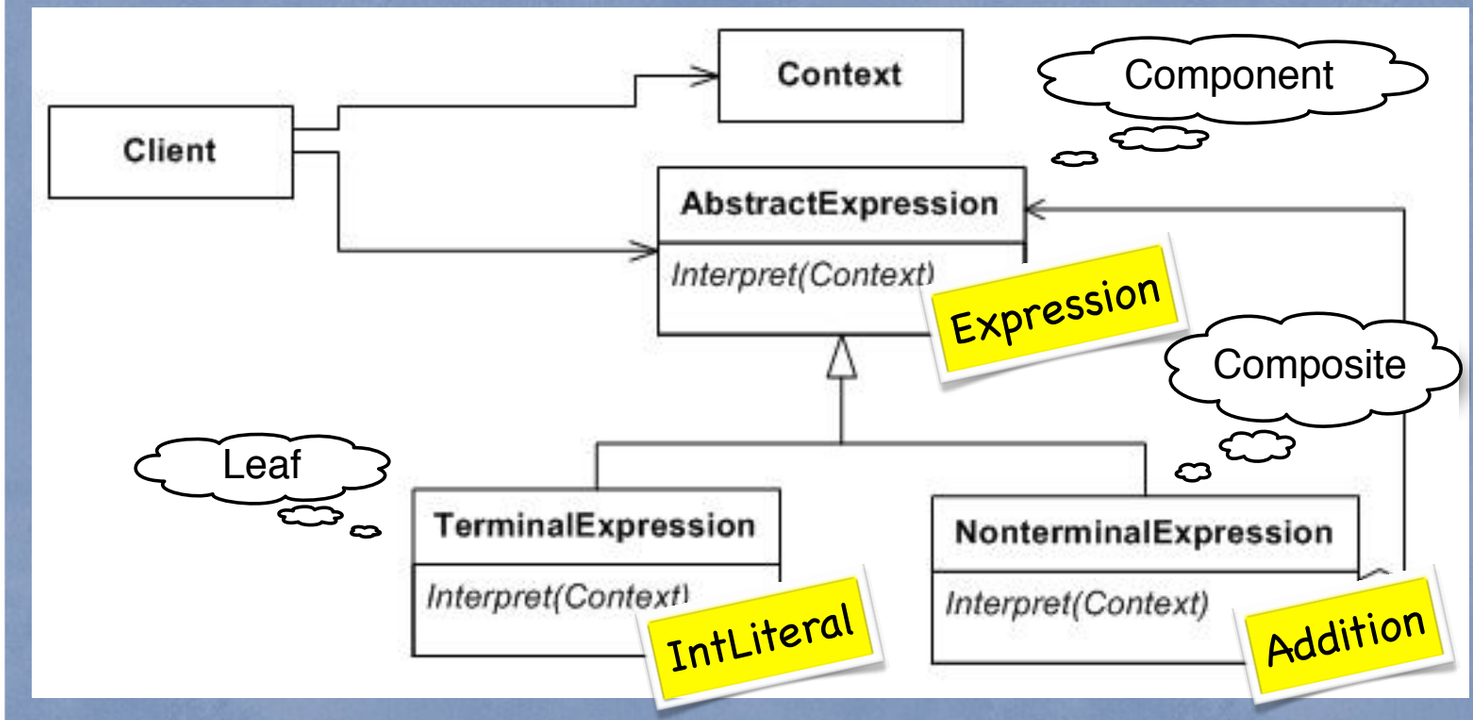


Fig. 4. The Interpreter Pattern with references to Composite (Figure 2).[7]

image from wikipedia.org

Interpreter Pattern



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Visitor Pattern

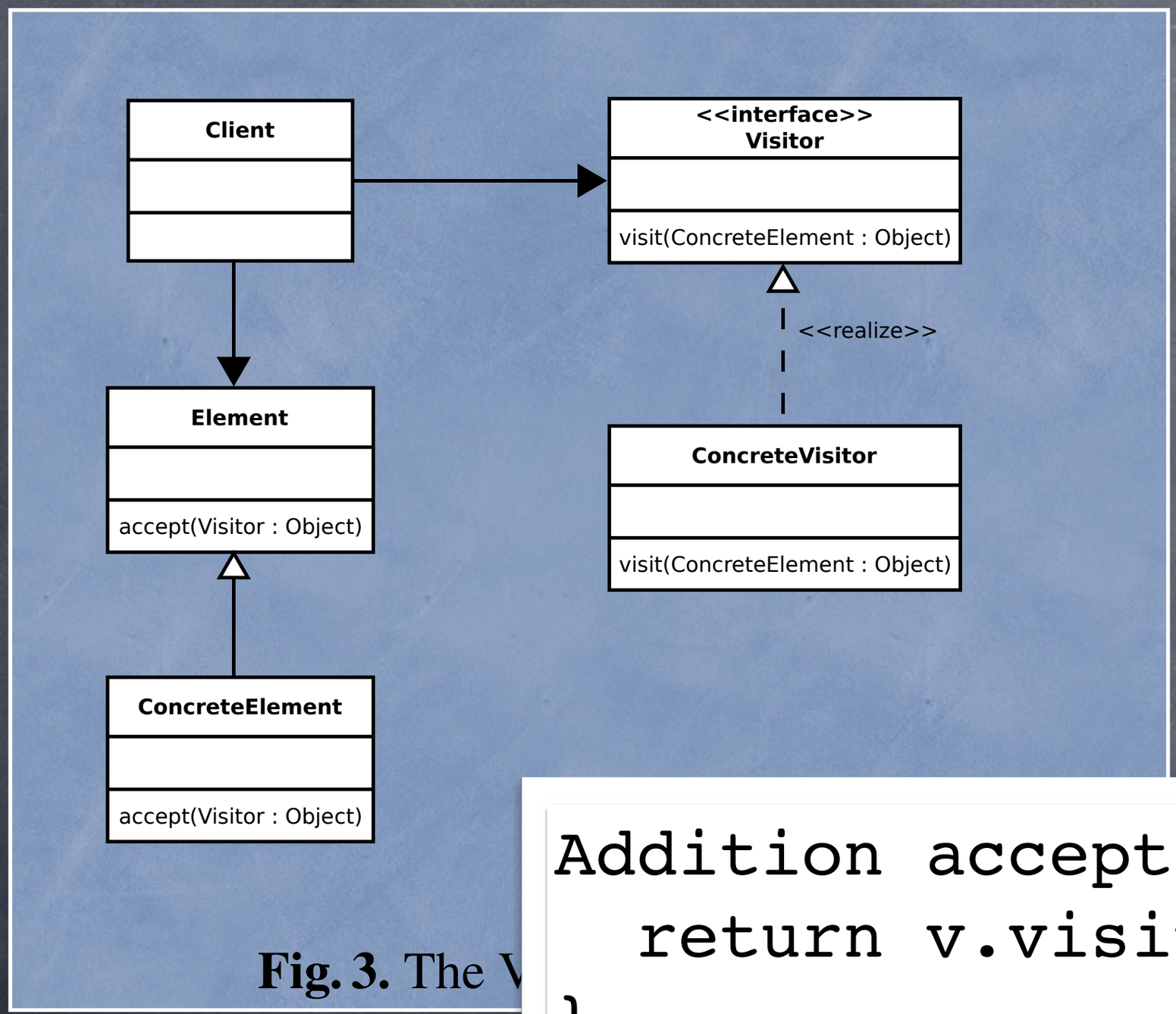
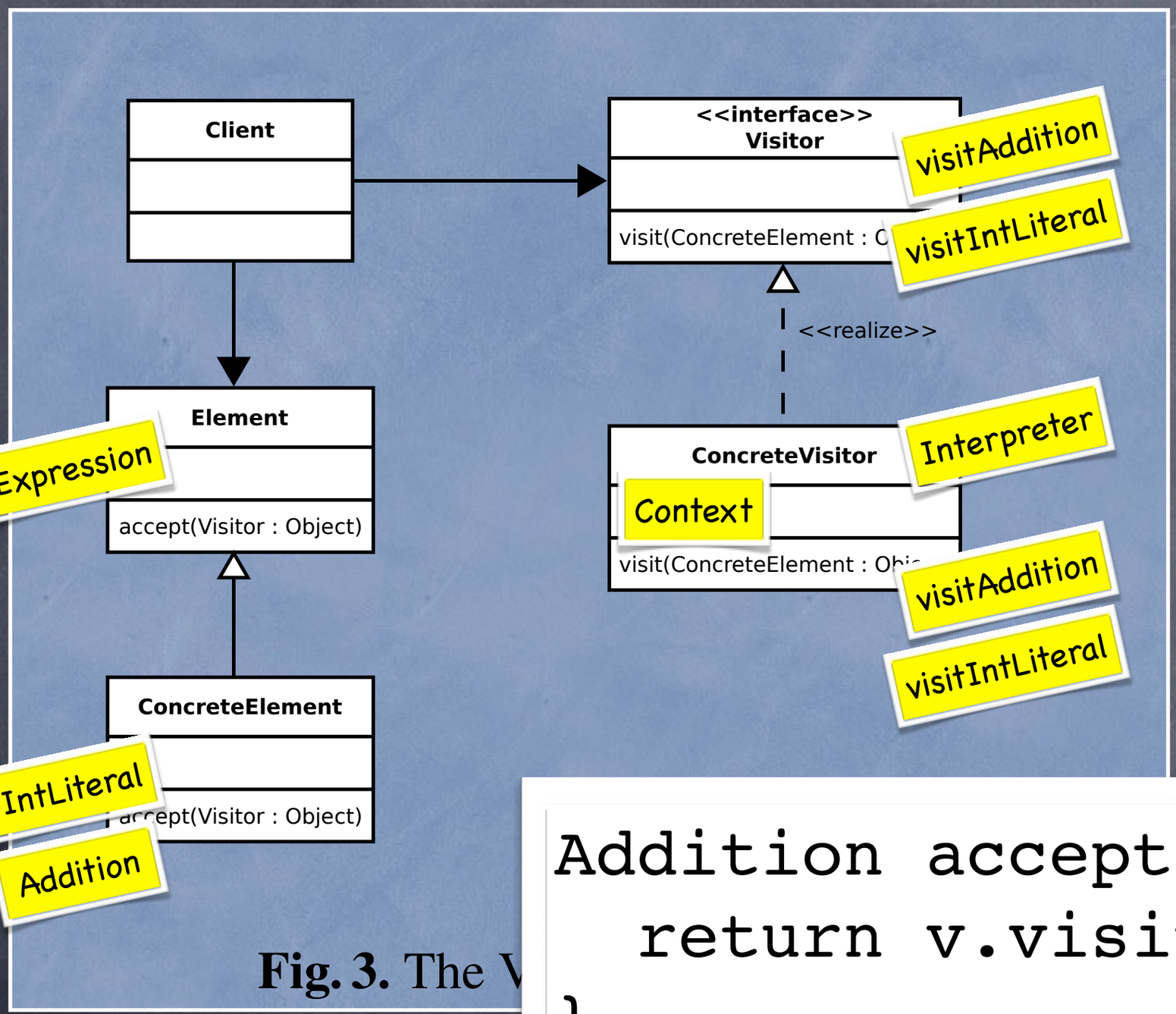


Fig. 3. The V

```
Addition accept(Visitor v) {
  return v.visitAddition(this);
}
```

image from wikipedia.org

Visitor Pattern



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Visitor design pattern and the **Interpreter** design pattern are functionally inter-changeable

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But, they are different in **non-functional** properties

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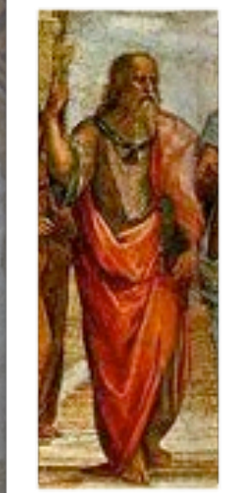
But, they are different in **non-functional** properties

And, these **emergent** properties tend to be difficult to predict

Theoretical Observations



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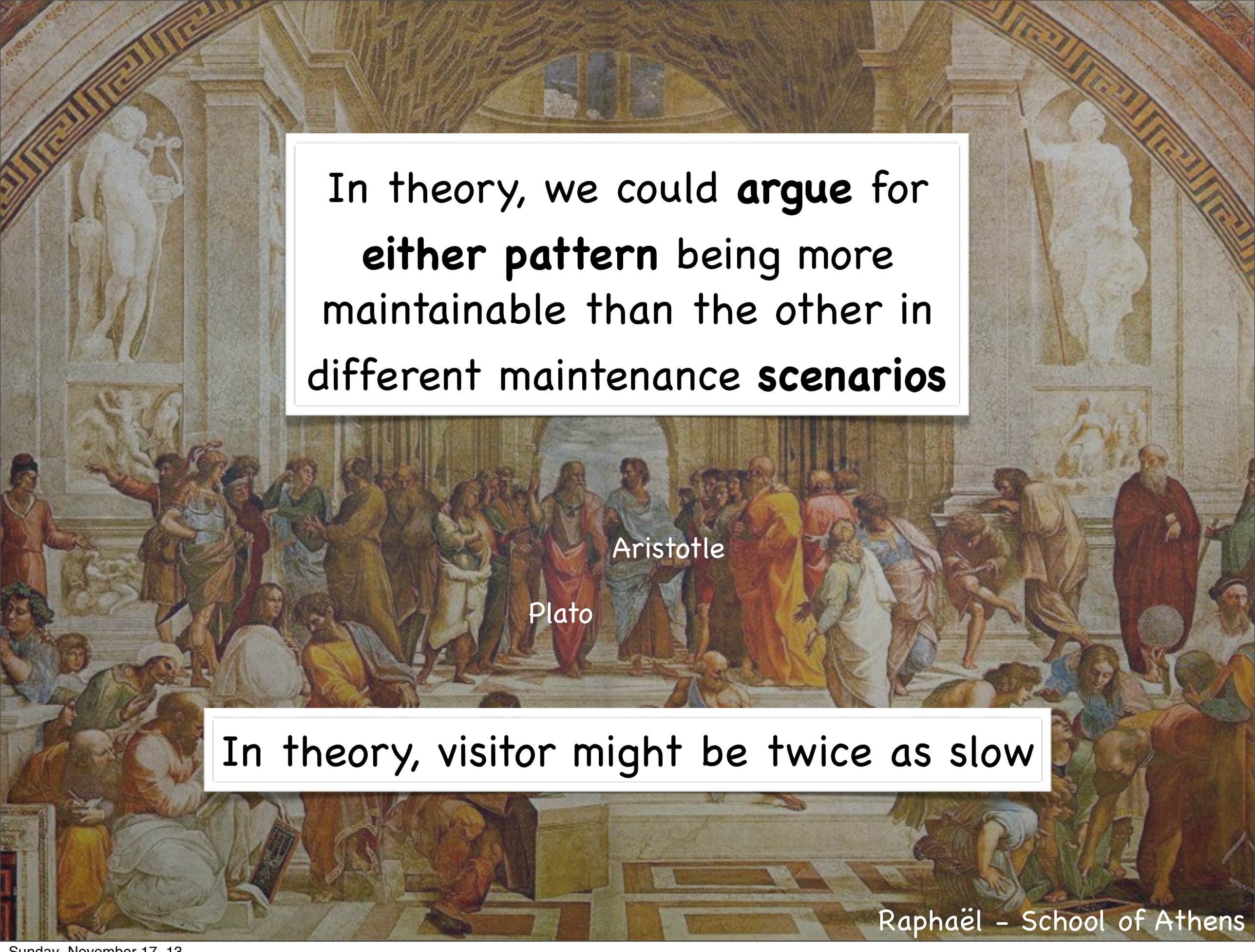
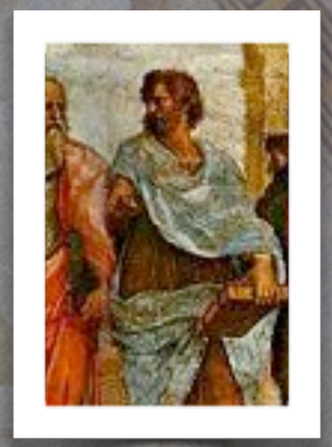
Slower, right?


In theory, we could **argue** for **either pattern** being more maintainable than the other in different maintenance **scenarios**
Aristotle
Plato
In theory, visitor might be twice as slow
Raphaël - School of Athens

Empirical Observations



- Visitor-based interpreter is complex
  - Many visitors classes
  - Main interpreter is a "God class"
- Interpreter should run faster than this

Why this experiment?

- Is the difference between Interpreter and Visitor **causing** a part of these two problems, or not at all?

- How does one answer such a question?

Why this lab setup?

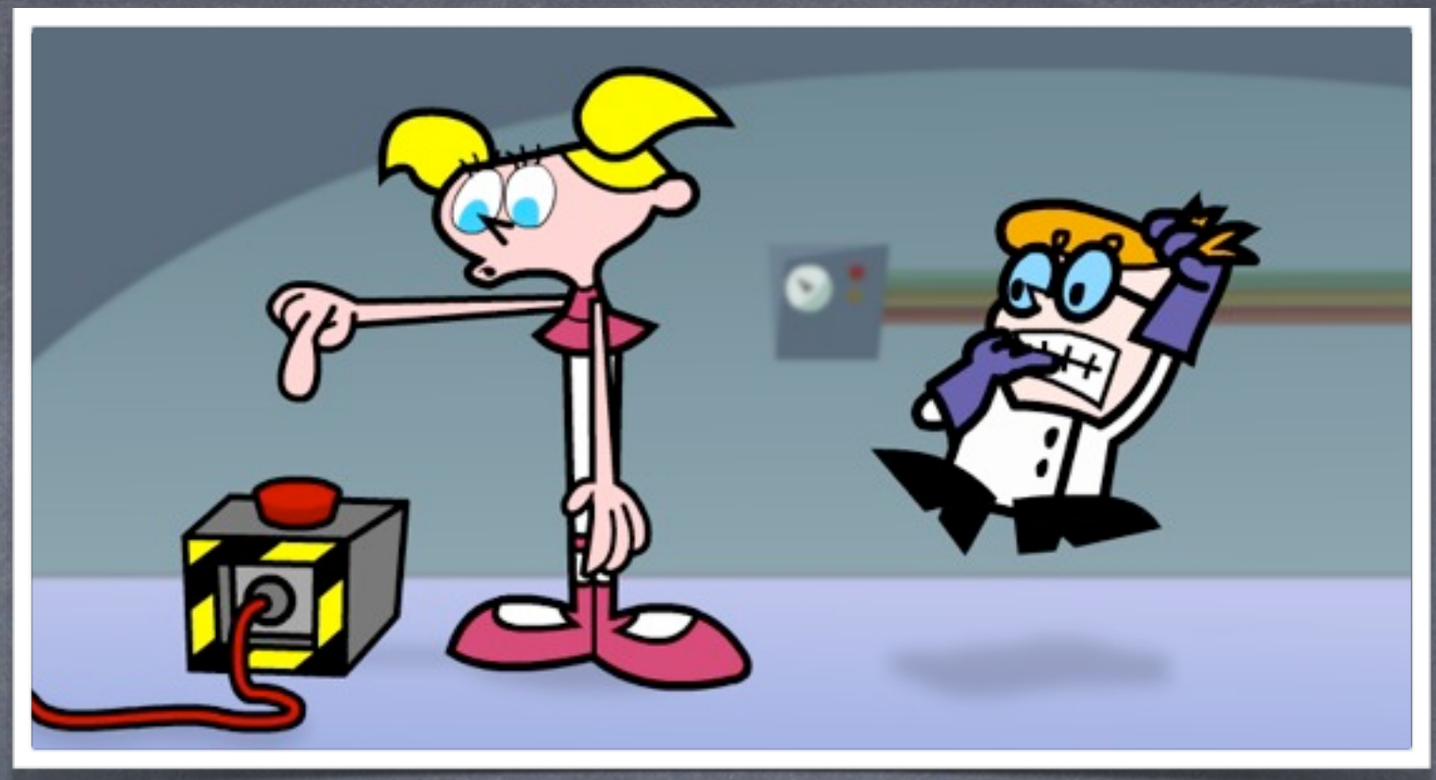
Observing software "in the wild"

- In reality, there exist **no two different versions** of the same interpreter

- In reality, there are **many other factors** influencing maintenance and efficiency other than this design choice

- Reality is perhaps easy to see, but it is **very hard to understand**

Lab Experiment



- In a lab we may **isolate** a factor
- In the lab we may **focus** on the effect
- In the lab we can observe **causality** more directly

Possible lab experiments

- Source code metrics for maintainability
- Construction of Cognitive Models
- New method based on "Evolution complexity"

Source Code Metrics are (perhaps) good for observing reality **statistically**, but not for observing implications of design choices

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Maintainability Index I&II

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SIG maintainability model

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Maintainability Index I&II

Maintenance Complexity Metric

SIG maintainability model

Computing and aggregating metrics values, **independent** of maintenance scenario, predicting long-term expectations on maintenance costs

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Maintainability Index I&II

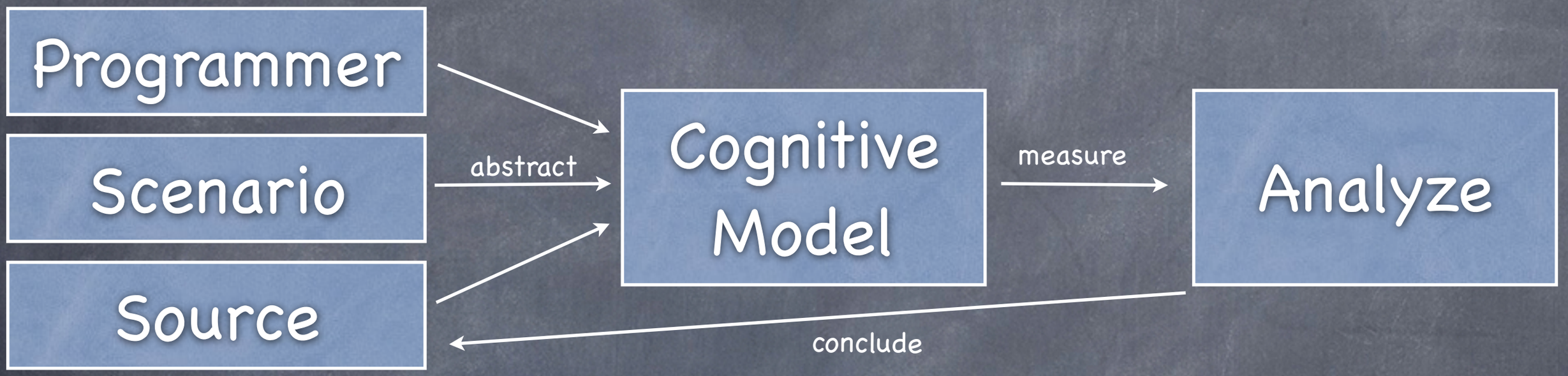
Maintenance Complexity Metric

SIG maintainability model

Computing and aggregating metrics values, **independent** of maintenance scenario, predicting long-term expectations on maintenance costs

If validated and calibrated these make sense on huge long-lived systems, but they say **nothing about the next maintenance scenario** applied to the system

What about using **Cognitive Models** of understanding the source code then?



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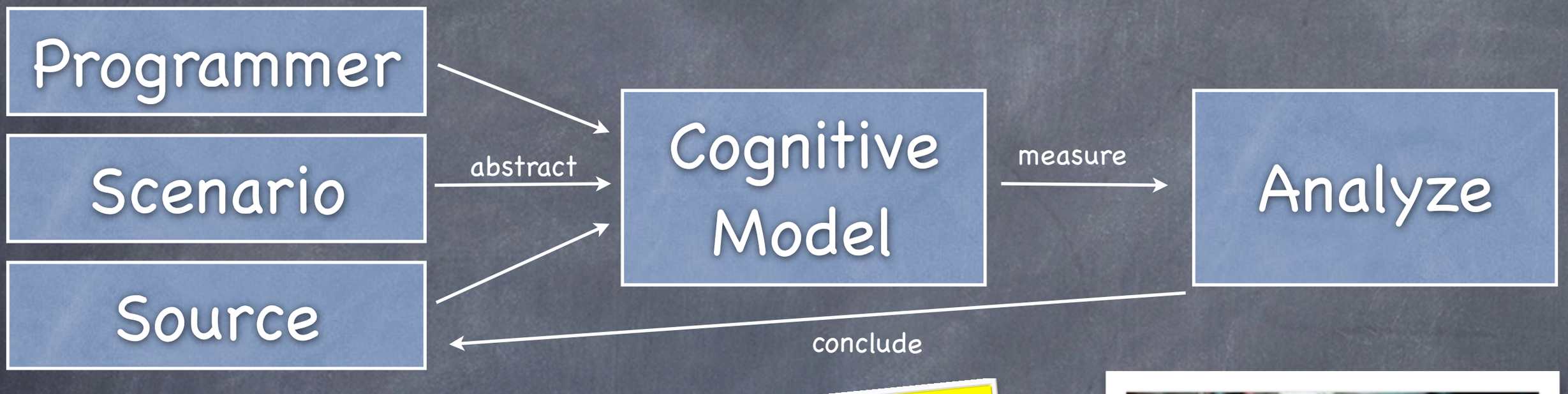

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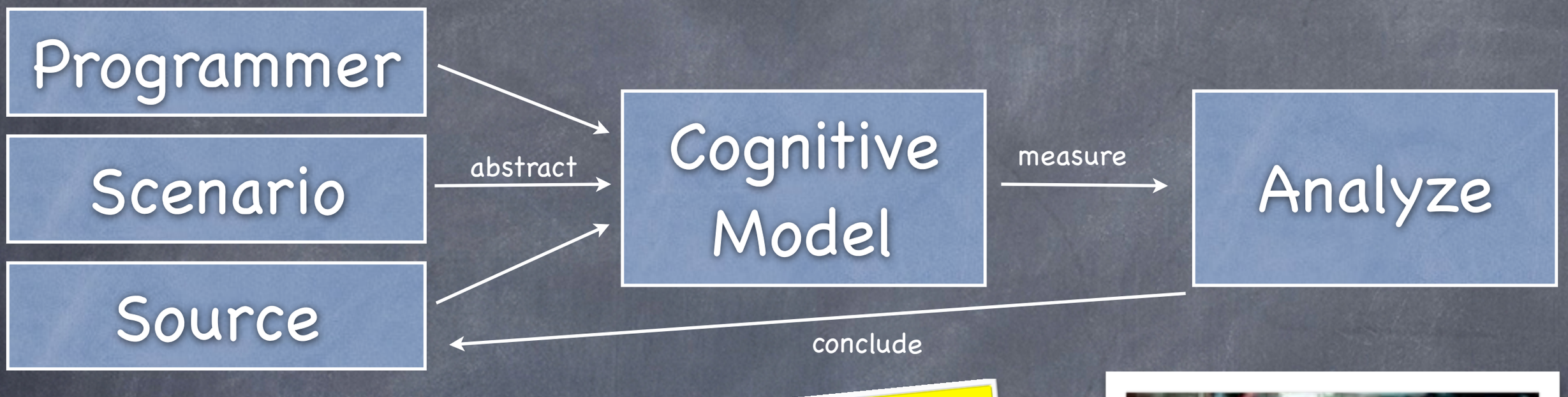


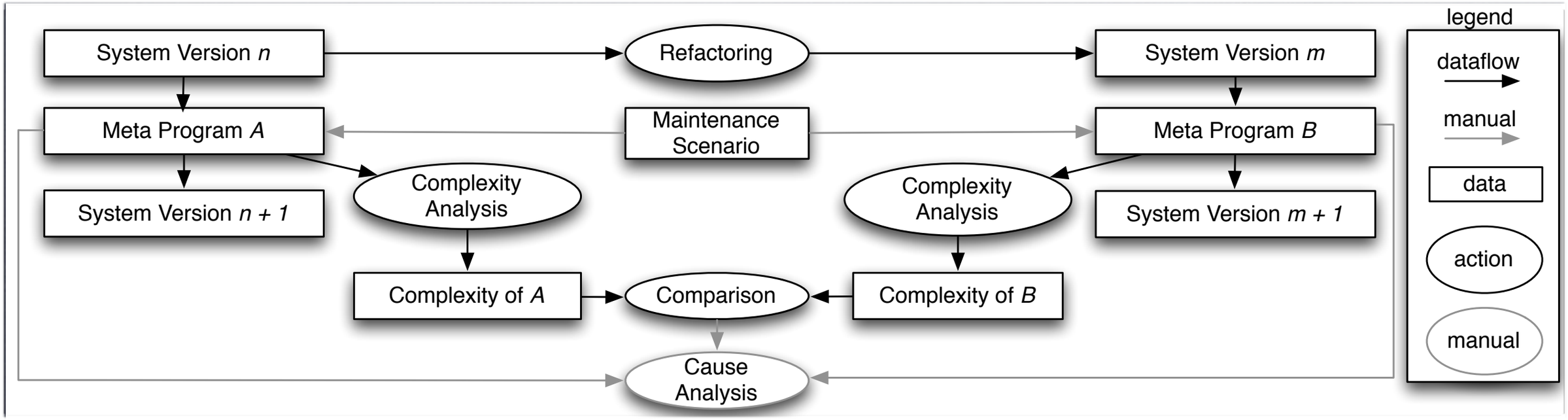
Unfortunately, we neither understand nor trust these models

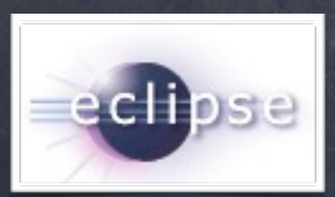
IDE + source code + human => very complex models of cognition

Our Lab Setup

- Refactoring to get two versions
- Applying realistic maintenance scenarios
- Measuring the optimal "effort" of doing maintenance
- Analyzing differences by tracing back to code

Isolating the variable

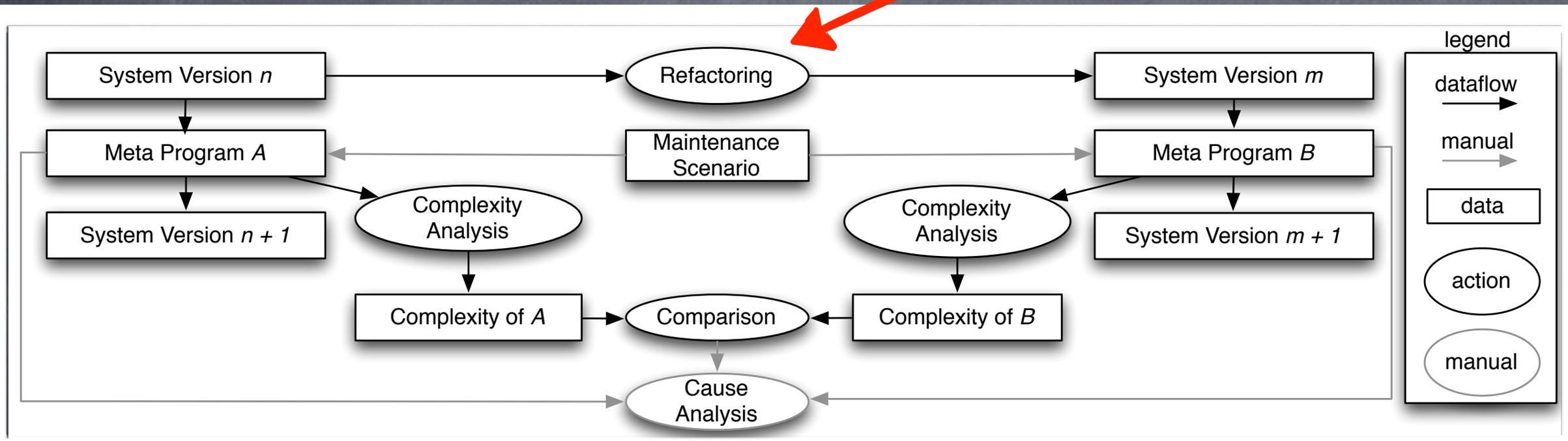


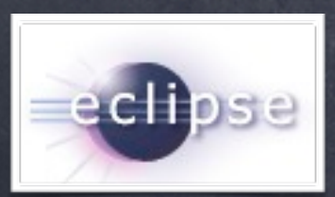


Rascal & JDT to implement Visitor to Interpreter **refactoring**

Isolating the variable

Key enabler





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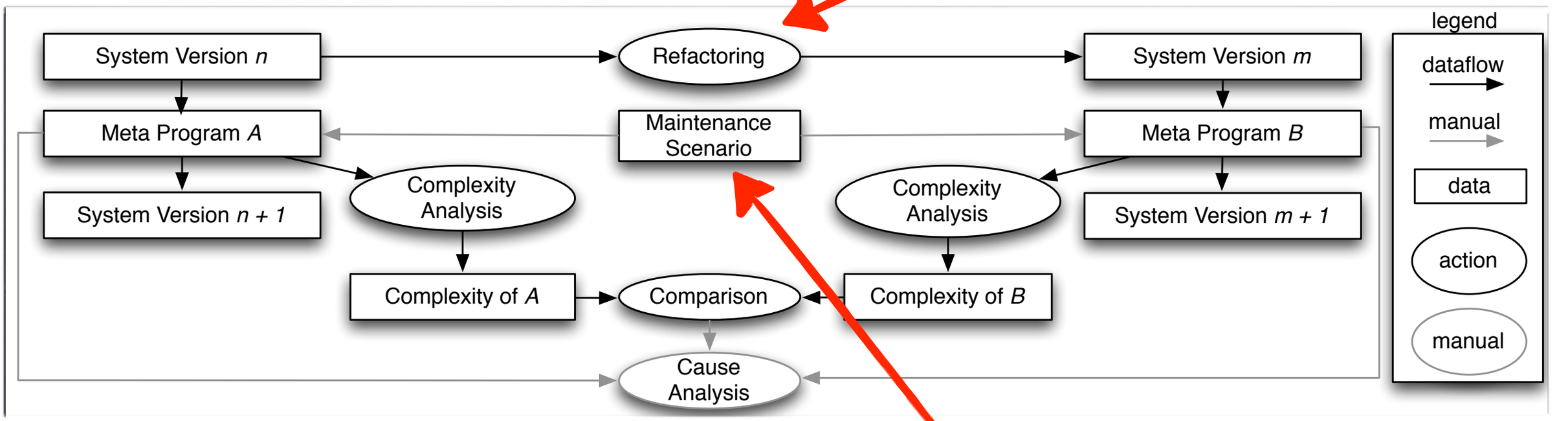
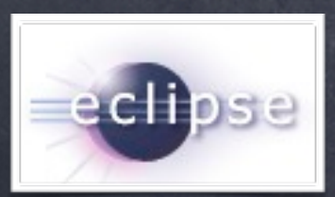


Manual labor



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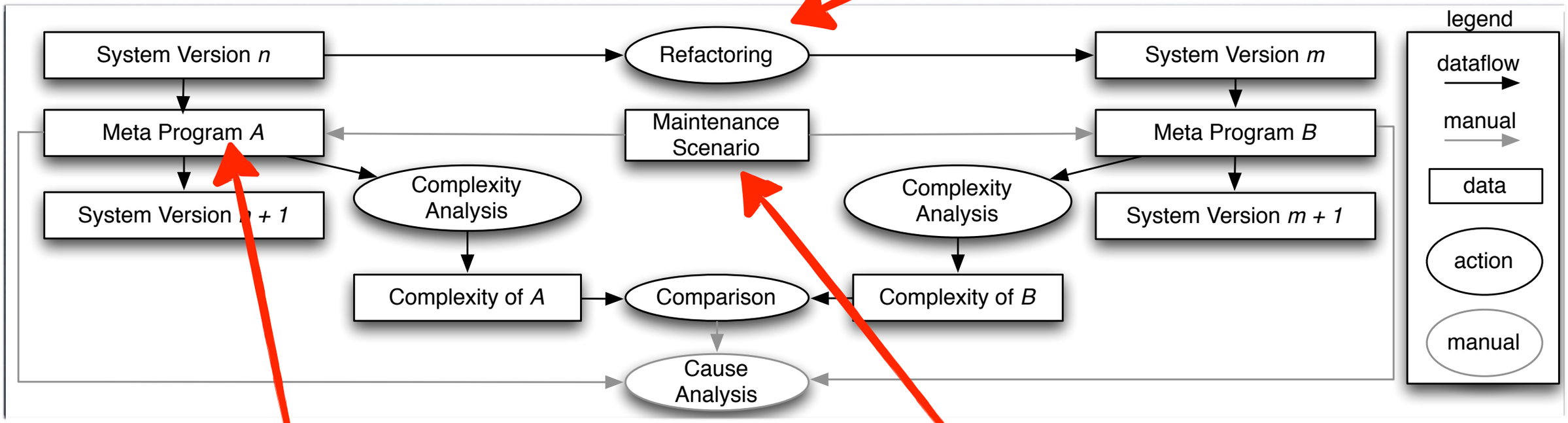
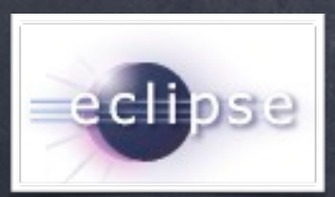


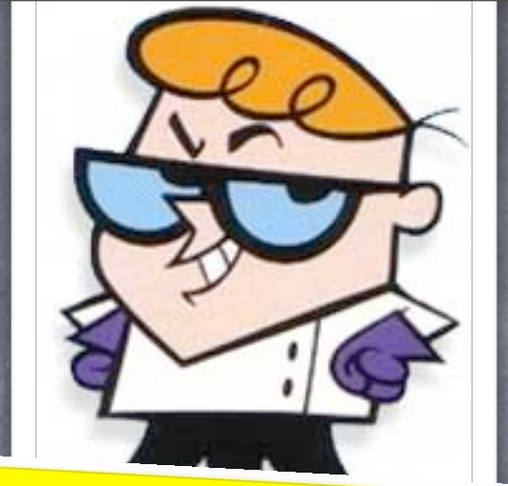
Traceability

Manual labor



Rascal & JDT to implement Visitor to Interpreter **refactoring**

"Complexity of Maintenance"

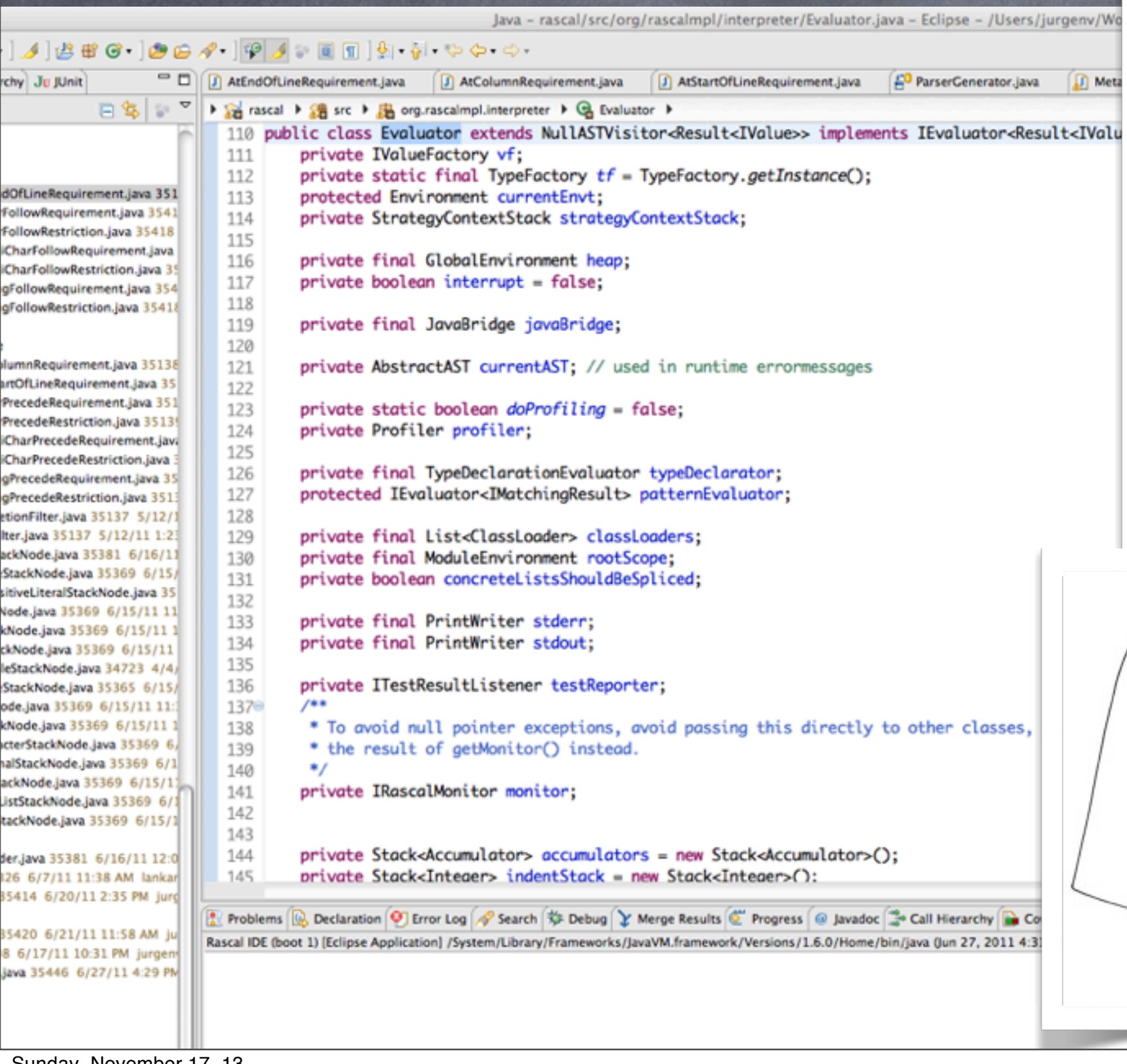


Precise definitions in the paper

- Maintainability = Understandability + Modifiability
- Complexity of a maintenance scenario is =
  - #steps to learn facts about a Program +
  - #steps to modify the Program
- Reify steps as a "Meta Program" that operates the IDE

Inspired by "Measuring Software Flexibility"
by Mens & Eden, IEE Software 2006

Collecting data



Sunday, November 17, 13

Results

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S1	$ci^{11}(g^2a)^2)$	(18)	$m^2b(ef^2)^3(ga)^2$	(16)	yes
S1(N)	$ci^{11}(g^Na)^2)$	$(14+2N)$	$m^Nb(ef^N)^3(ga)^N$	$(4+6N)$	if $N \leq 2$
S1'(N,2)	$ci^{11}(g^Na)^2)$	$(14+2N)$	$m^N(ga)^N$	$(3N)$	if $N \leq 14$
S1'(N,M)	$ci^{9+M}(g^Na)^M$	$(10+NM+2M)$	$m^N(ga)^{MN}$	$(N+2MN)$	if $N \leq \frac{2M+10}{M+1}$
S2	i^2g^3iga	(8)	$i^2g^3gaig^3aiga$	(14)	no
S3	$dg^5egcg^{15}g^2a(eea)^4i^2h(ga)^3$	(43)	$d(ig)^2a(iga)^{15}(ig)^3gai$ $(ig^2)a(igg)^2anigaih(ga)^3$	(83)	no
S3'	$d(ga)^5egac(ga)^{15}(ga)^2$ $(eea)^4i^2h(ga)^3$	(70)	$d(ig)^2a(iga)^{15}(ig)^3gai$ $(ig^2)a(igg)^2anigaih(ga)^3$	(83)	no
S4	$mg^{11}a$	(13)	$bga(bga)^{11}$	(36)	no
S5	$biga$	(4)	bga	(3)	yes

Table 2. A comparison of all maintenance programs (see Table 1).

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				6)	no
				3)	yes

steps to add N constructs to **Visitor** 14 + 2N

steps to add N constructs to **Interpreter** 3N

break-even at N = 14

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we do **not** know

Summary

*given the scope of the experiment

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Summary

Feedback on paper and research method more than welcome!

- We used **Rascal** to build a **refactoring** tool
- to **isolate** the difference between **Visitor** & **Interpreter**
- and using the "**Complexity of Maintenance**" method
- we found that **Visitor is better***

*given the scope of the experiment

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