Understand and Use Software Metrics

Confoo.ca

Kore Nordmann (@koredn)

27. Feb 2013

About me

- Degree in computer sience

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- Professional PHP since 2000

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- Degree in computer sience
- Professional PHP since 2000
- Open source enthusiast

About me

- Degree in computer sience
- Professional PHP since 2000
- Open source enthusiast
- Passion for
  - Software Design
  - Automated Testing

Co-founder of

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Helping people to create high quality web applications.

`http://qafoo.com`

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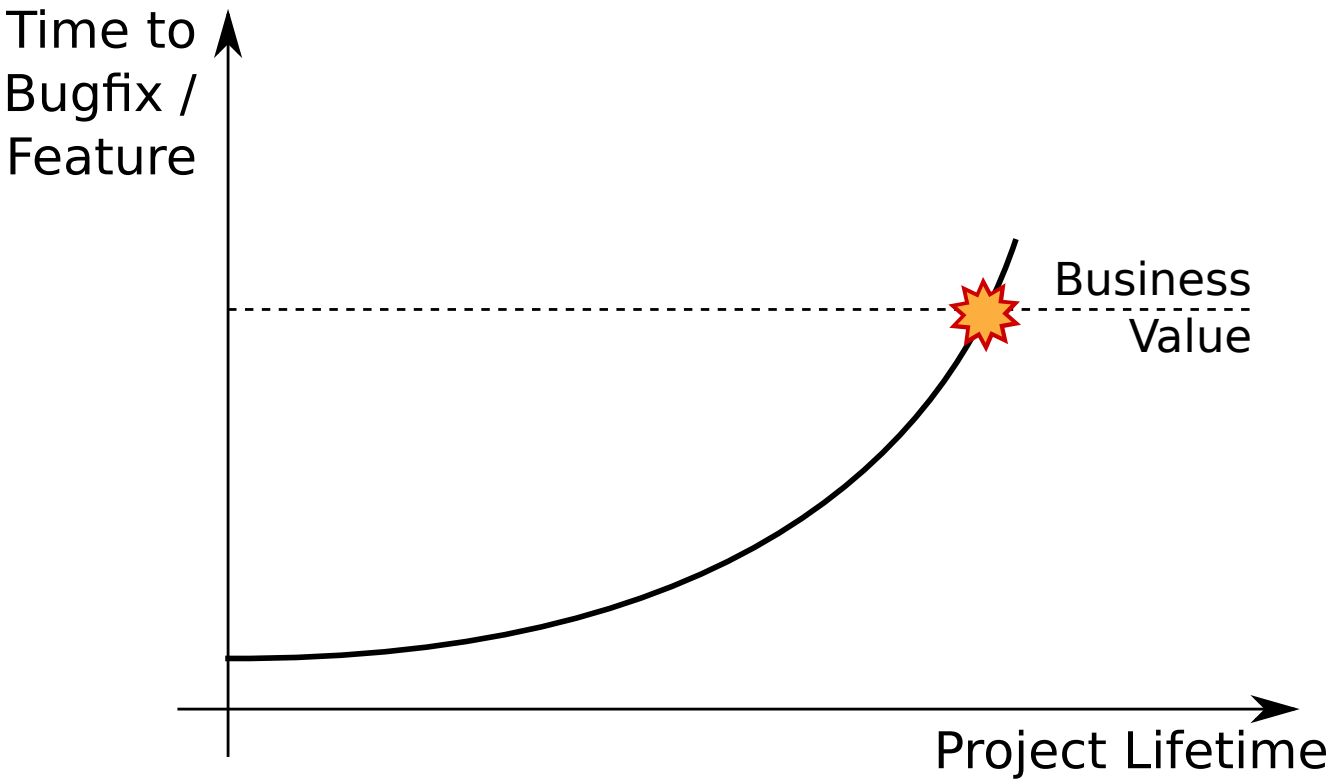
Get a training on object oriented design for your team!

Why quality?



Software metrics

"A software metric is a measure of some property of a piece of software or its specifications"
(Wikipedia)

Applications

- Code Review
  - Find weak spots
  - Find high impact code

Applications

- Code Review
  - Find weak spots
  - Find high impact code
- Measure Progress
  - Watch change rate over time
  - Watch quality over time

Outline

Classic software metrics

Object oriented software metrics

Conclusion

Scale metrics

- How big is my project?

Scale metrics

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  - Lines Of *

LOC	Lines Of Code
ELOC	Executable Lines Of Code
CLOC	Comment Lines Of Code
NCLOC	Non-Comment Lines Of Code

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NOC	Number Of Classes
NOM	Number Of Methods
NOP	Number Of Packages

Lines Of *, Number Of *

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<?php
namespace foo\bar;

abstract class FooBar {
    abstract function bar();
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class Foo extends FooBar {
    /* Does this ... */
    public function bar() {
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    }

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class Bar extends Foo {
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ELOC	3
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NCLOC	21

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Run yourself

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$ pear install pear.phpunit.de/phploc
$ phploc src/main/

Lines of Code (LOC):                            4699
Comment Lines of Code (CLOC):                   1792
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Namespaces:                                       12
Interfaces:                                        1
Classes:                                          32
  Abstract:                                        4 (12.50%)
  Concrete:                                       28 (87.50%)
  Average Class Length (NCLOC):                   88
Methods:                                         135
  Scope:
    Non-Static:                                  134 (99.26%)
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- NPath Complexity
  - Number of *execution paths*
  - Minds the structure of blocks

Cyclomatic Complexity


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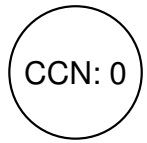

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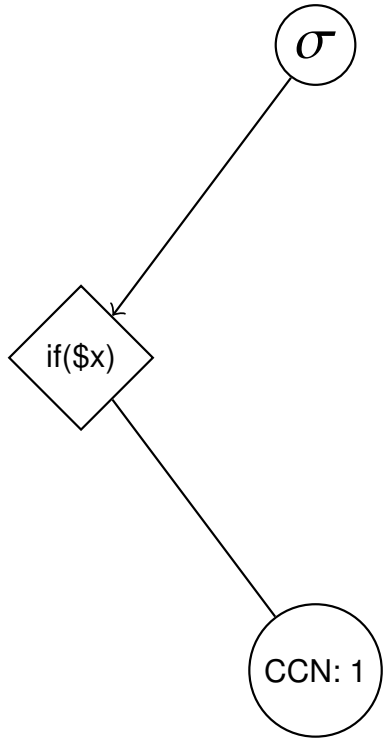

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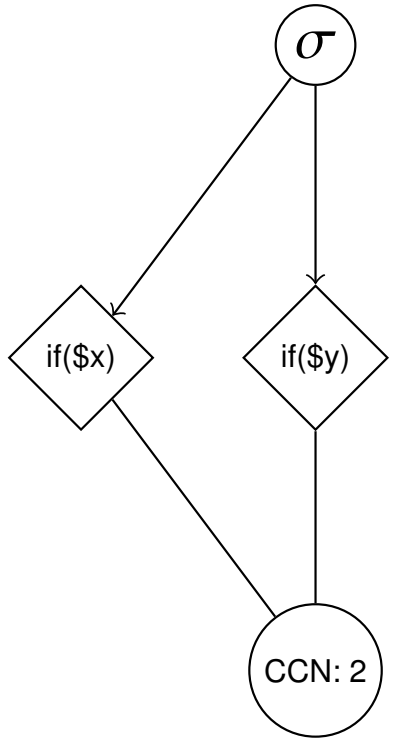

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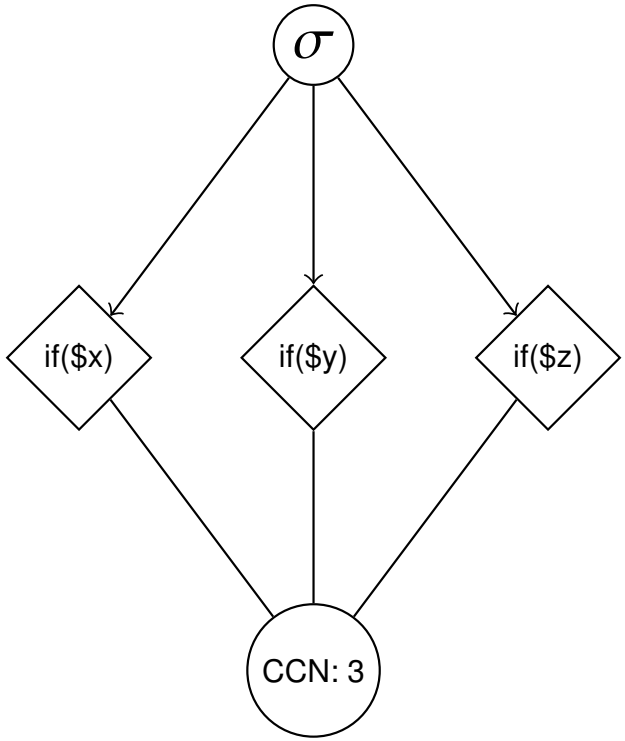

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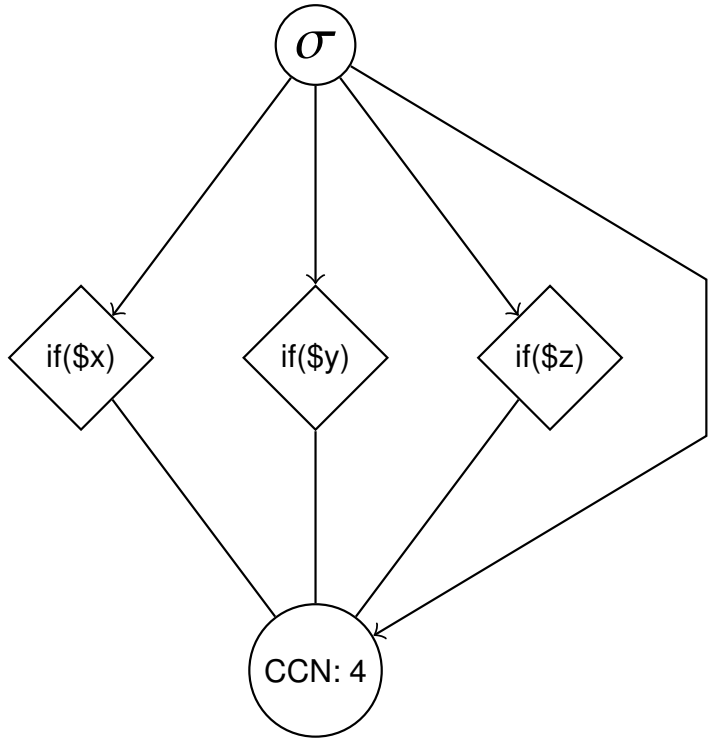

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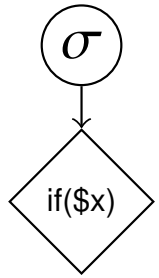

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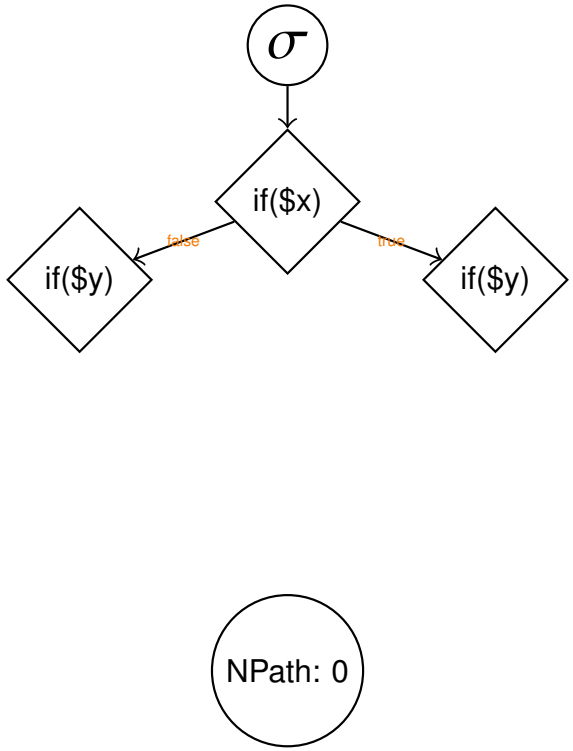

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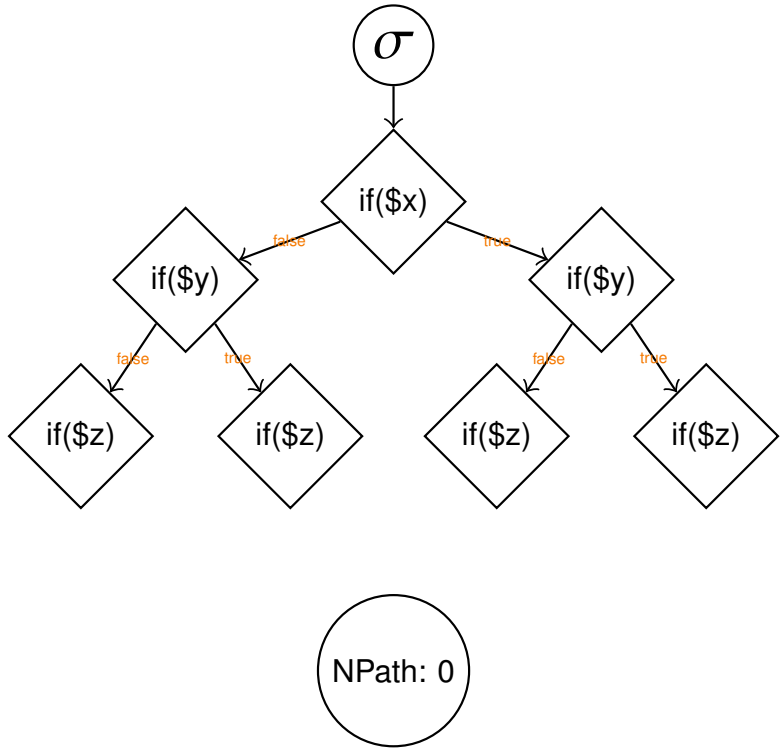

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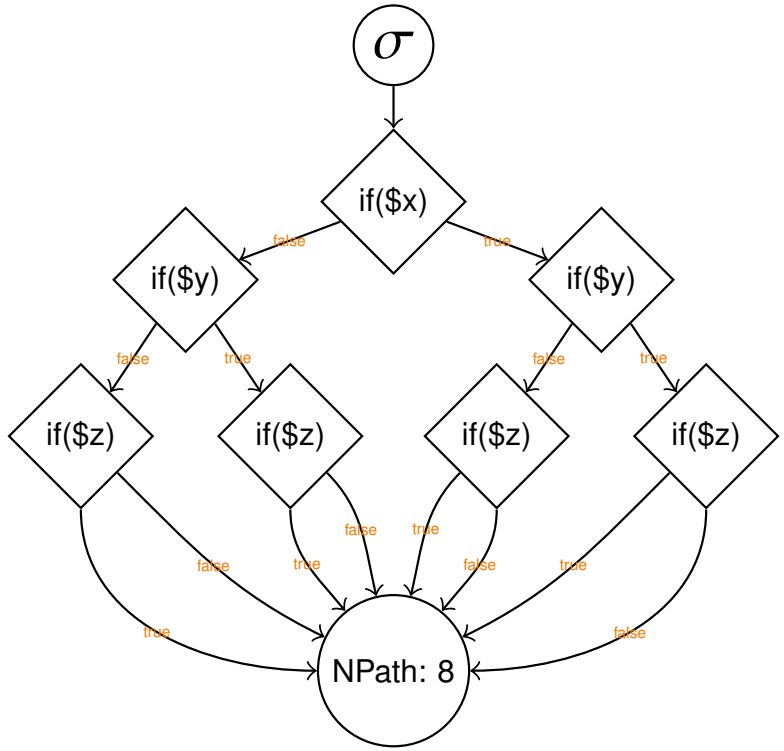

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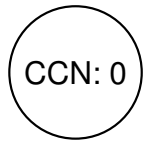

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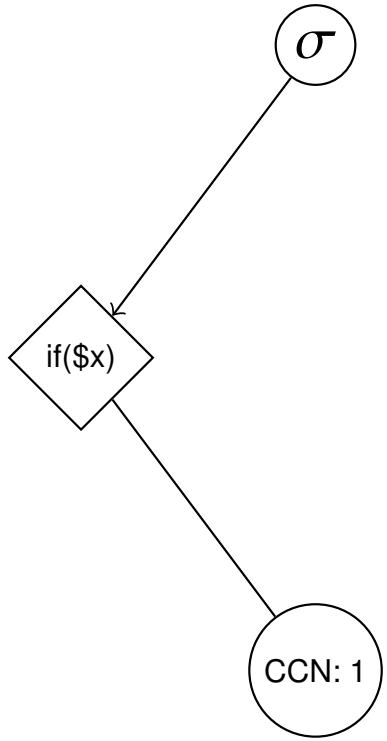

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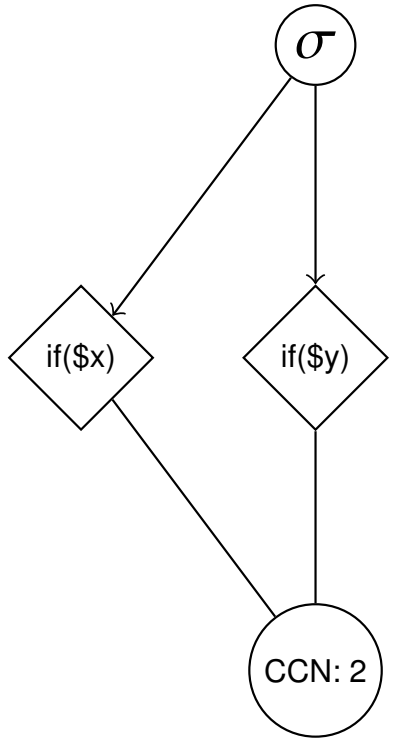

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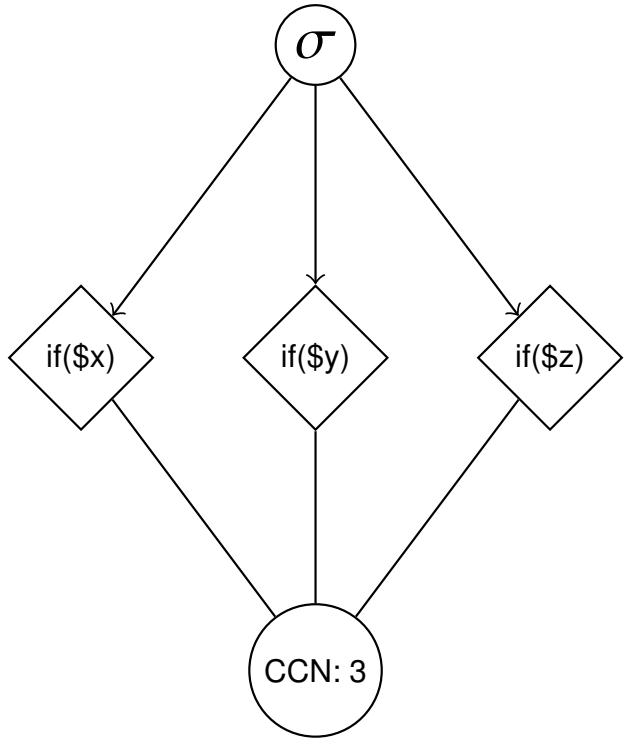

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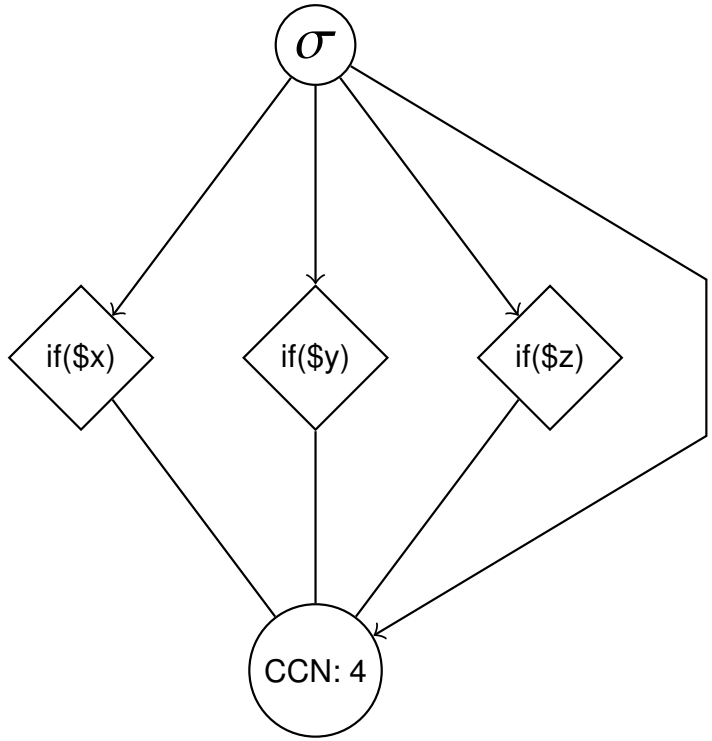

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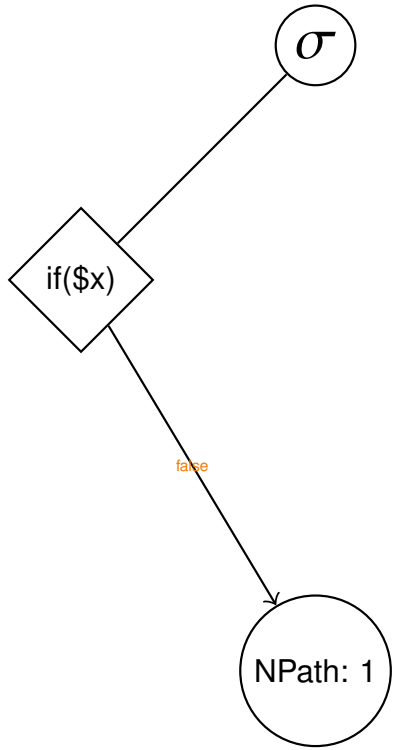

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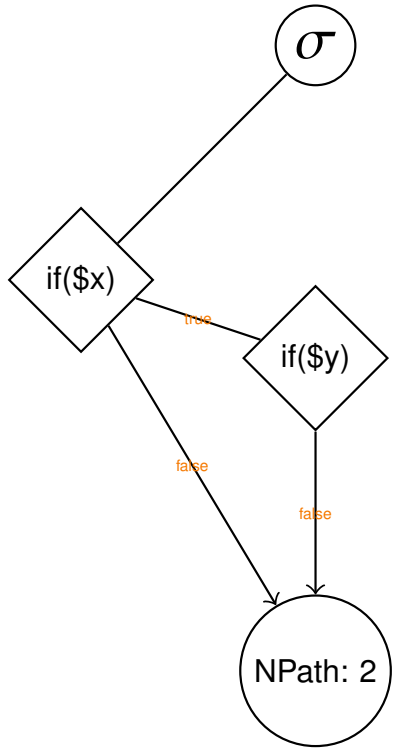

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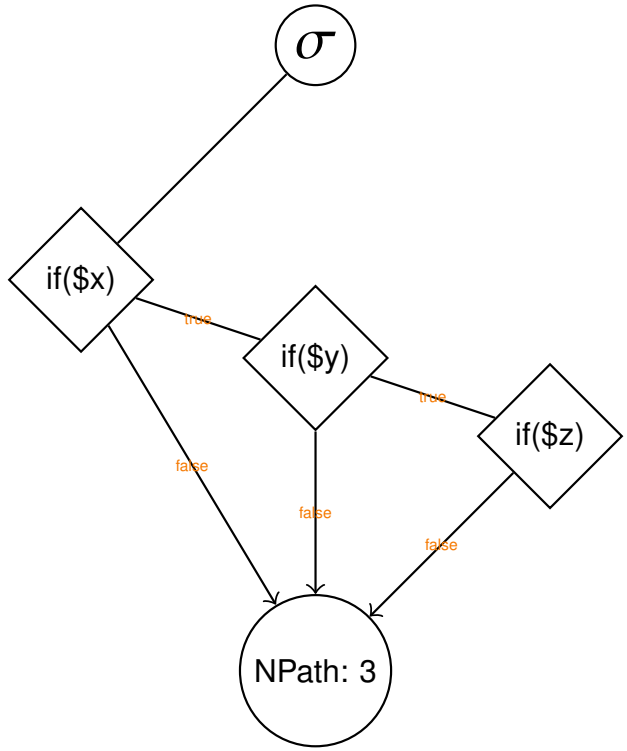

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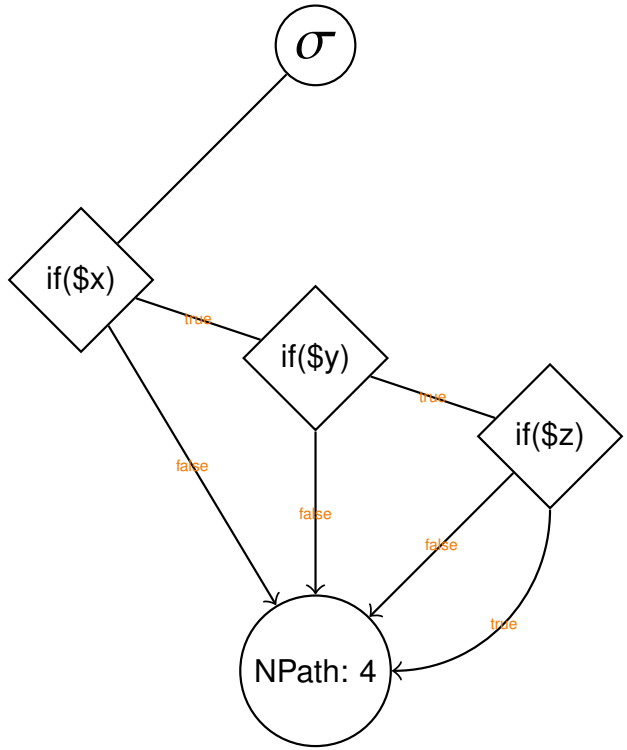

What do you like more?

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            if ($y) {
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Sensible limits

- Numbers do not tell anything by themselves
- To judge you need limiting values
  - Cyclomatic Complexity
    - 1-4: low, 5-7: medium, 8-10: high, 11+: hell
  - NPath Complexity
    - 200: critical mass

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    - 200: critical mass
- Limiting values are at your discretion

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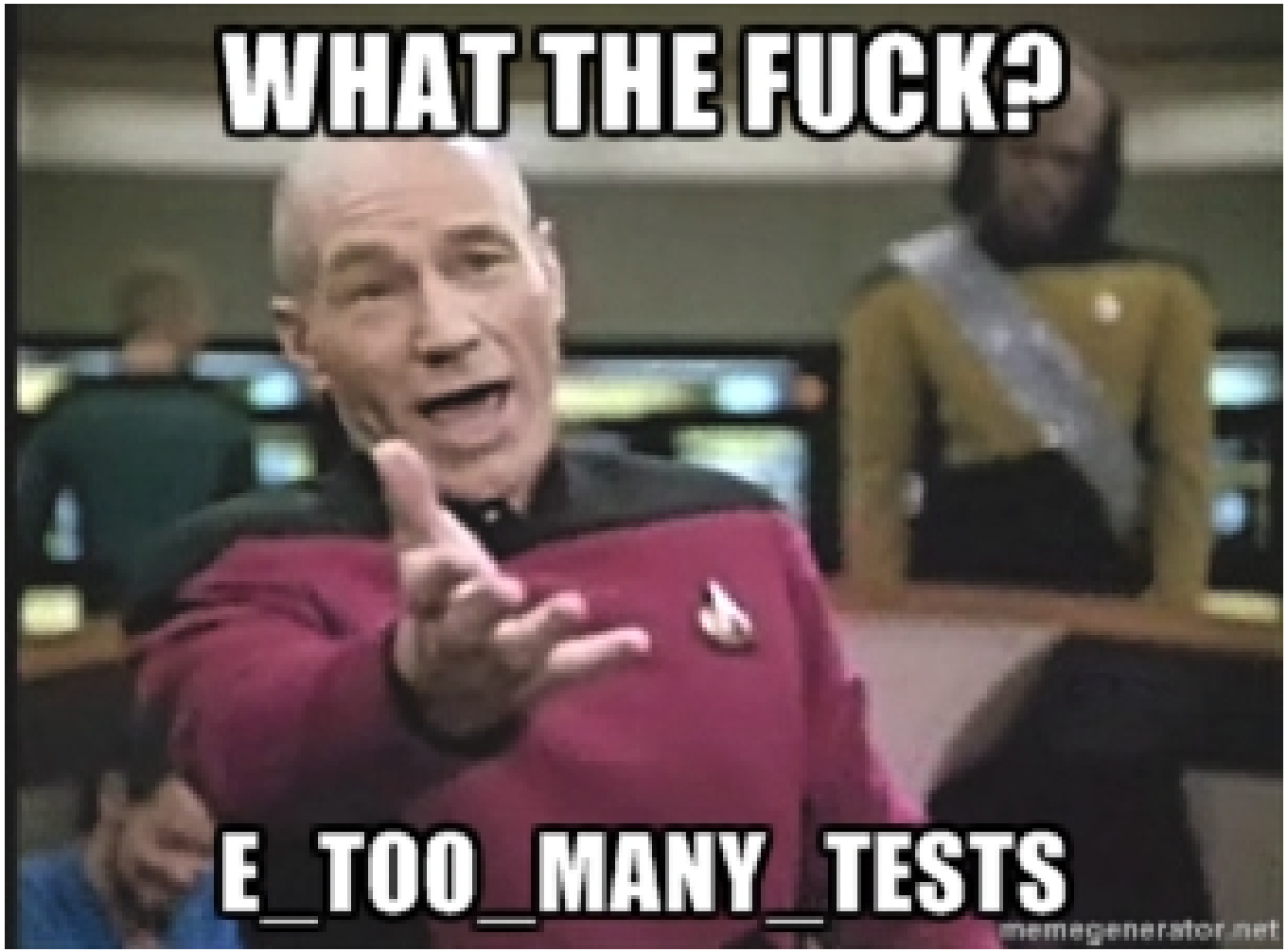
  - Common integer boundaries: $-2^{63}, -2^{31}, -1, 0, 1, 2^{31}, 2^{63}$

Are you kidding me?



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    - Average method length
  - CCN / NOM
    - Average method complexity

Combine metrics: CRAP

Is your code CRAP?

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$$CRAP(m) = \begin{cases} ccn(m)^2 + ccn(m), & \text{if } cov(m) = 0 \\ ccn(m), & \text{if } cov(m) \geq .95 \\ ccn(m)^2 * (1 - cov(m))^3 + ccn(m), & \text{else} \end{cases}$$

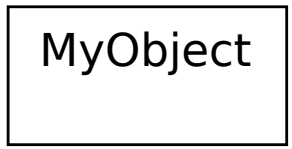
- Change Risk Anti Patterns
  - $ccn(m)$ – Cyclomatic complexity of a method
  - $cov(m)$ – Line coverage of a method

Outline

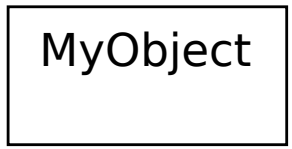
Inheritance

Is inheritance used correctly?

Object Oriented Systems

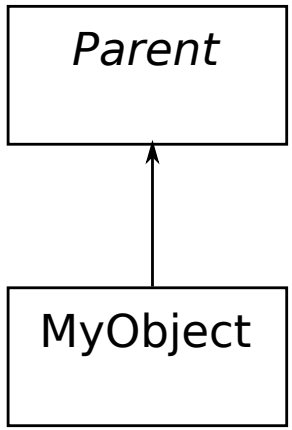


Object Oriented Systems



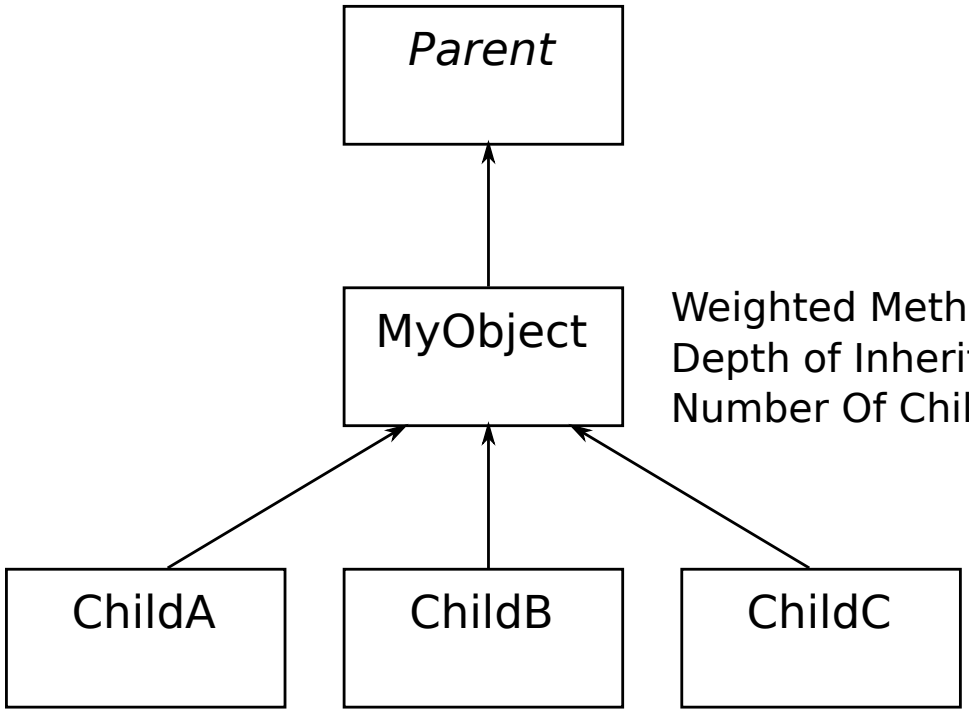
Weighted Method per Class (WMC)

Object Oriented Systems



Weighted Method per Class (WMC)
Depth of Inheritance Tree (DIT): **1**

Object Oriented Systems



Weighted Method per Class (WMC)
Depth of Inheritance Tree (DIT): **1**
Number Of Children (NOC): **3**

Chidamber & Kemerer

- A Metrics Suite for Object Oriented Design

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  - Weighted Methods per Class (WMC)
    - Sum of method complexities
    - Limiting value: 20 - 50

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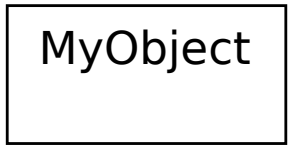
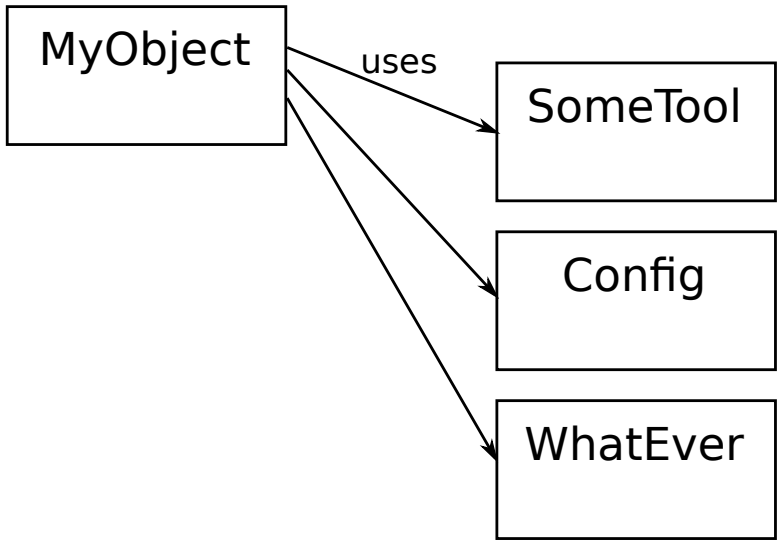
Composition

Are there any evil entities?

Object Oriented Systems



Object Oriented Systems



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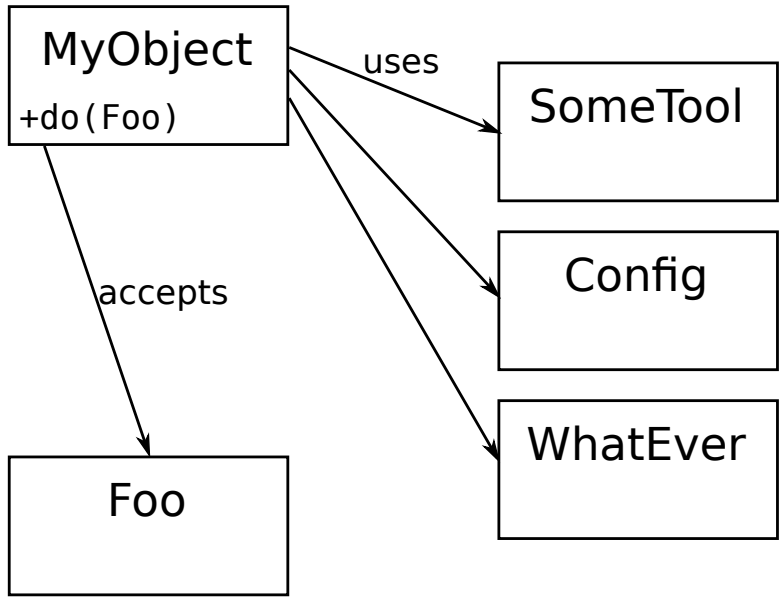

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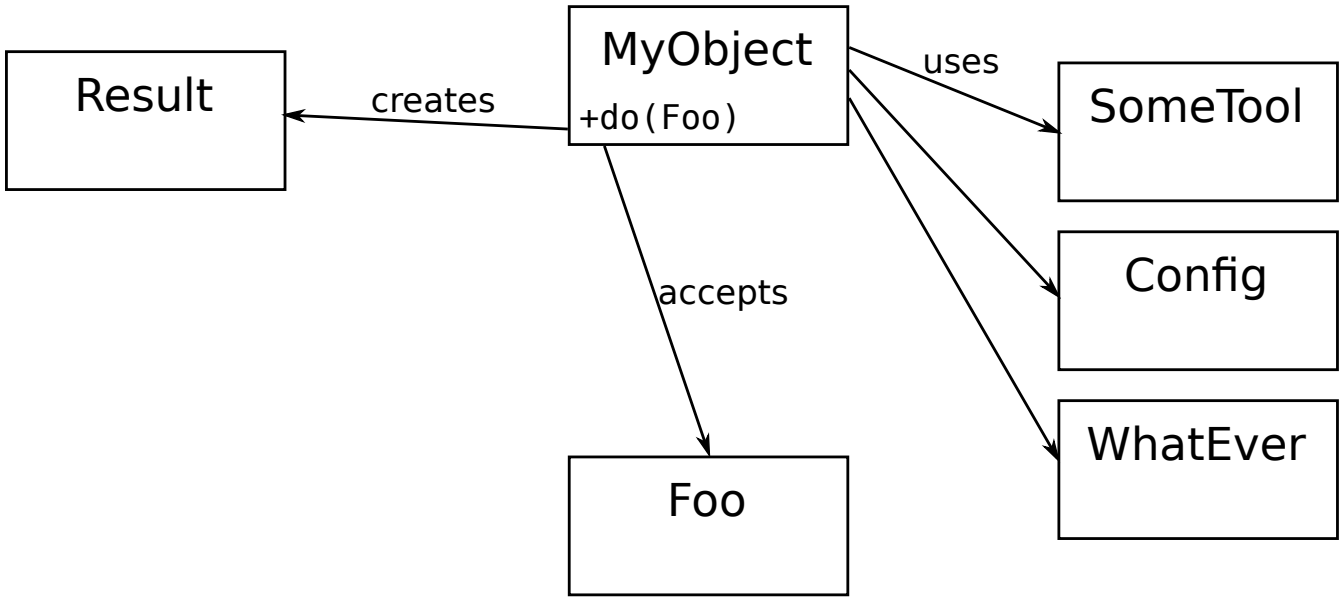

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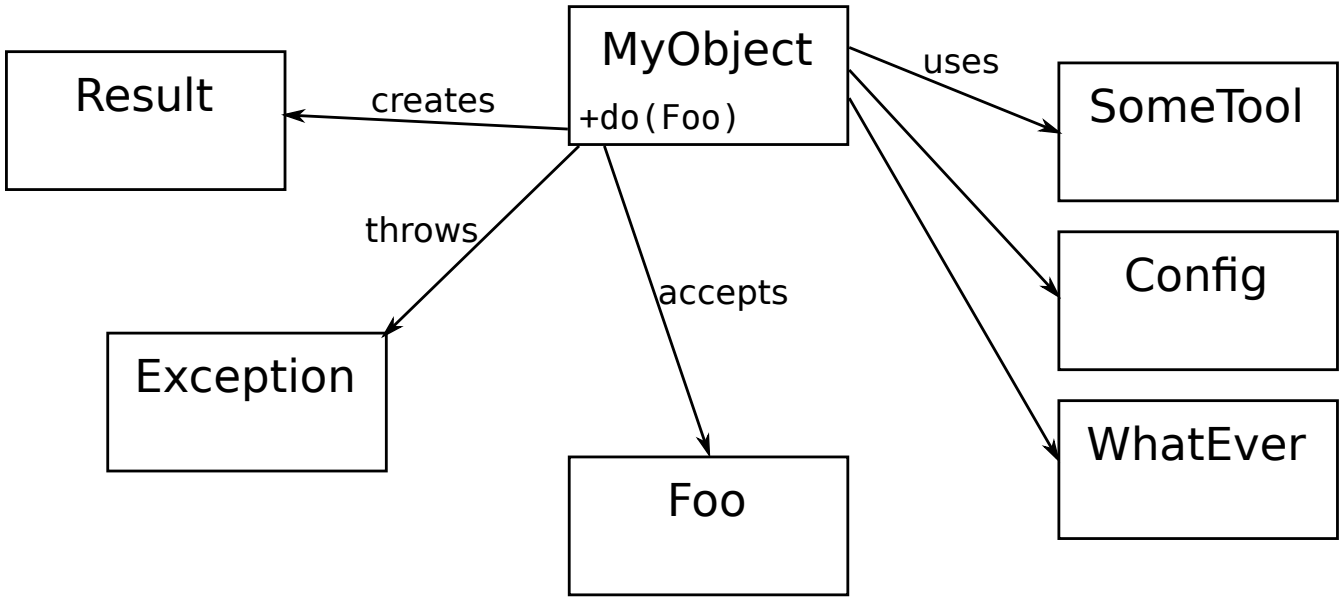

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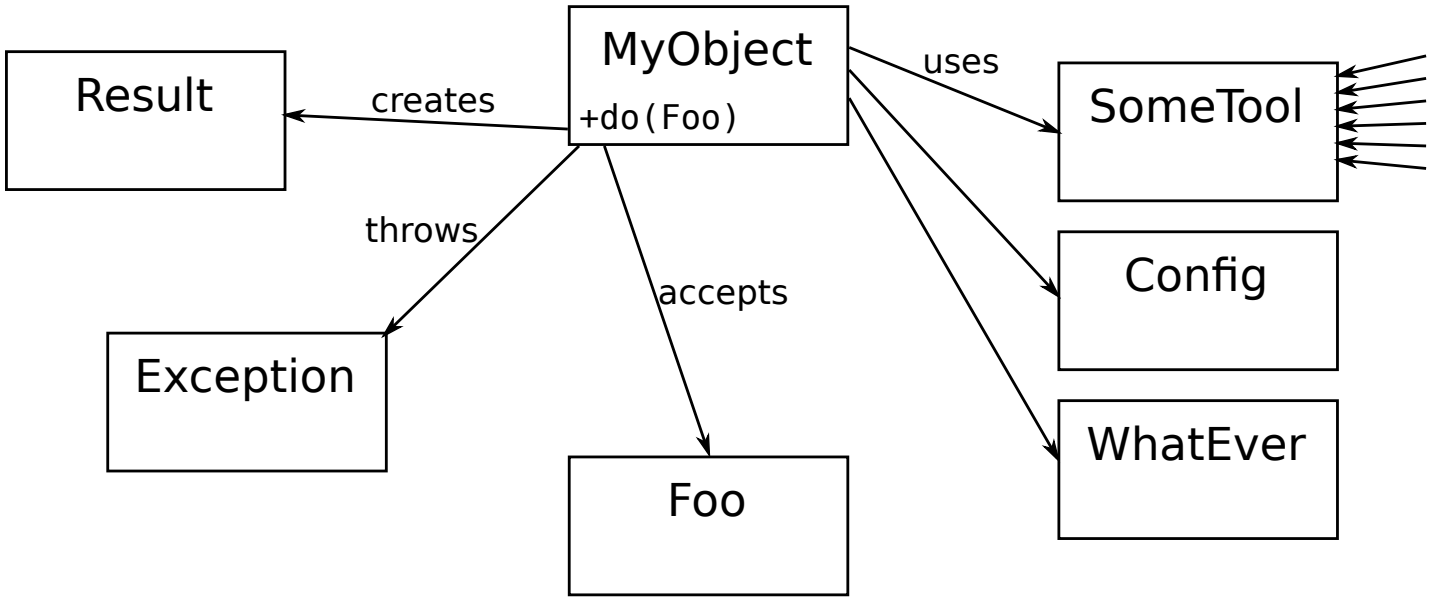

Coupling

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  - Also called “Coupling Between Objects” (CBO)
- (High) Afferent Coupling C_A (incoming dependencies)
  - A lot of code relies on artifact
  - Artifact should be really stable

Instability vs. Abstractness

Instability:

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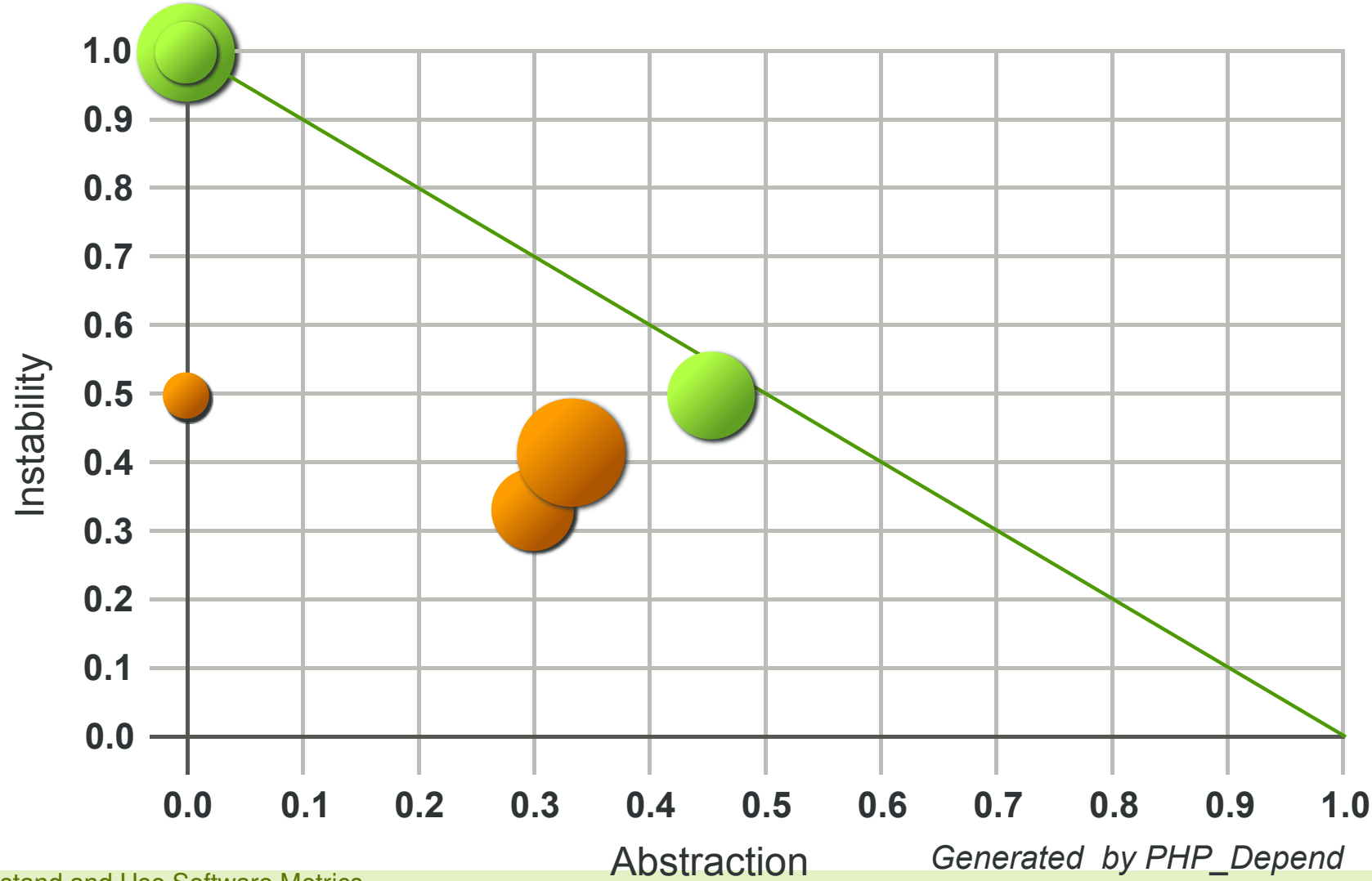
- What instability could we expect for an abstract class or an interface?

Abstractness & Instability



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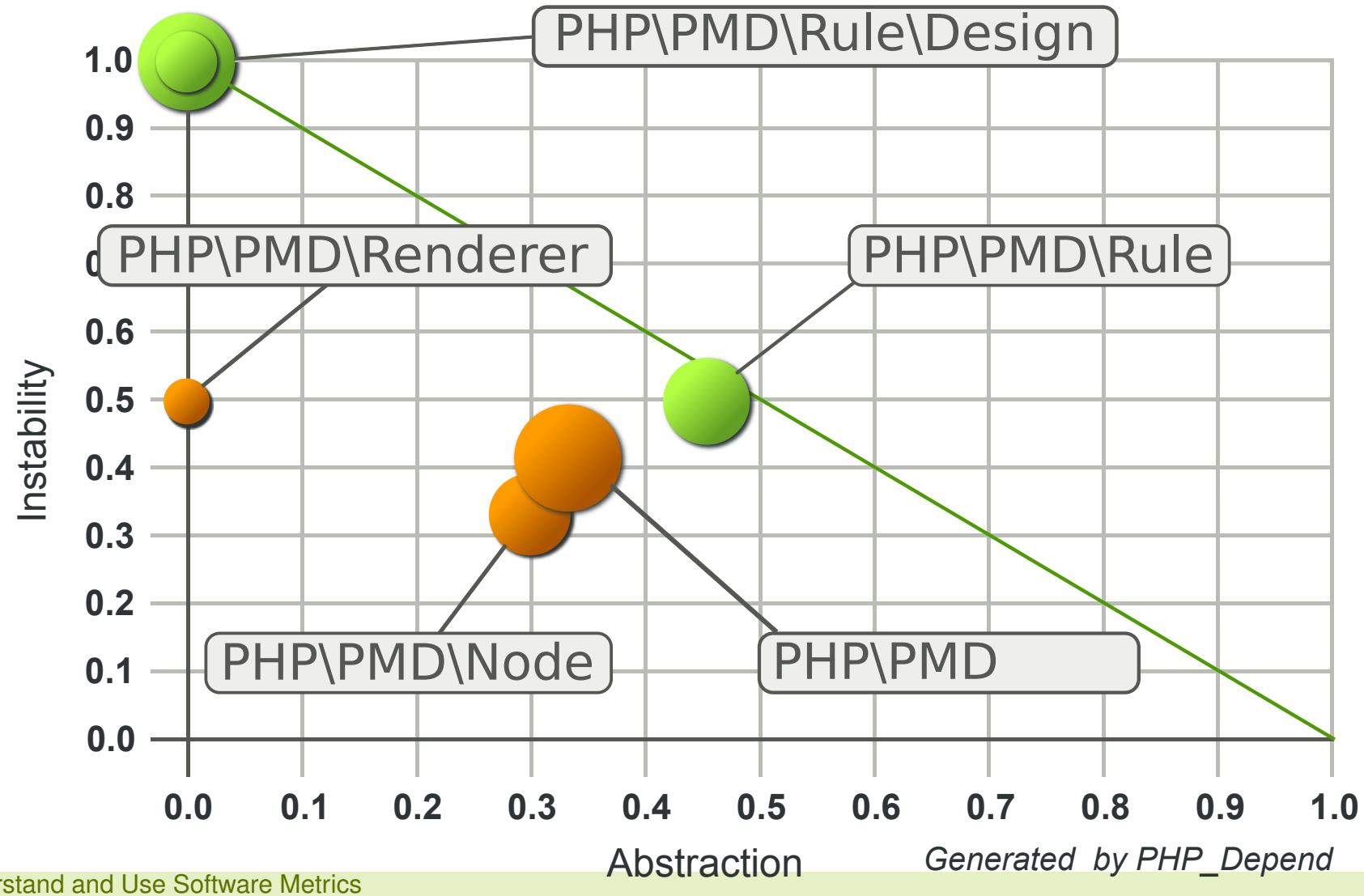

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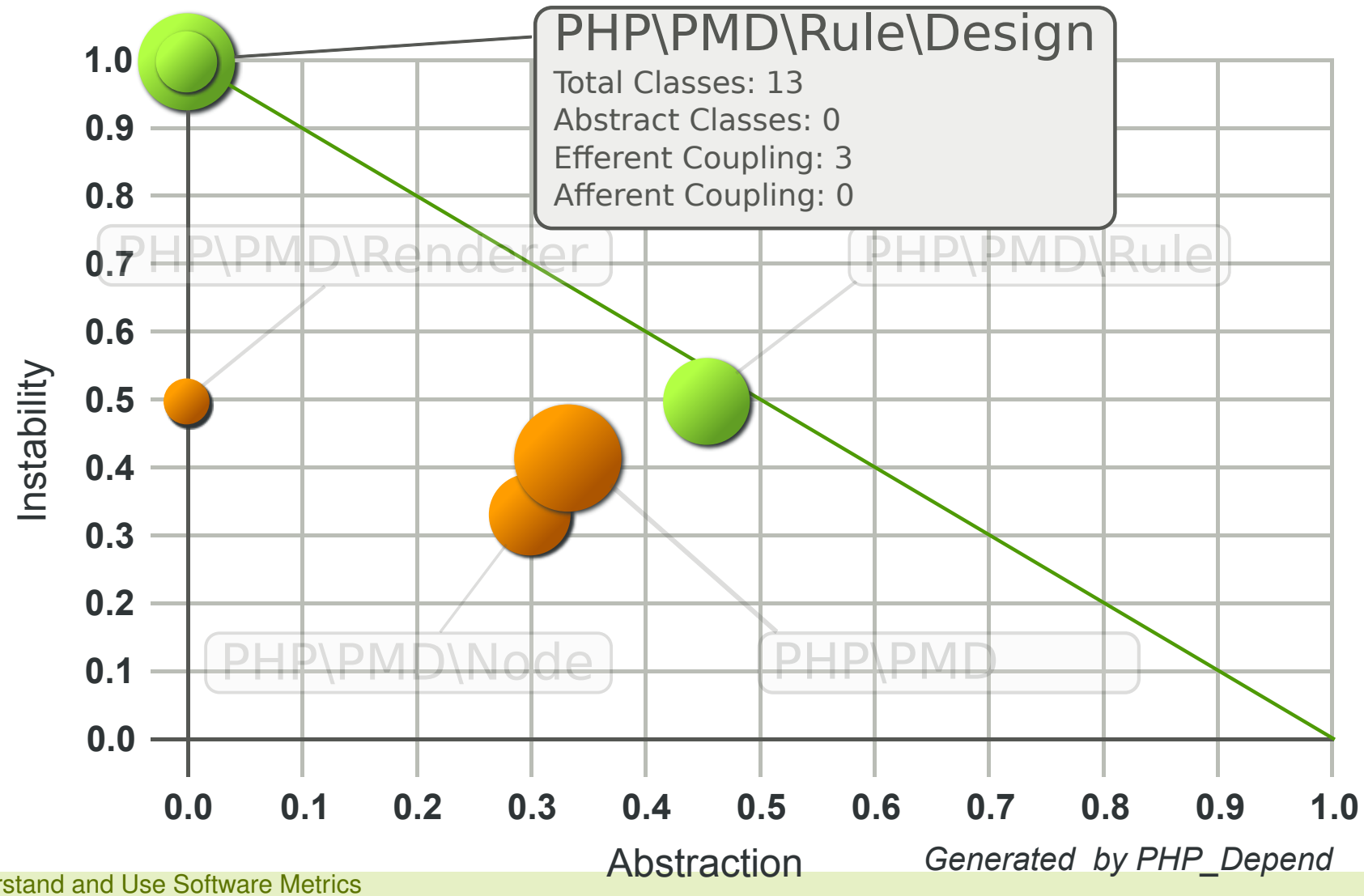

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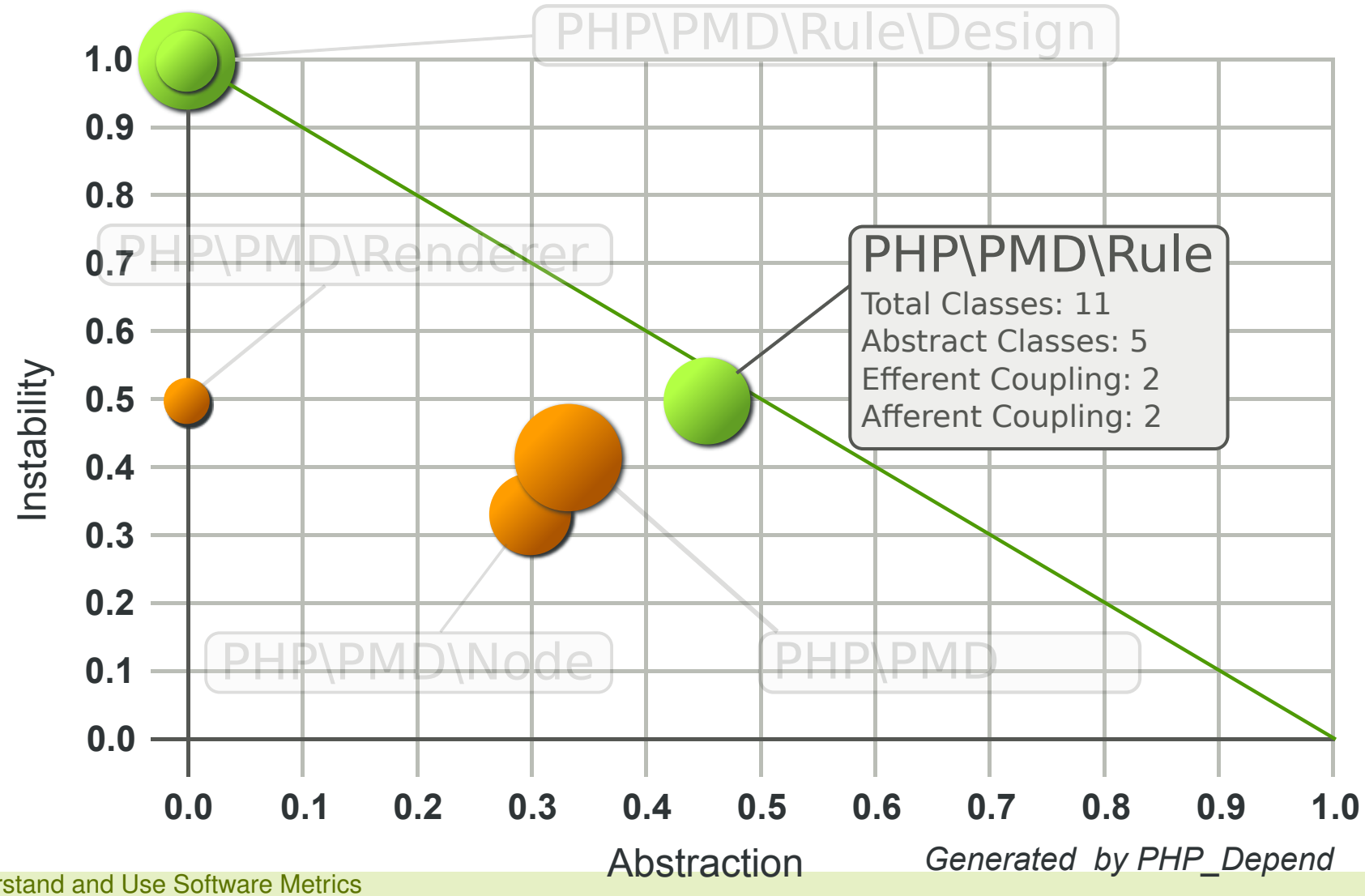

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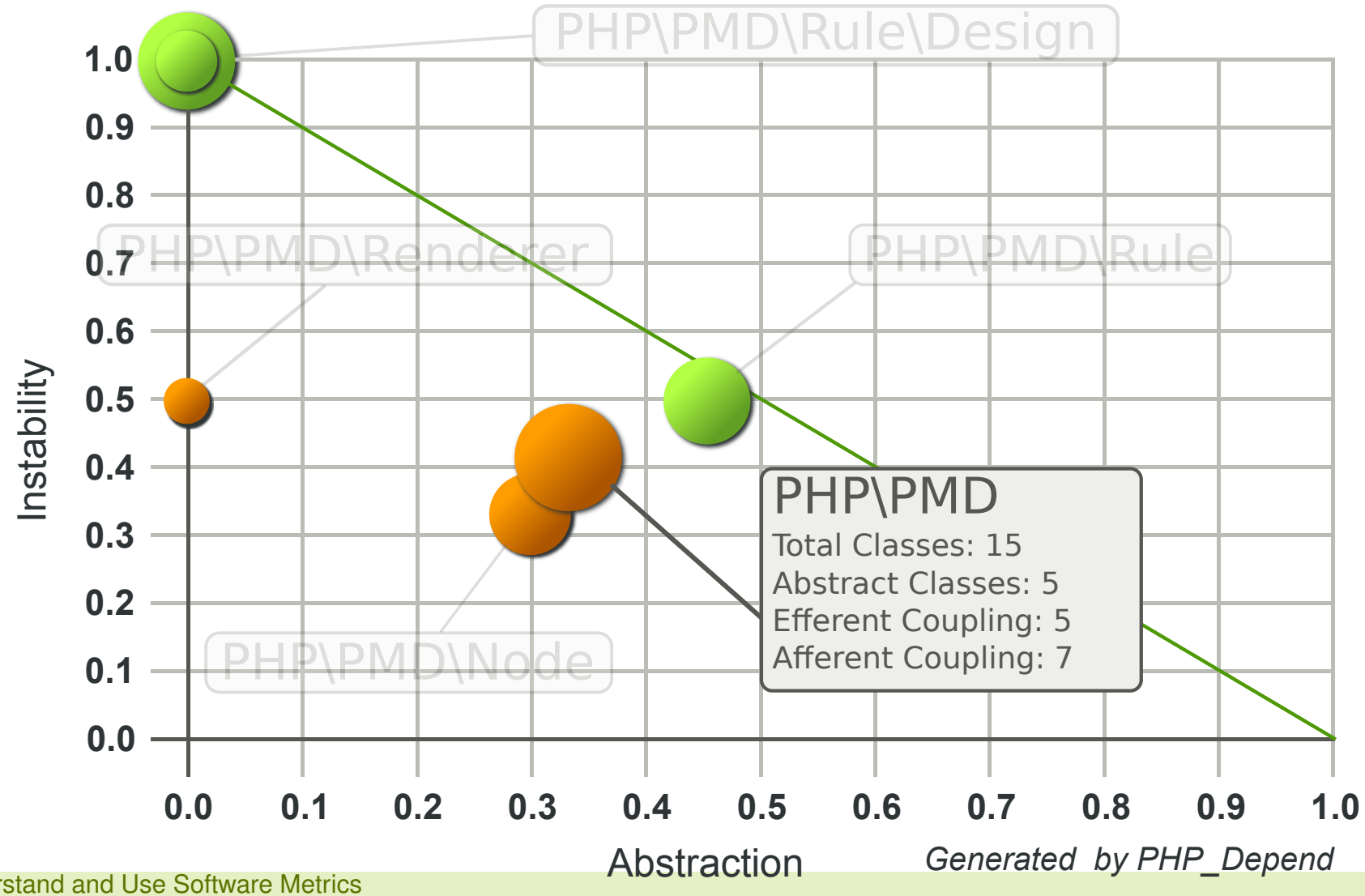

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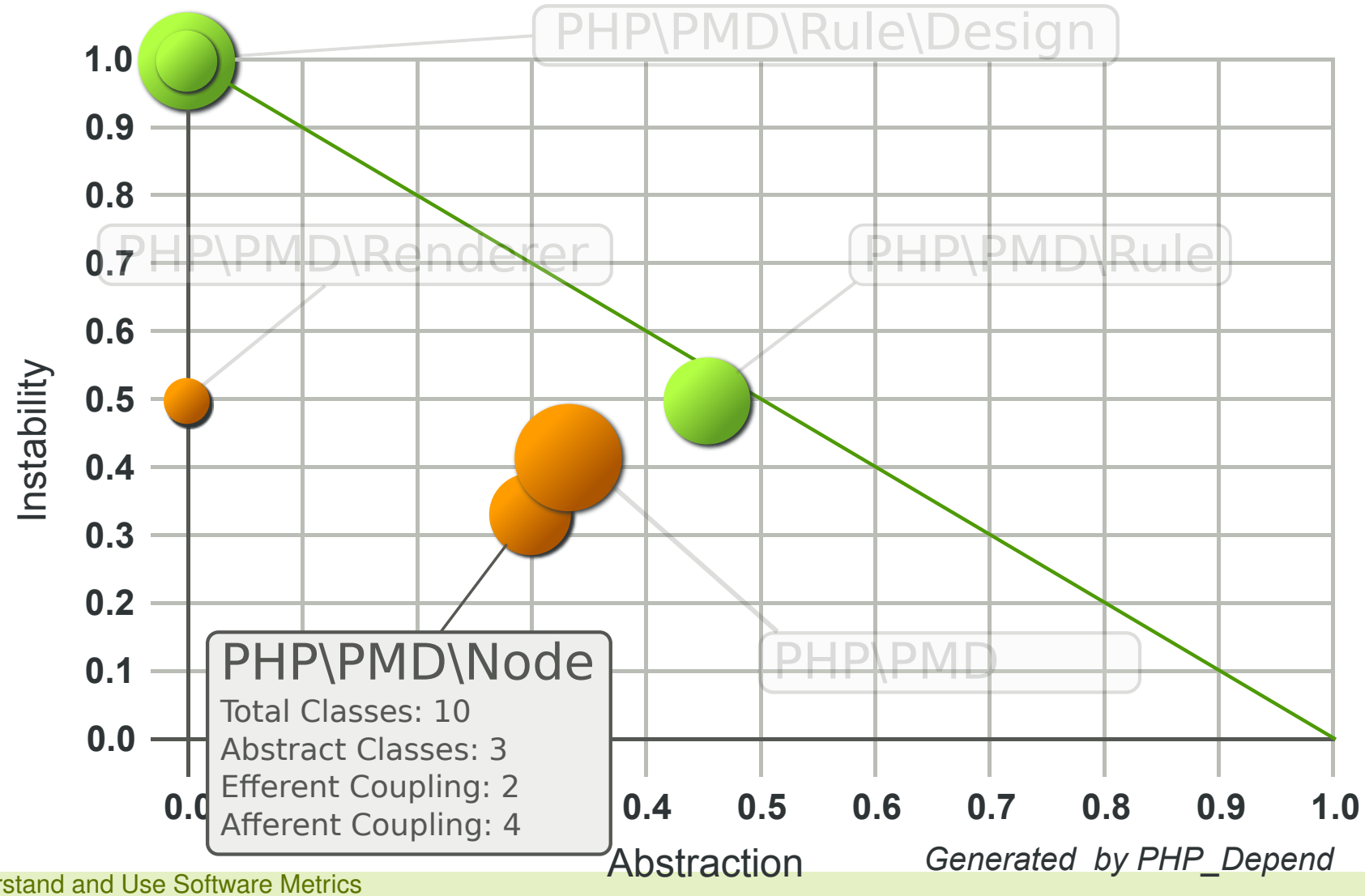

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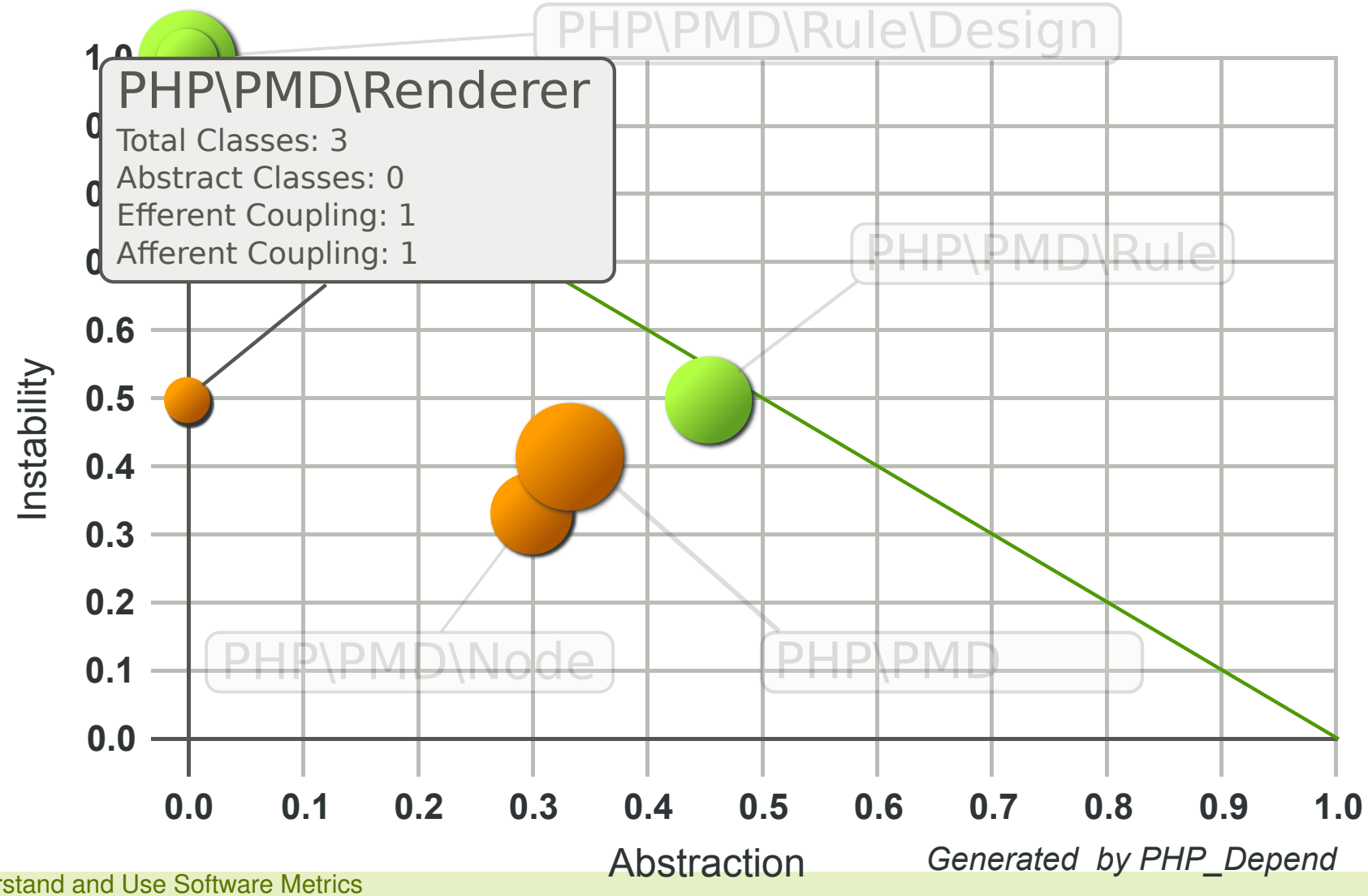

CodeRank

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- Maps software to a graph
  - A node (π) for each software artifact
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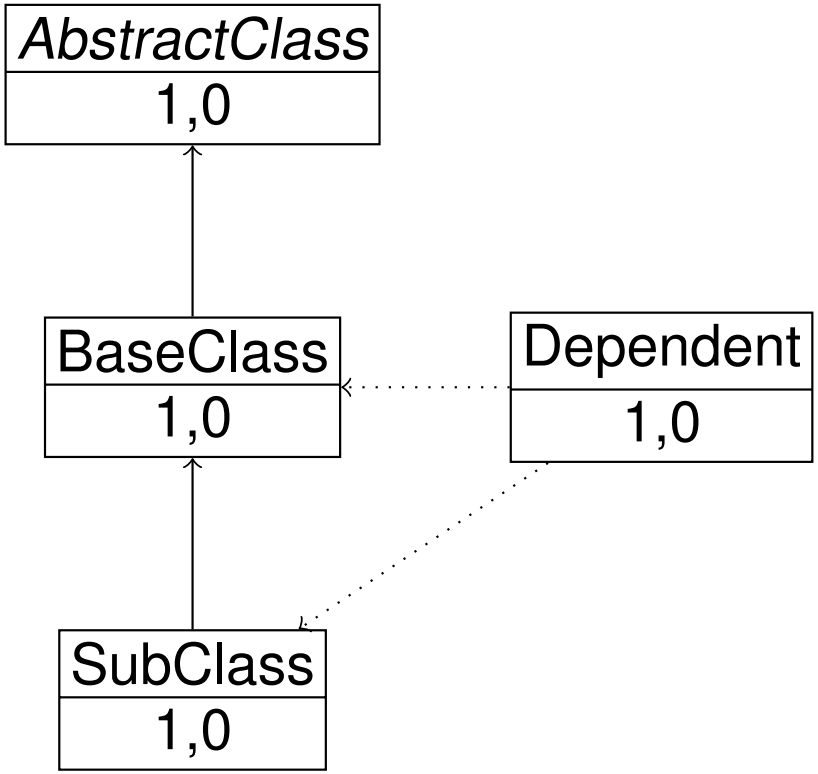
- CodeRank:

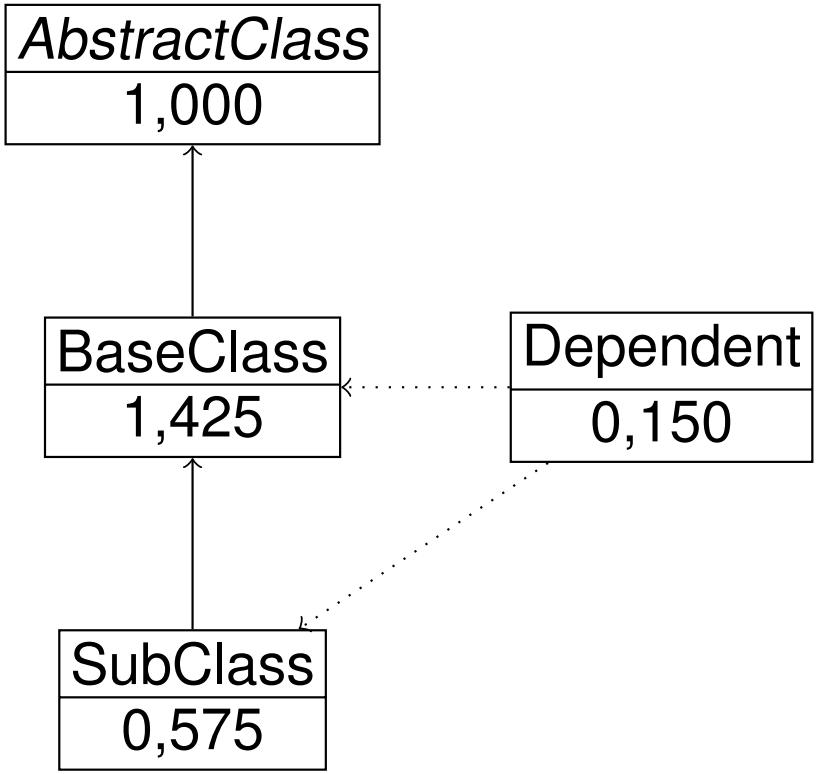
$$CR(\pi_i) = \sum_r r((1-d) + d \sum_r r(CR(\pi_r)/\rho_r))$$

CodeRank



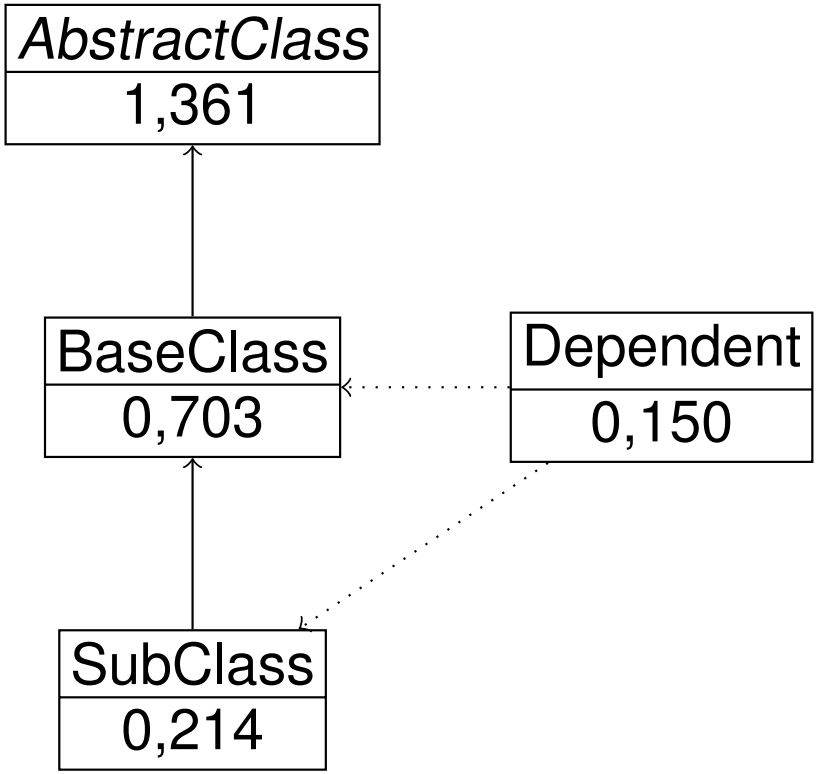
- Iteration: 0

CodeRank



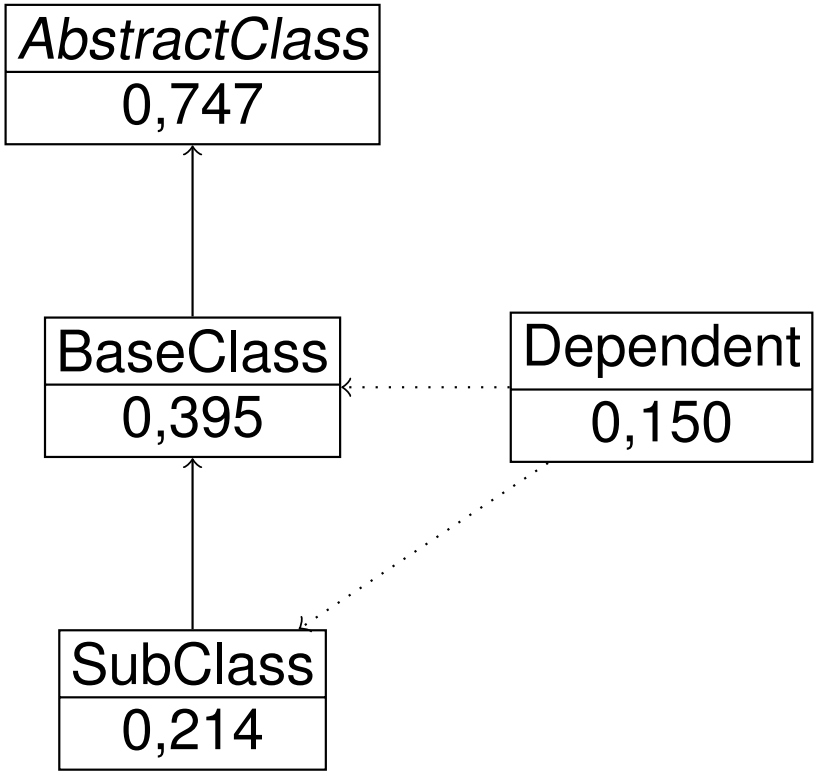
- Iteration: 1

CodeRank



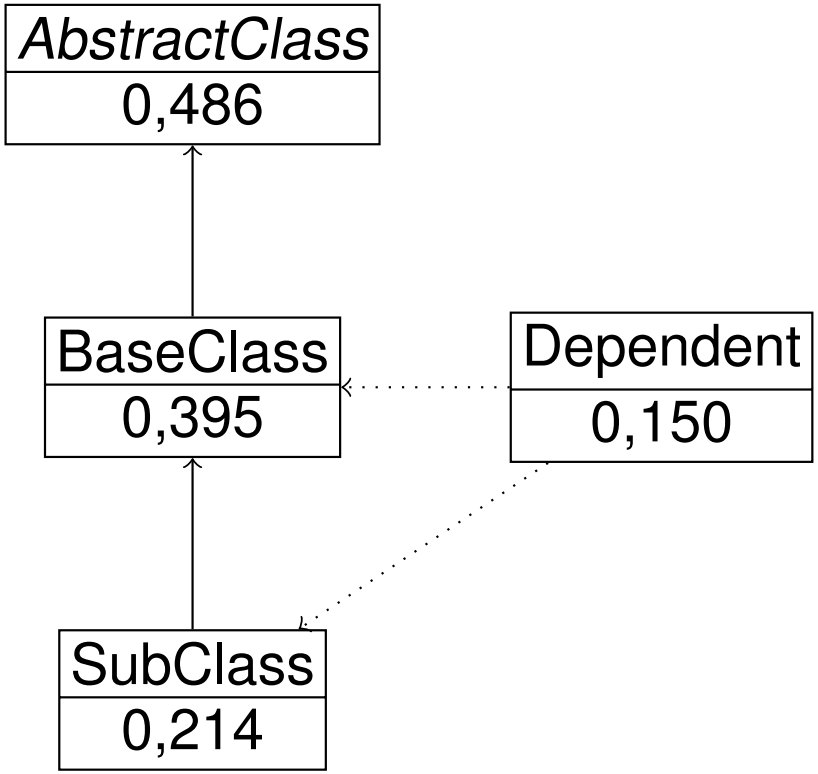
- Iteration: 2

CodeRank



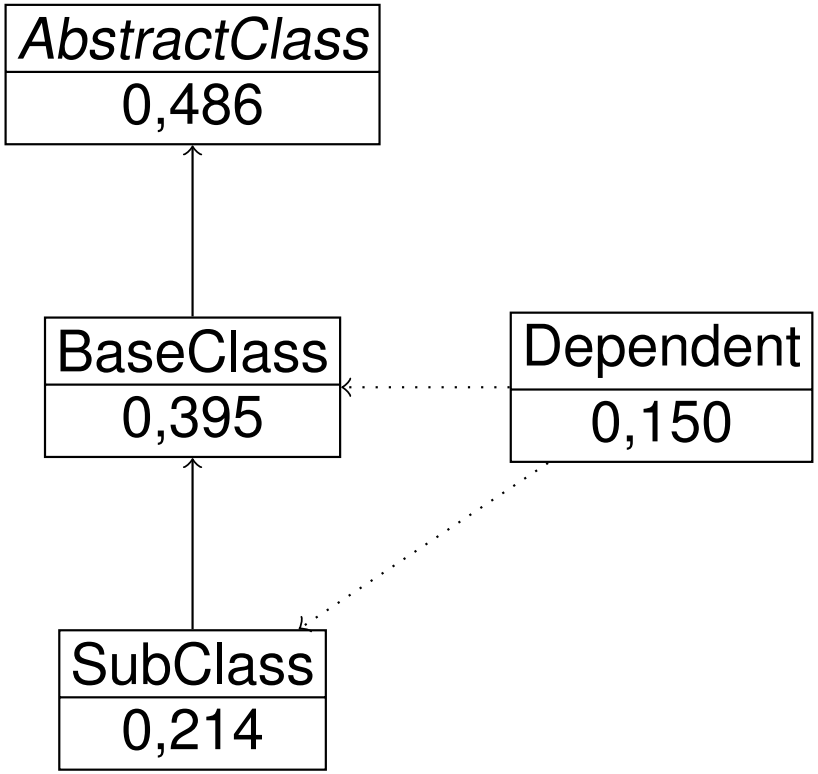
- Iteration: 3

CodeRank



- Iteration: 4

CodeRank



- Iteration: 5

CodeRank

- Incorporates indirect dependencies
- Locates elements with high effect on the whole system
- Reverse CodeRank:
  - Shows dependent components

Combined Metrics

- Important classes to test: $CR * WMC$
- Easy test subjects: $C_E = 0$ (and high CR or WMC)

Outline

Metrics are . . .

- . . . no magic, but simple measured values
- . . . useless without limiting values
- . . . scalable – grow with project growth
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- . . . highly interpretable – interpretation depends on viewer

Projects used

- PHPLoc:
  `https://github.com/sebastianbergmann/phploc`
- PDepend:
  `http://pdepend.org/`
- PHP Mess Detector (PHPMD):
  `http://phpmd.org/`
- Qafoo Code Review (CRT):
  `https://github.com/Qafoo/review`

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