When does a Refactoring Induce Bugs? An Empirical Study

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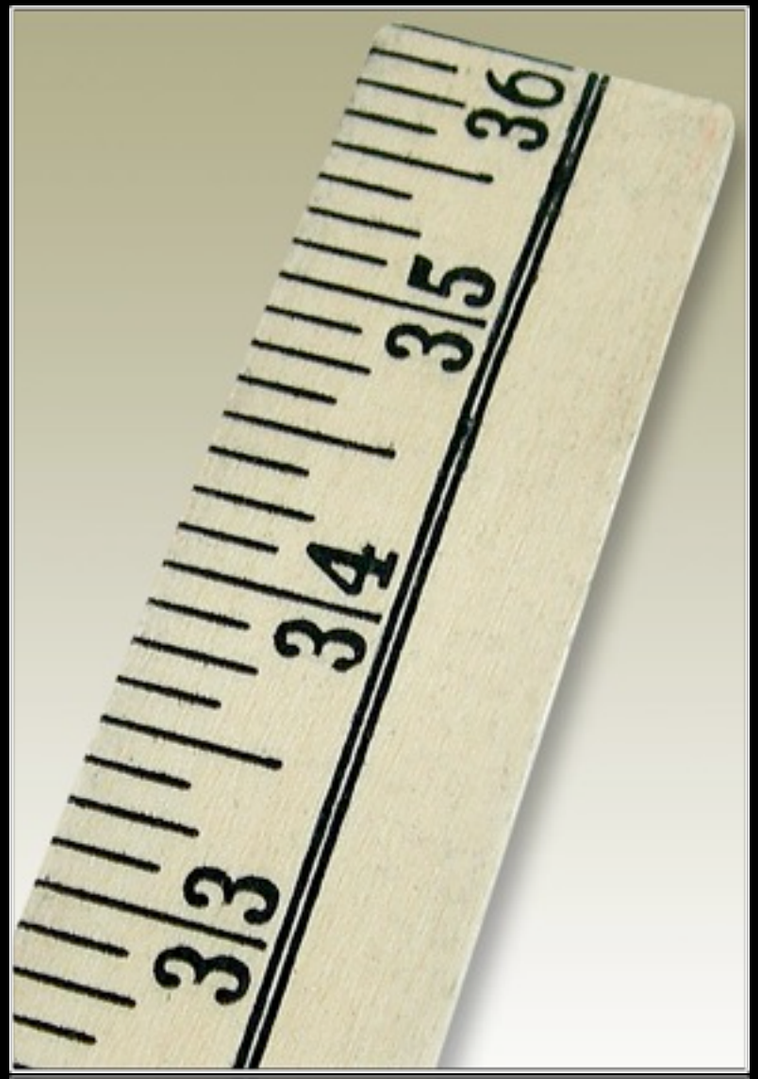
outline

Refactoring



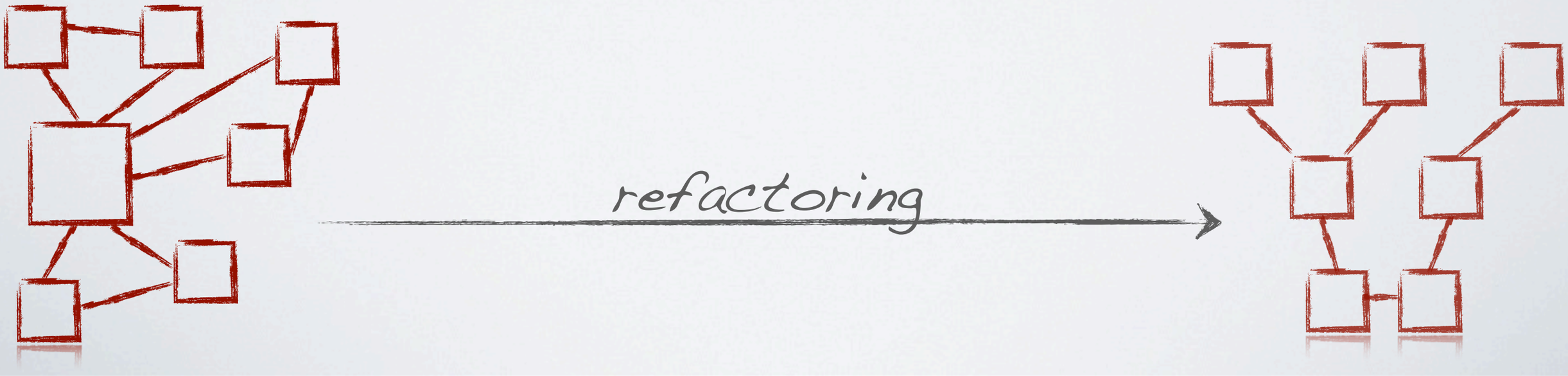
Empirical Study

Conclusion and Future Work

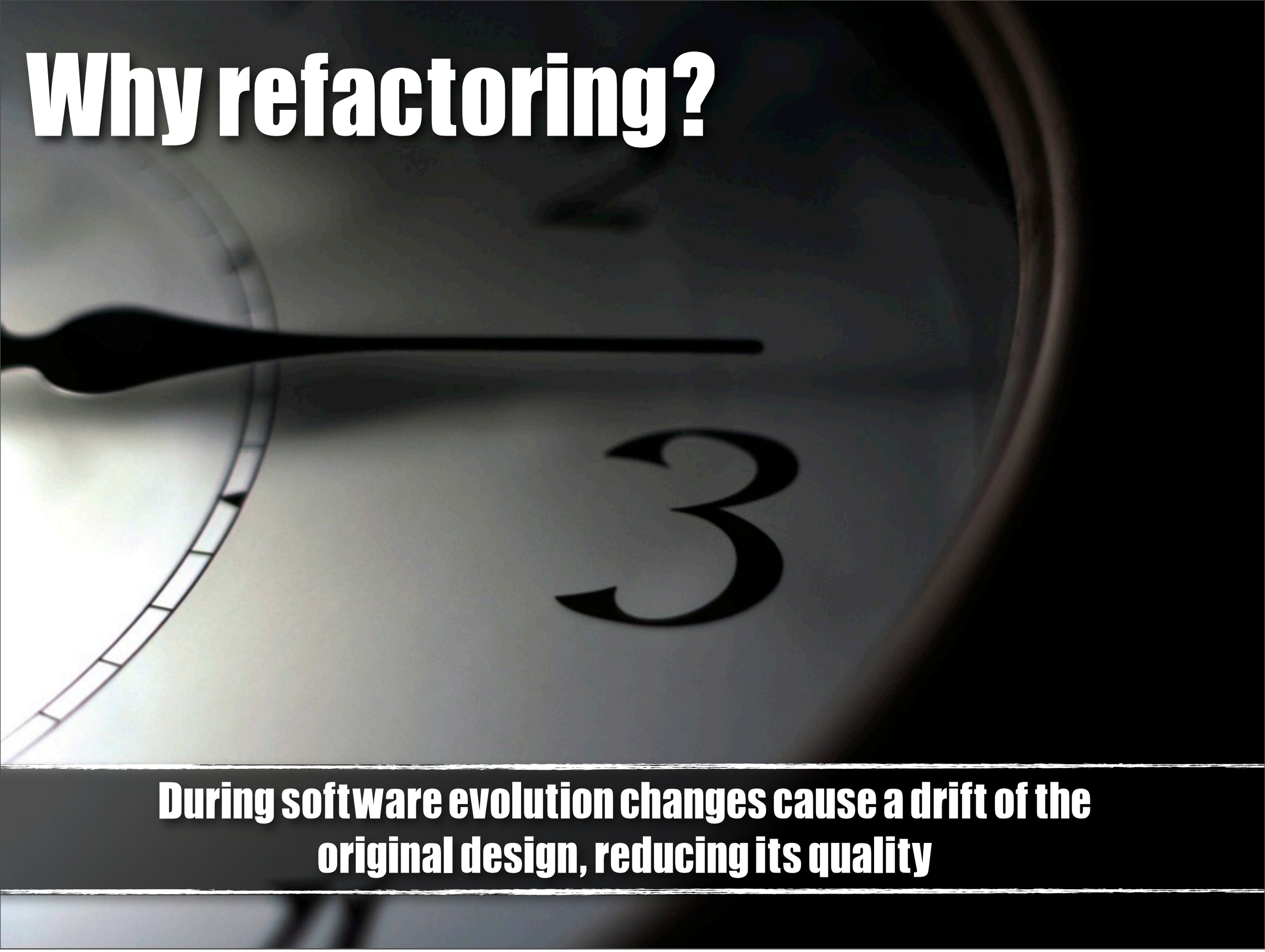
Refactoring

Refactoring is ...

..changing software to improve its non-functional attributes without modifying its external behaviour

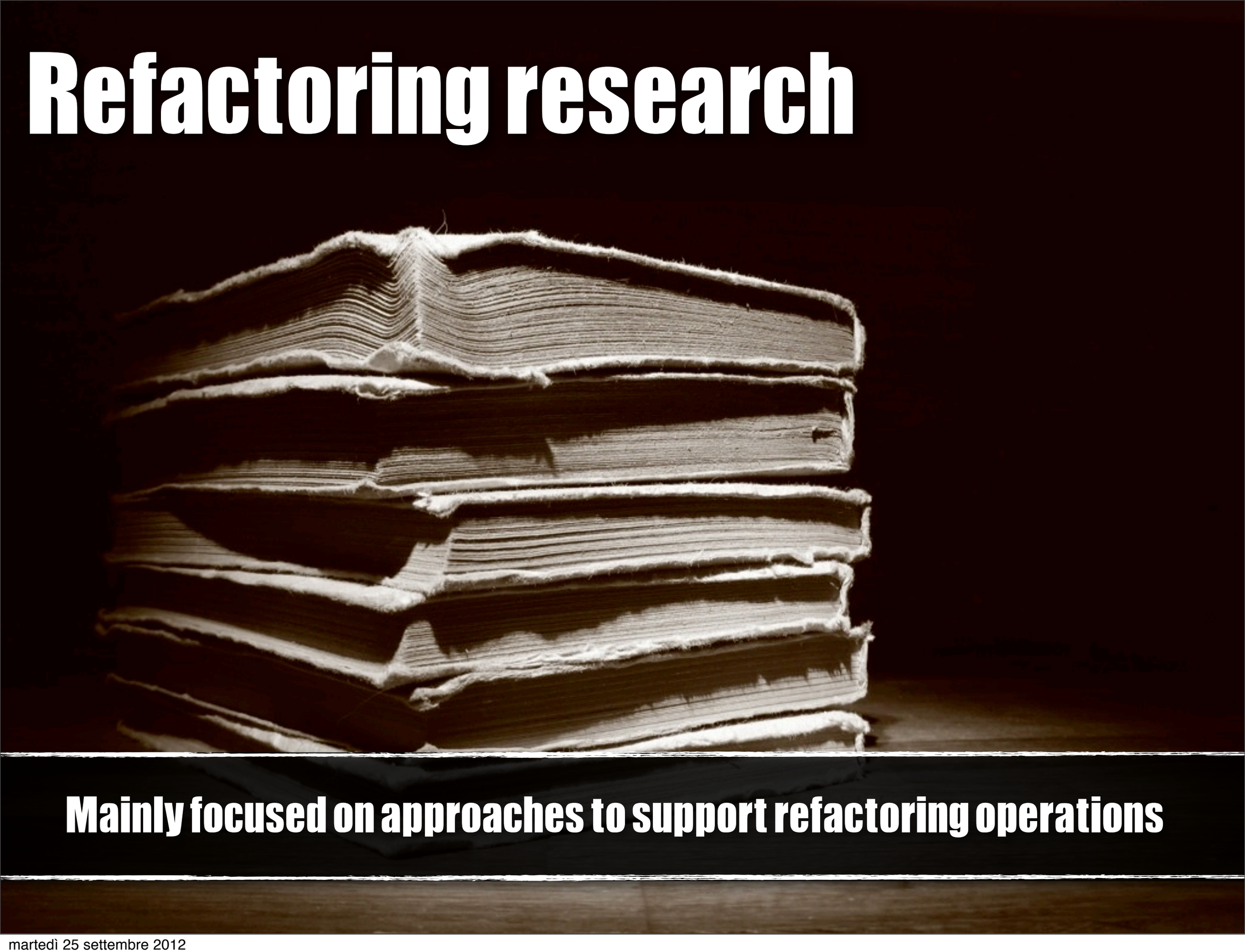


Why refactoring?



During software evolution changes cause a drift of the original design, reducing its quality

Refactoring research



Mainly focused on approaches to support refactoring operations

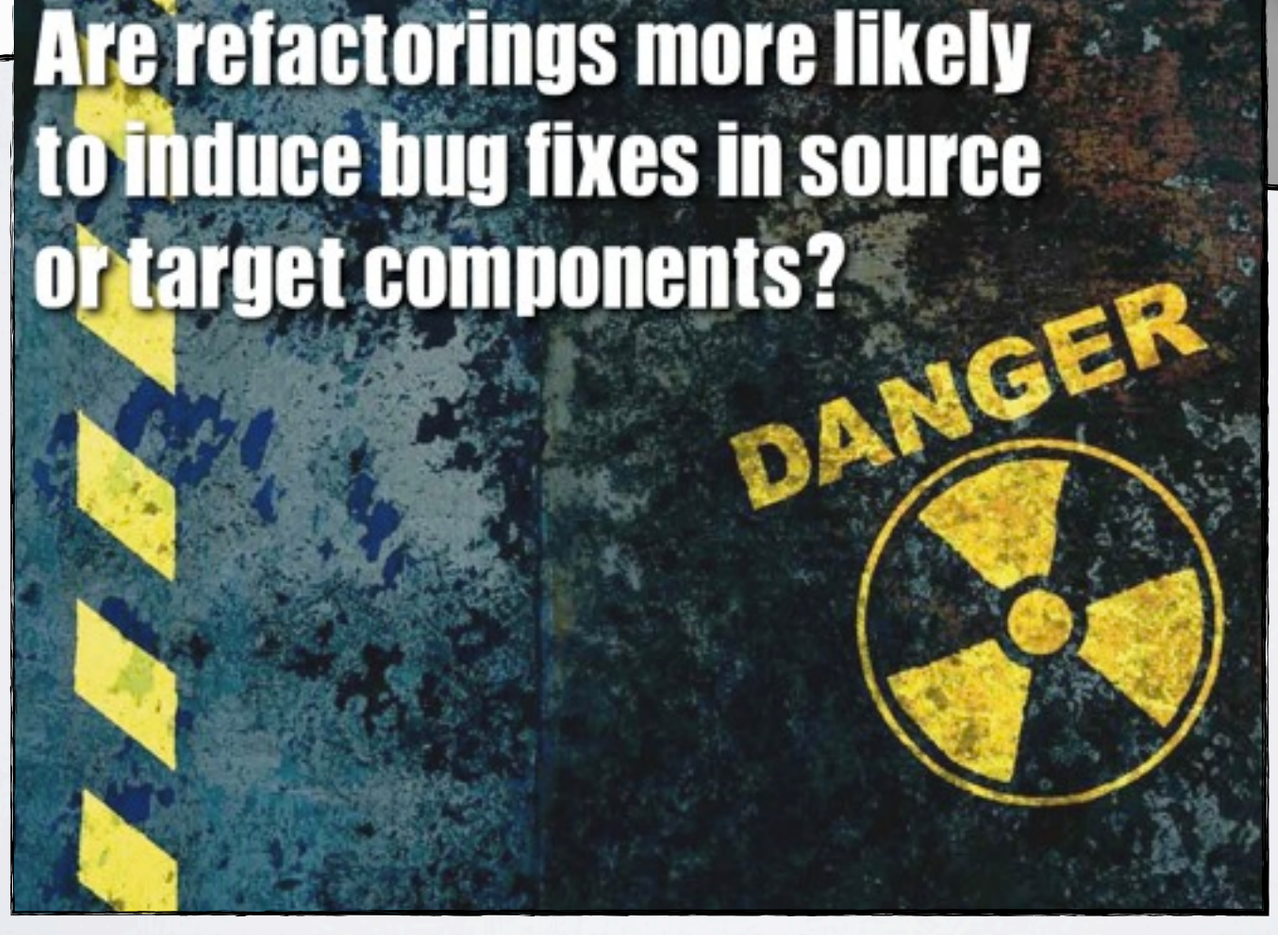
Refactoring

Is there a dark side?

To what extent do refactorings induce bug fixes?

How do various refactorings differ in terms of proneness to induce bug fixes?

Are refactorings more likely to induce bug fixes in source or target components?



63 releases of 3 systems

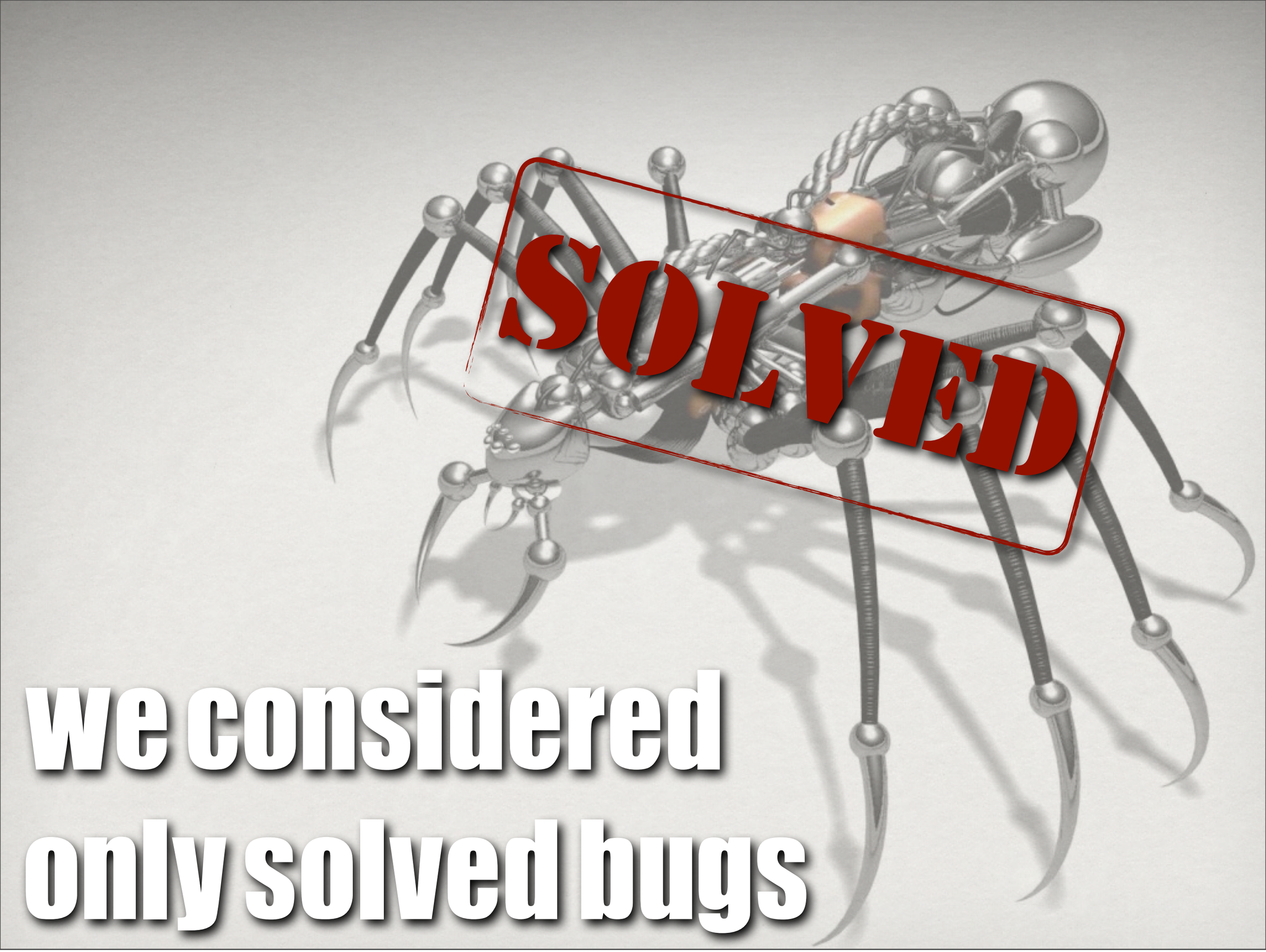
Apache Ant ArgoUML Xerces

15,008 refactorings of 52 different types

MANUALLY VALIDATED

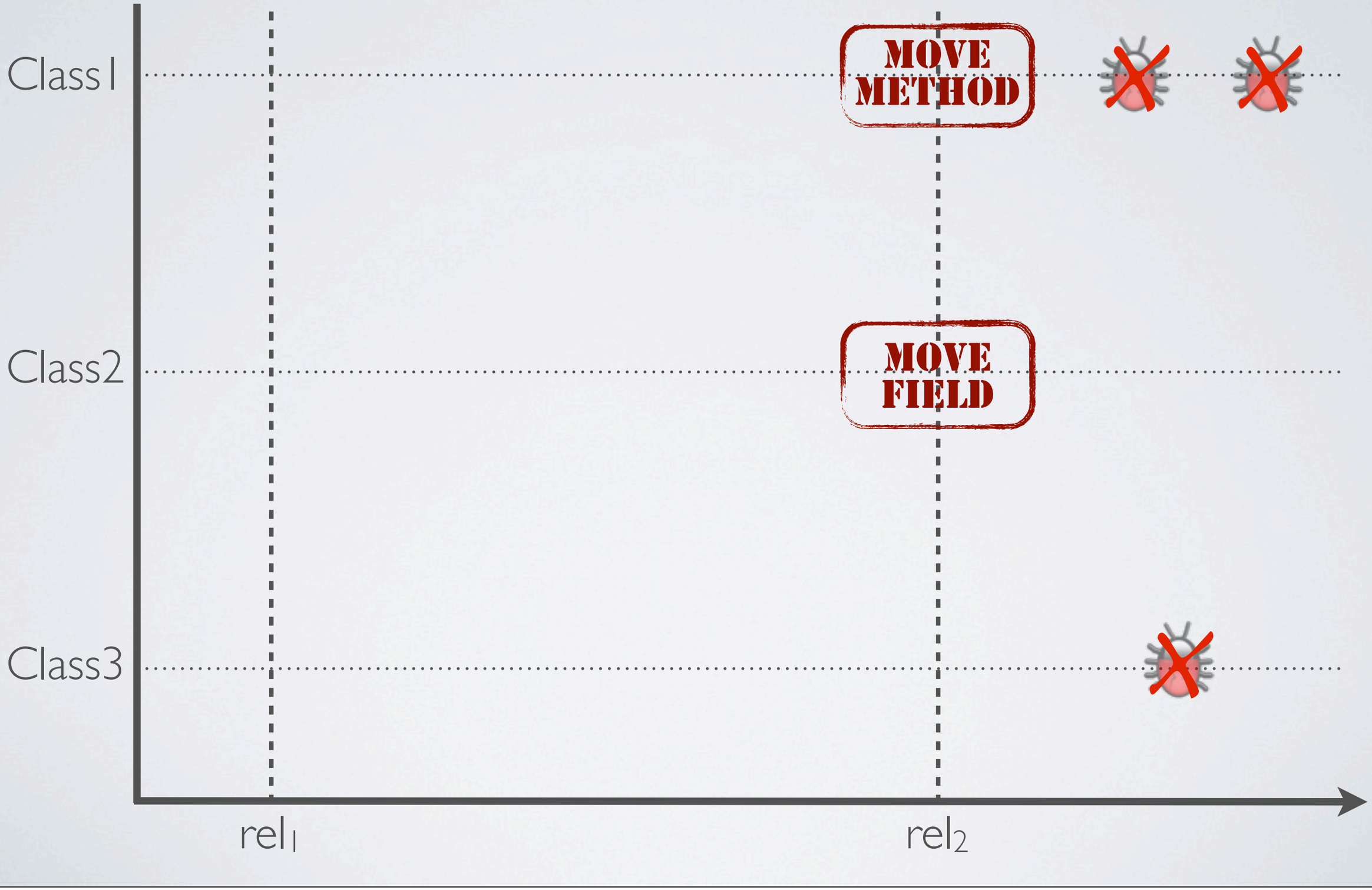
12,922 refactorings of 52 different types

what about bugs?

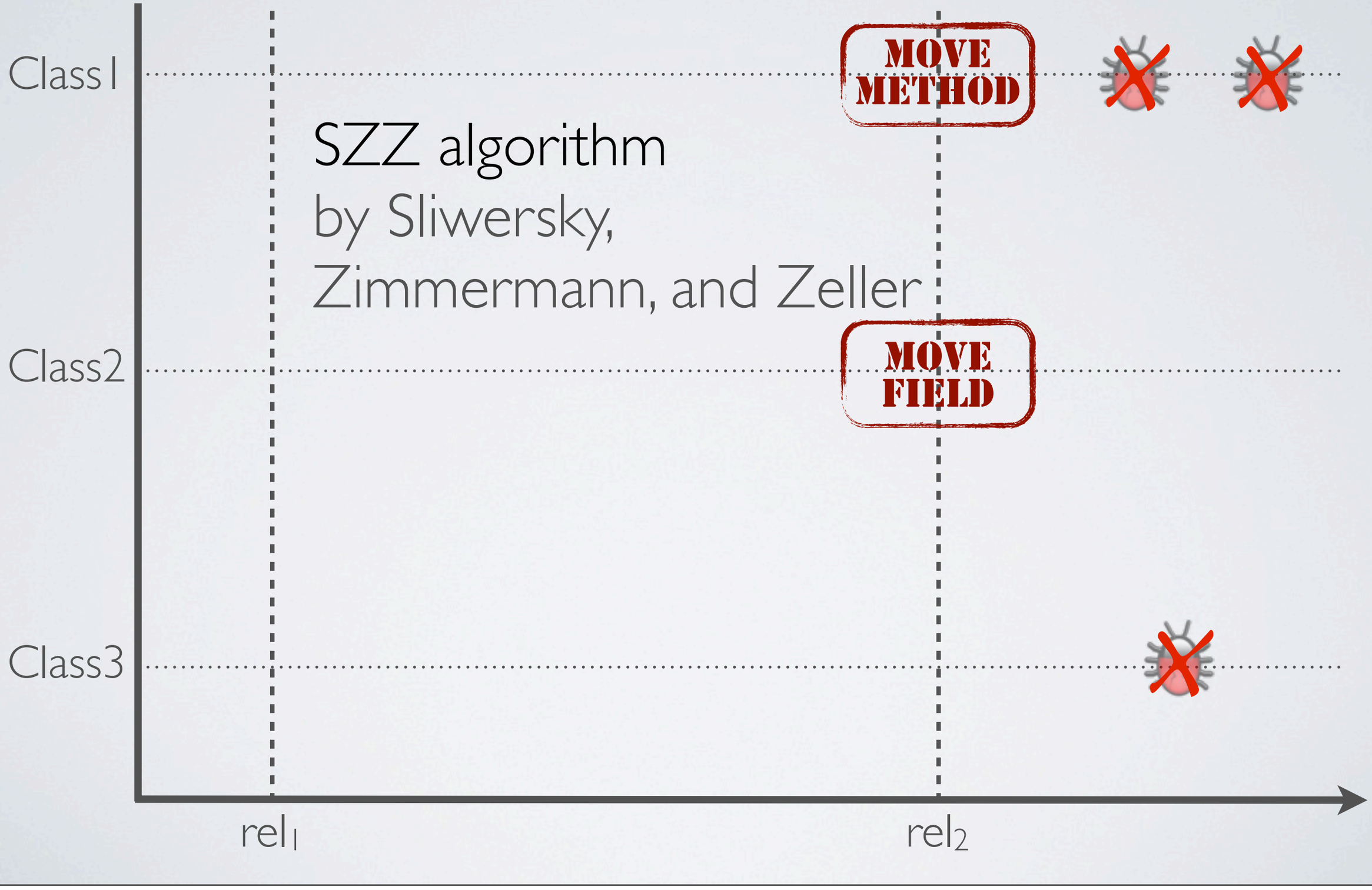


we considered only solved bugs

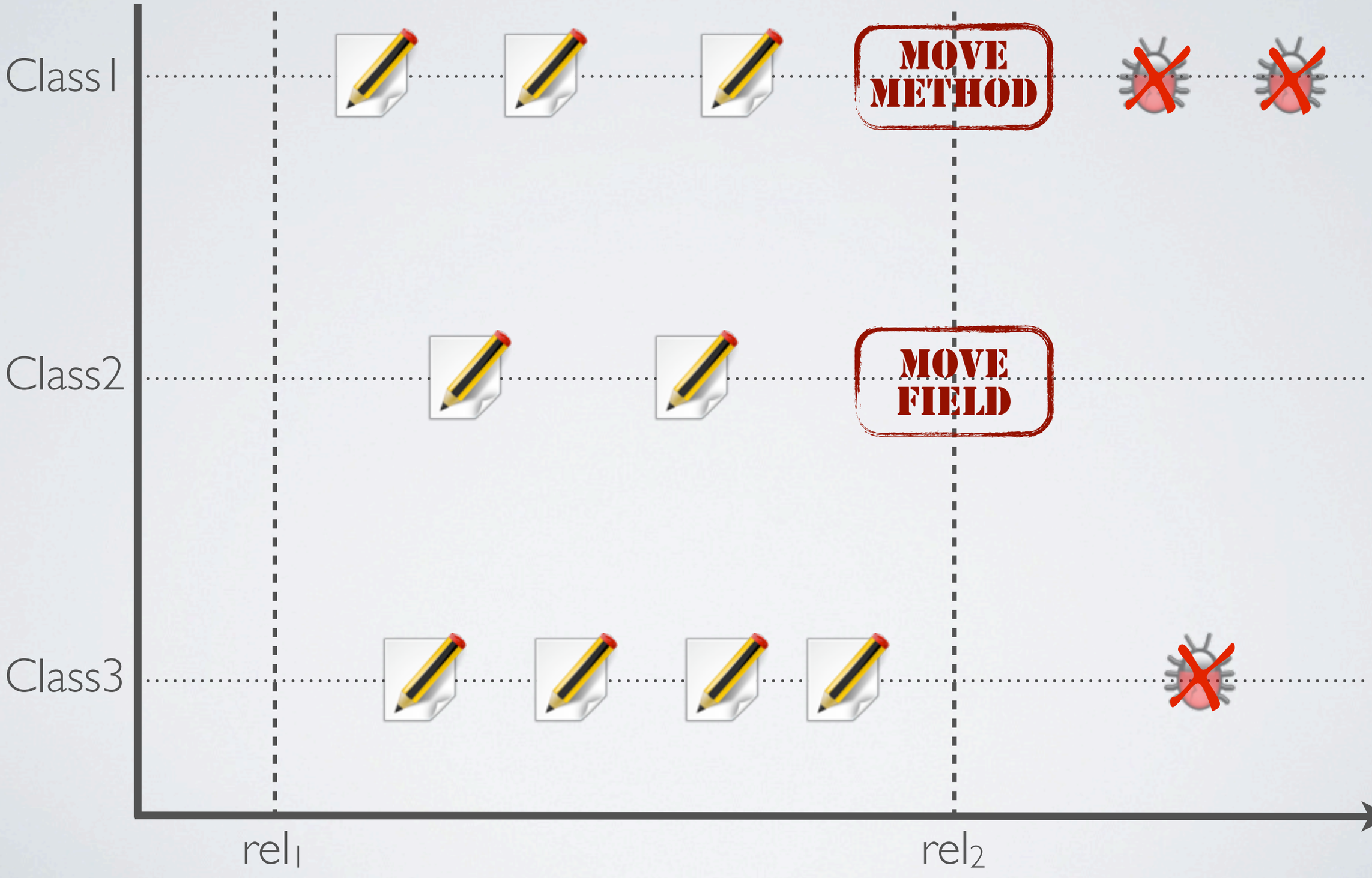
bug-inducing refactorings for rel_2



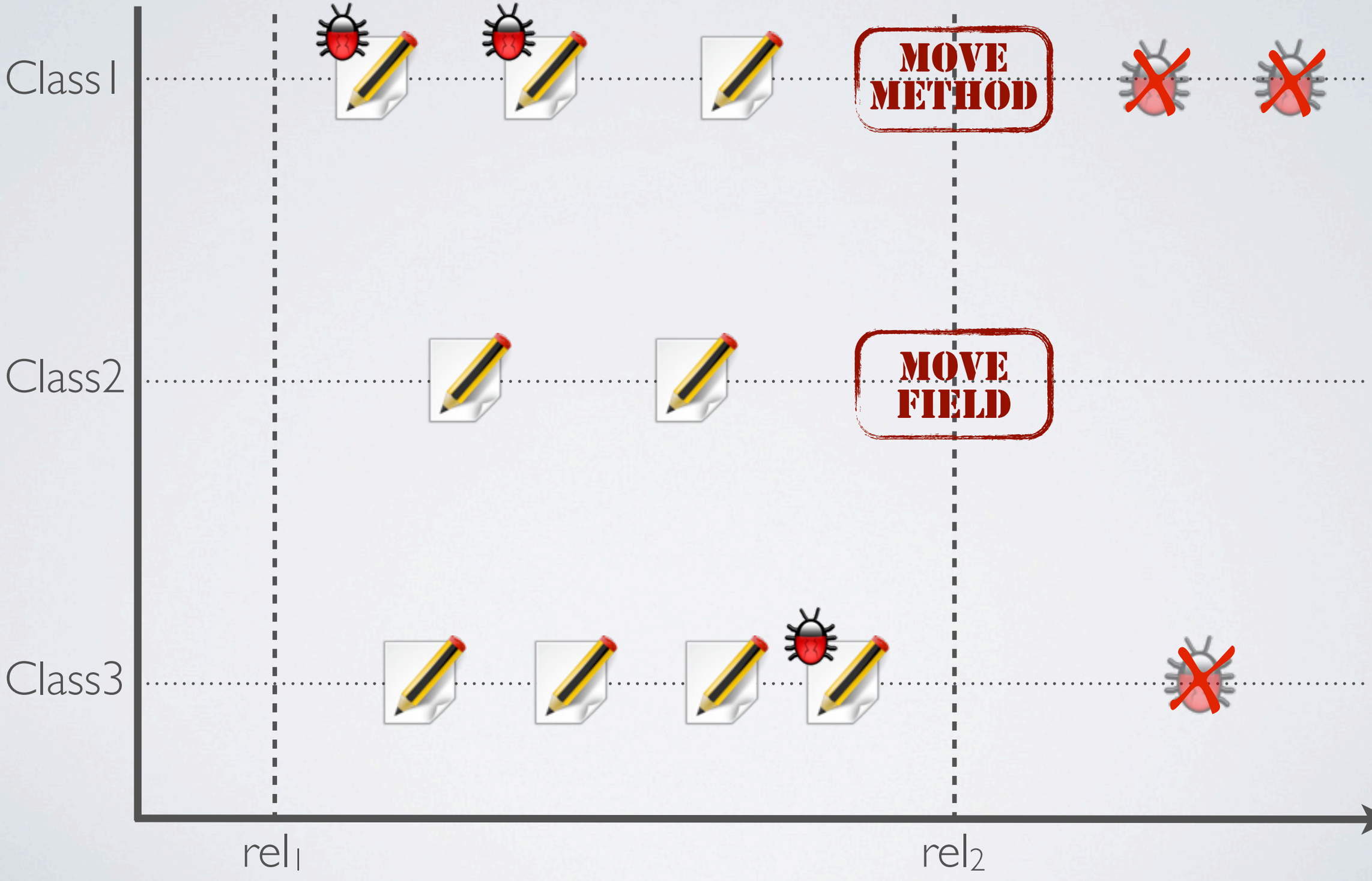
bug-inducing refactorings for rel_2



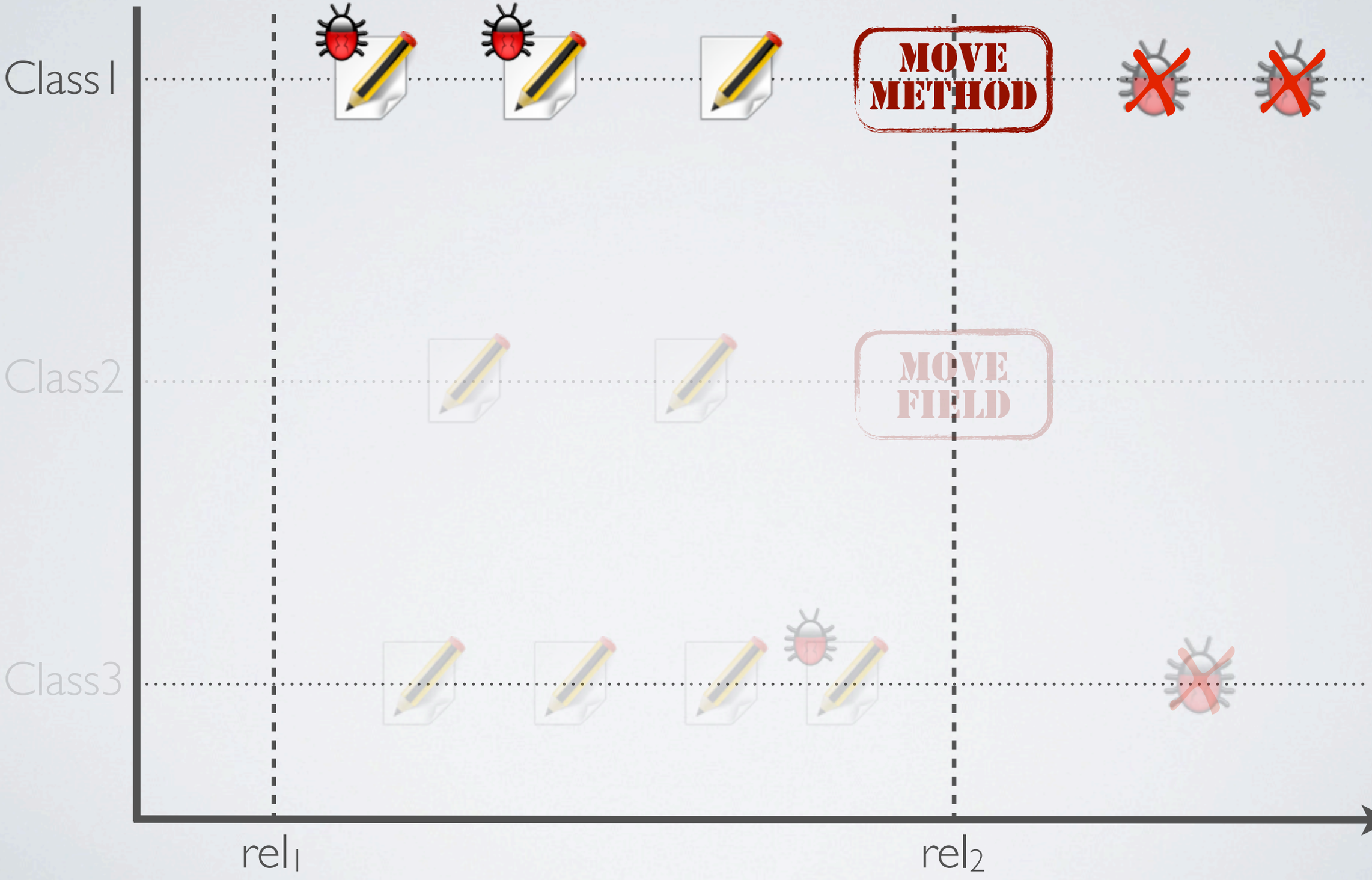
bug-inducing refactorings for rel_2



bug-inducing refactorings for rel_2



bug-inducing refactorings for rel_2



To what extent do refactorings induce bug fixes?

We compared the proportion of classes involved in bug-fixes between classes involved or not in refactorings

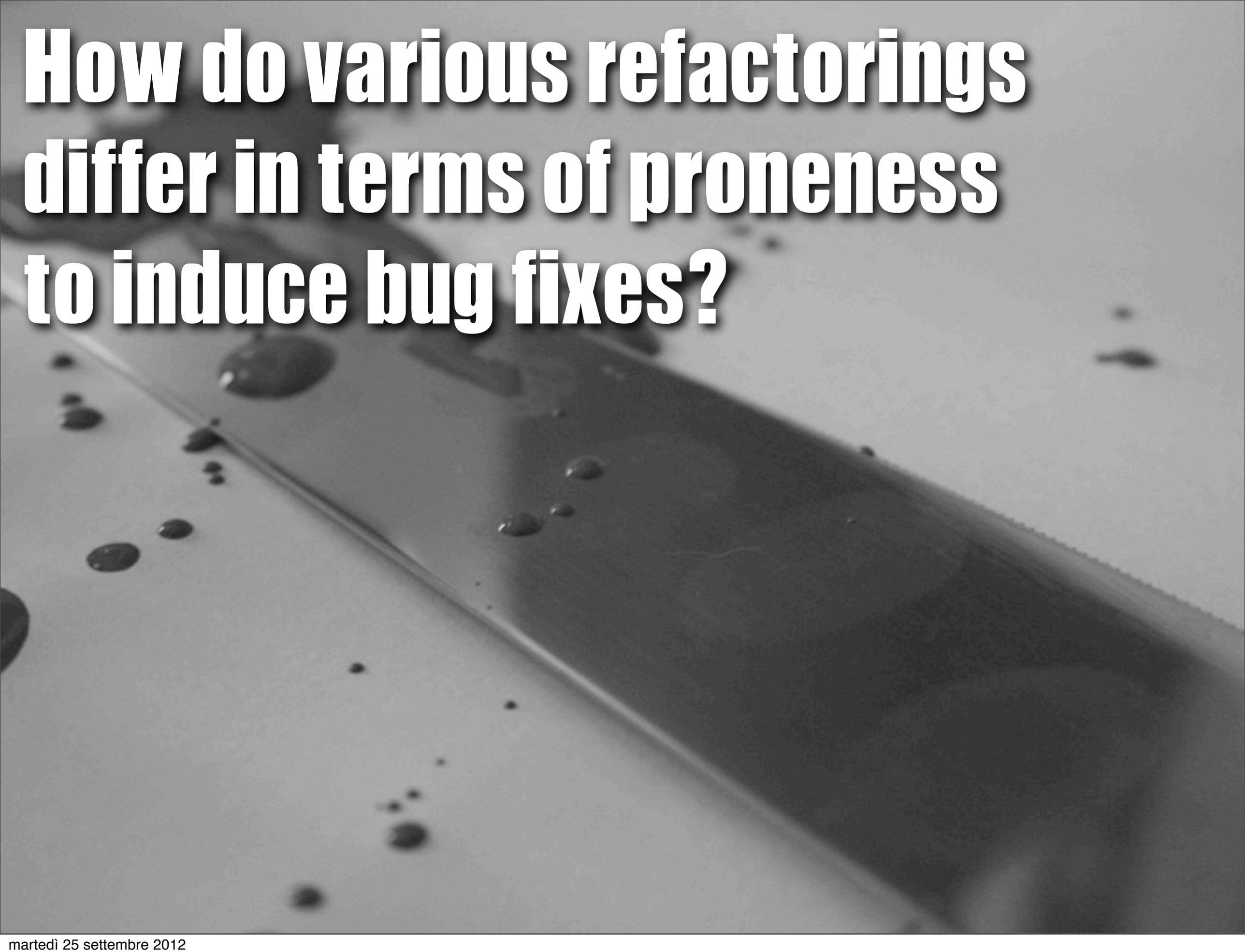
11 releases showed significant difference

In all 11 releases classes involved in refactorings have a higher chance of being involved in bug-fixes

23 times higher on average

158 times in the worst case

How do various refactorings differ in terms of proneness to induce bug fixes?



For 52 different kinds of refactorings, we compared the percentage of refactored classes for which refactorings induced a bug fix

13%

median percentage of fault-prone refactored classes

we identified very dangerous refactorings

...some numbers...

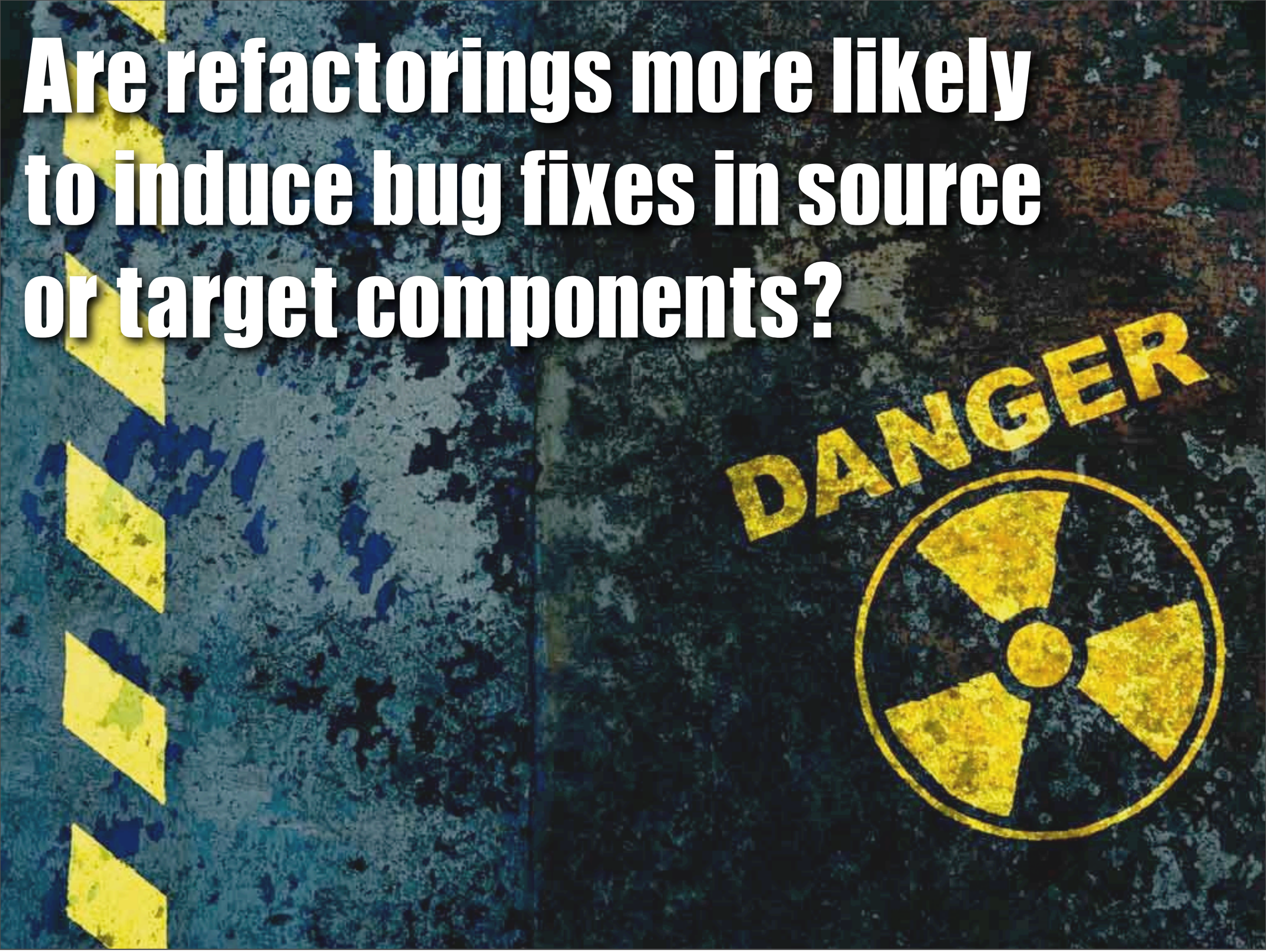
40%

The percentage of classes refactored through **pull up method** or **extract subclass** subject to bug-fixing

20%

Inline Temp
Replace Method With Method Object
Extract Method

Are refactorings more likely to induce bug fixes in source or target components?



We analyzed if **refactorings** involving **more** than **one class** are more prone to inducing errors in **source** or **target** class

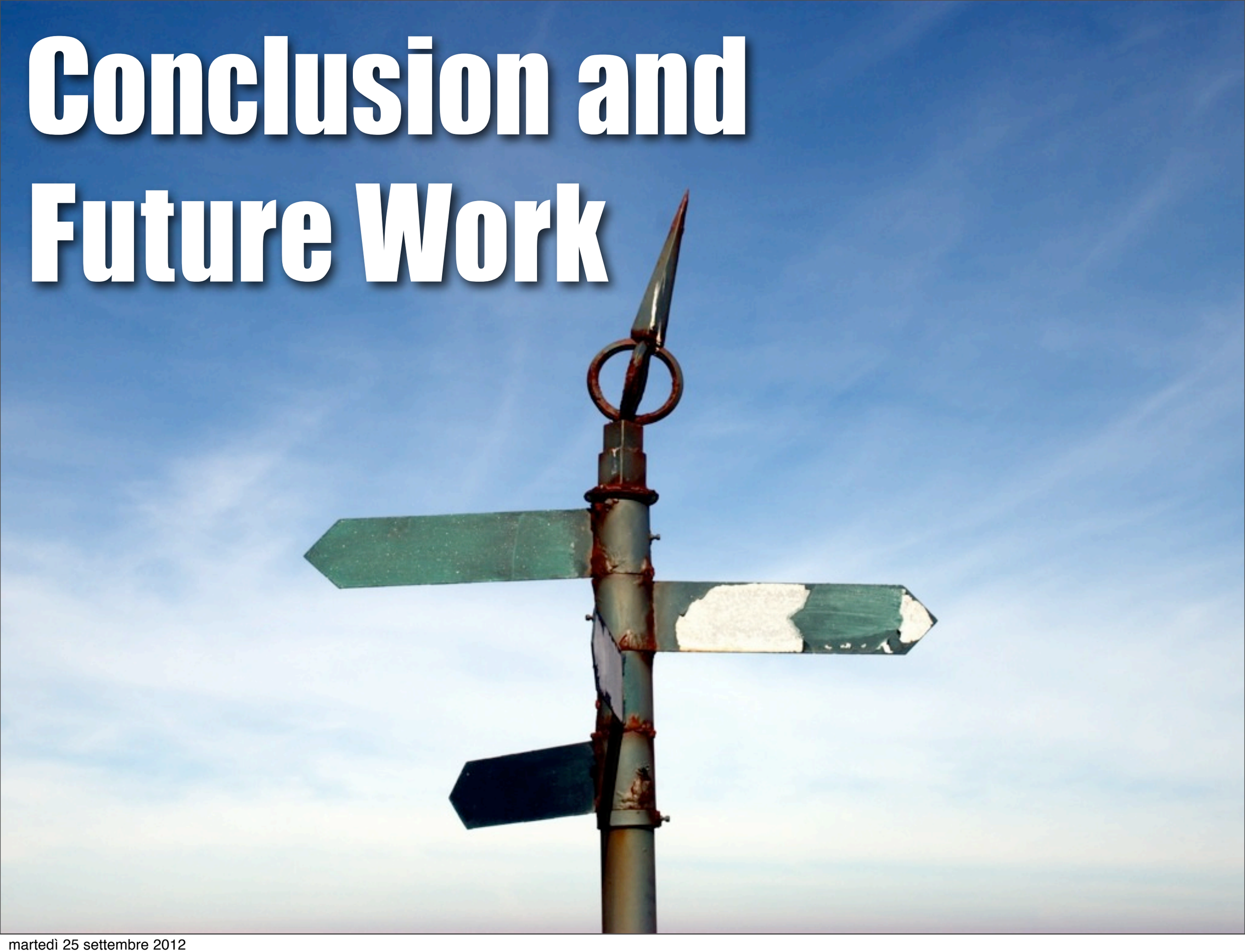
move method
and
move field

target class

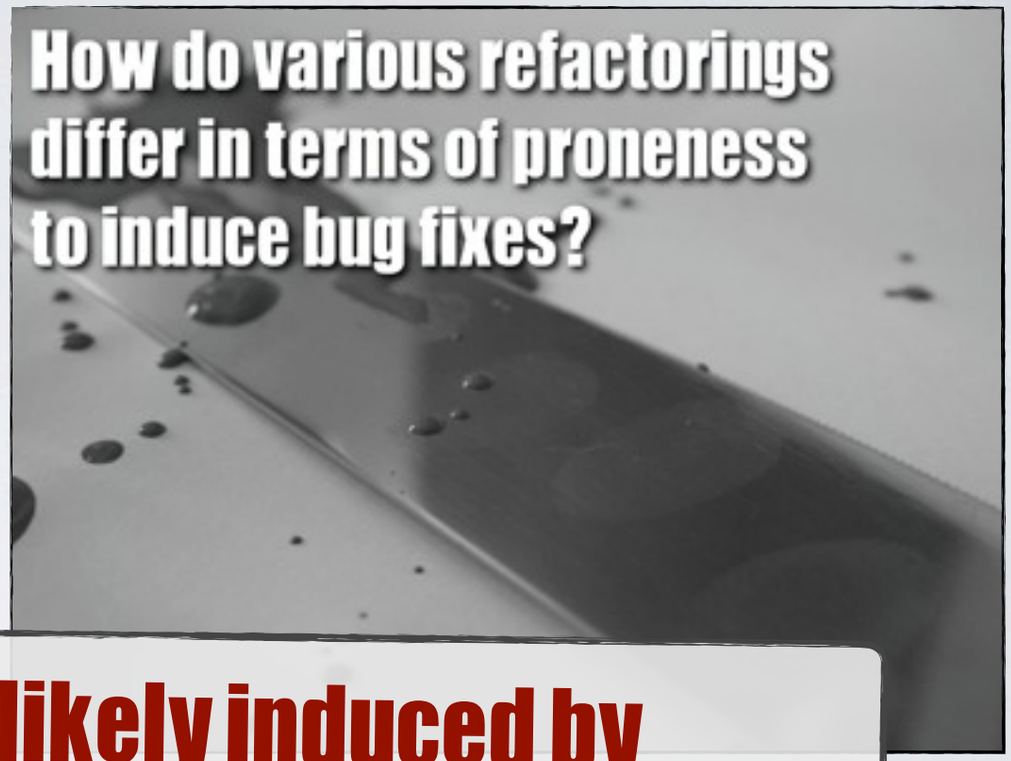
replace method with method object
and
pull up method

source class

Conclusion and Future Work



...conclusion...

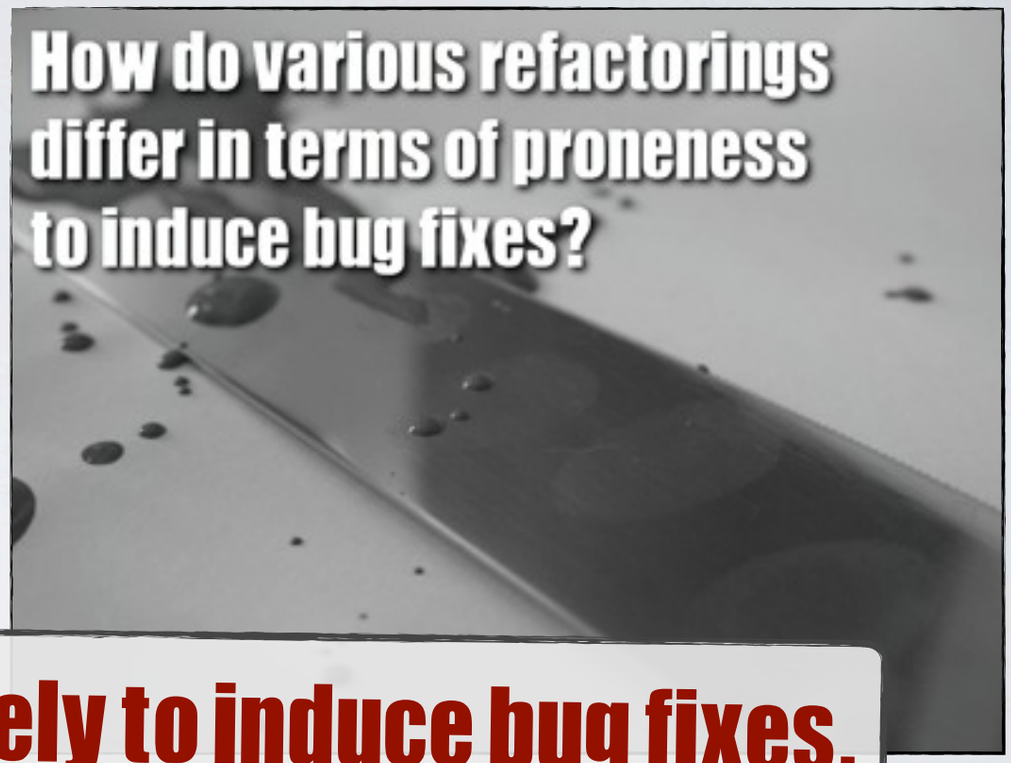


The percentage of faults likely induced by refactorings is relatively low (i.e., 13%).

40% The percentage of classes refactored through **pull up method** or **extract subclass** subject to bug-fixing

20% **Inline Temp**
Replace Method With Method Object
Extract Method

...conclusion...



Some refactorings are very likely to induce bug fixes, such as Pull Up Method and Extract Subclass (40%)

40% The percentage of classes refactored through **pull up method** or **extract subclass** subject to bug-fixing

20% **Inline Temp**
Replace Method With Method Object
Extract Method

...future work...

corroborate our results by replicating our study on different systems

consider other kinds of refactoring do not detected by Ref-Finder, e.g., Extract Class

Thank you!

Questions and / or comments

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