Inconsistency management in source code with abductive logic programming

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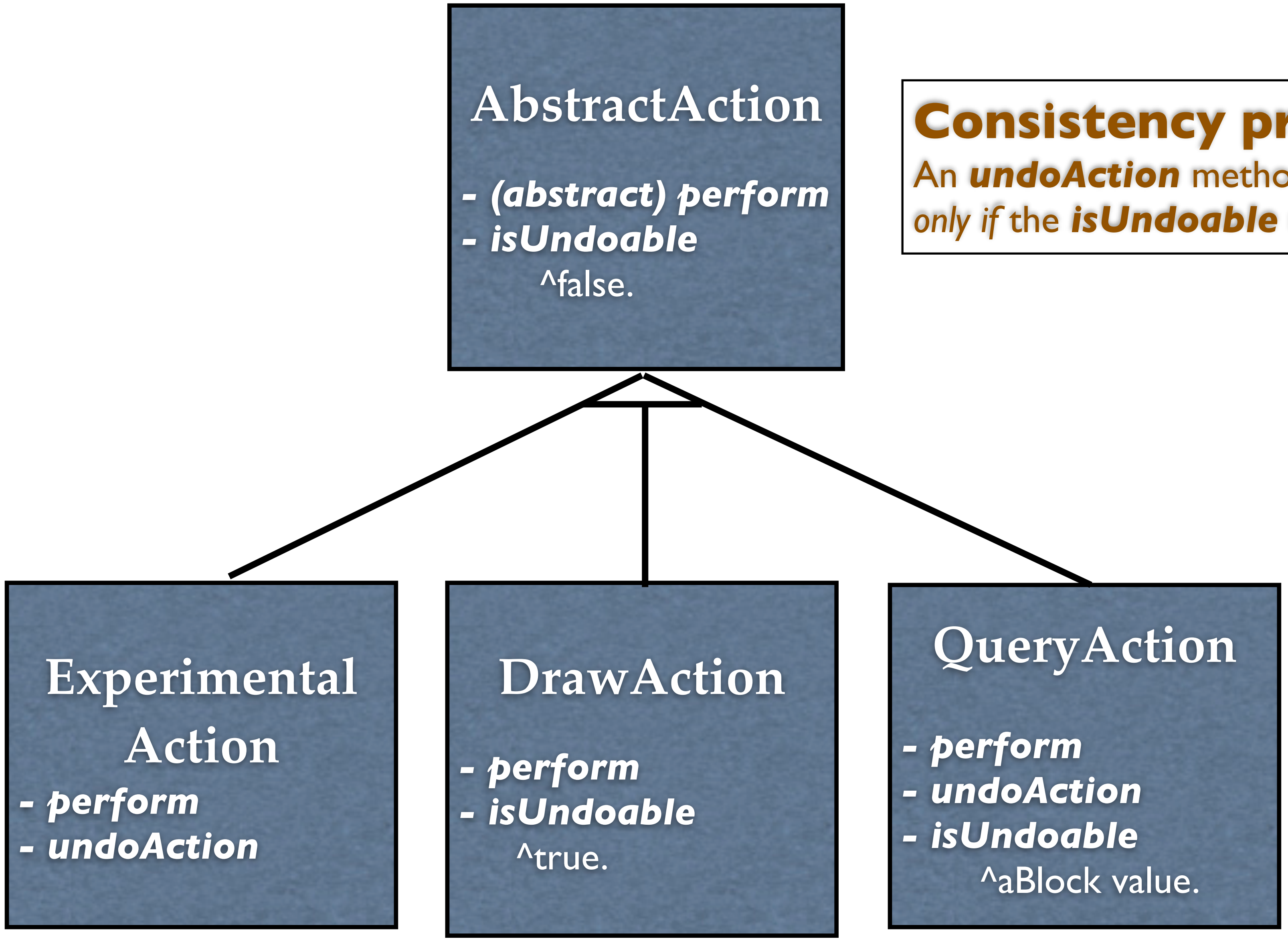
An example

An inconsistency in the command design pattern



AbstractAction

- *(abstract) perform*
- ***isUndoable***

^false.

Experimental Action

- ***perform***
- ***undoAction***

DrawAction

- ***perform***
- ***isUndoable***

^true.

QueryAction

- ***perform***
- ***undoAction***
- ***isUndoable***

^aBlock value.

Consistency property:

An ***undoAction*** method should be provided *if and only if* the ***isUndoable*** method returns *true*

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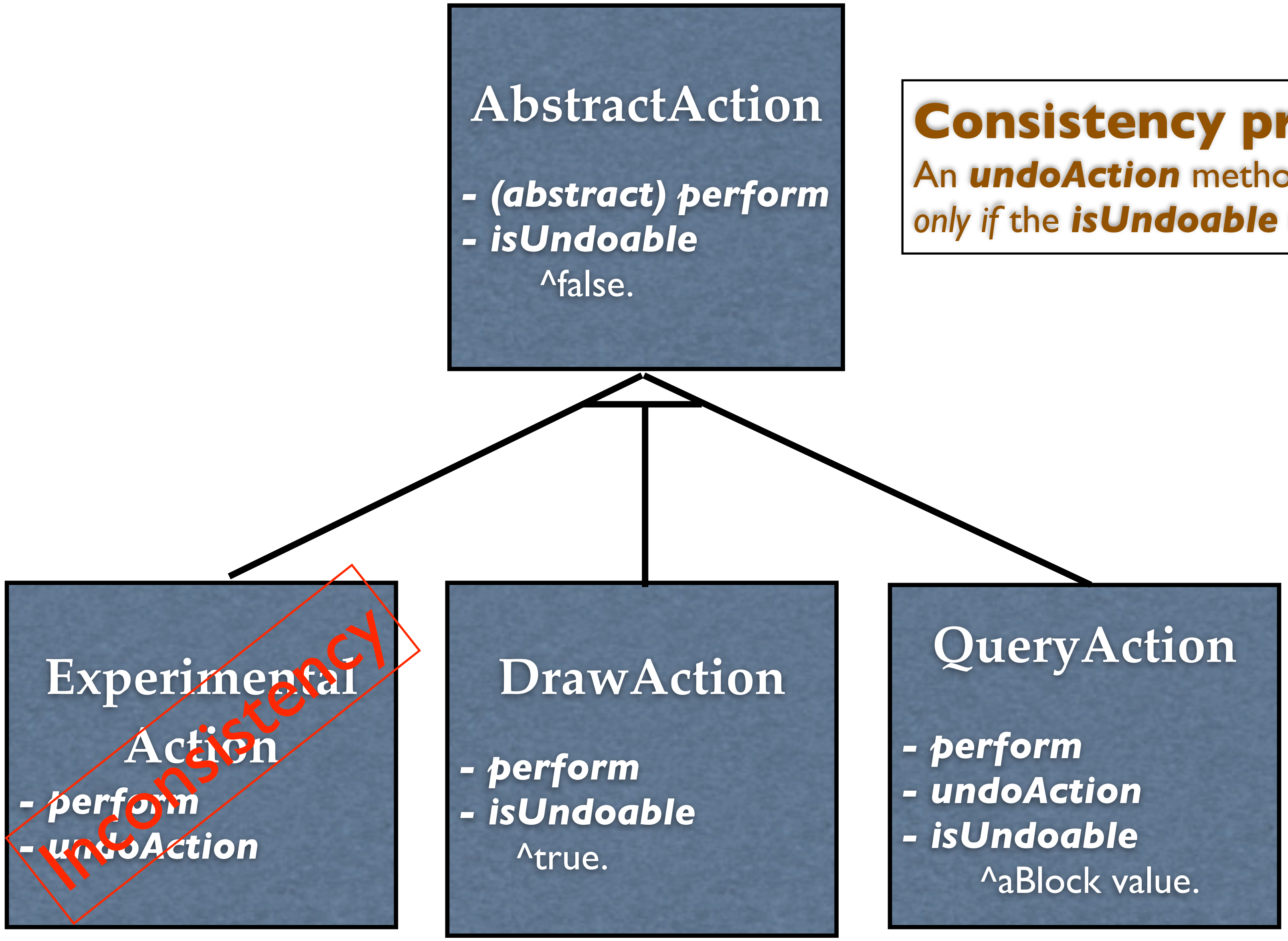

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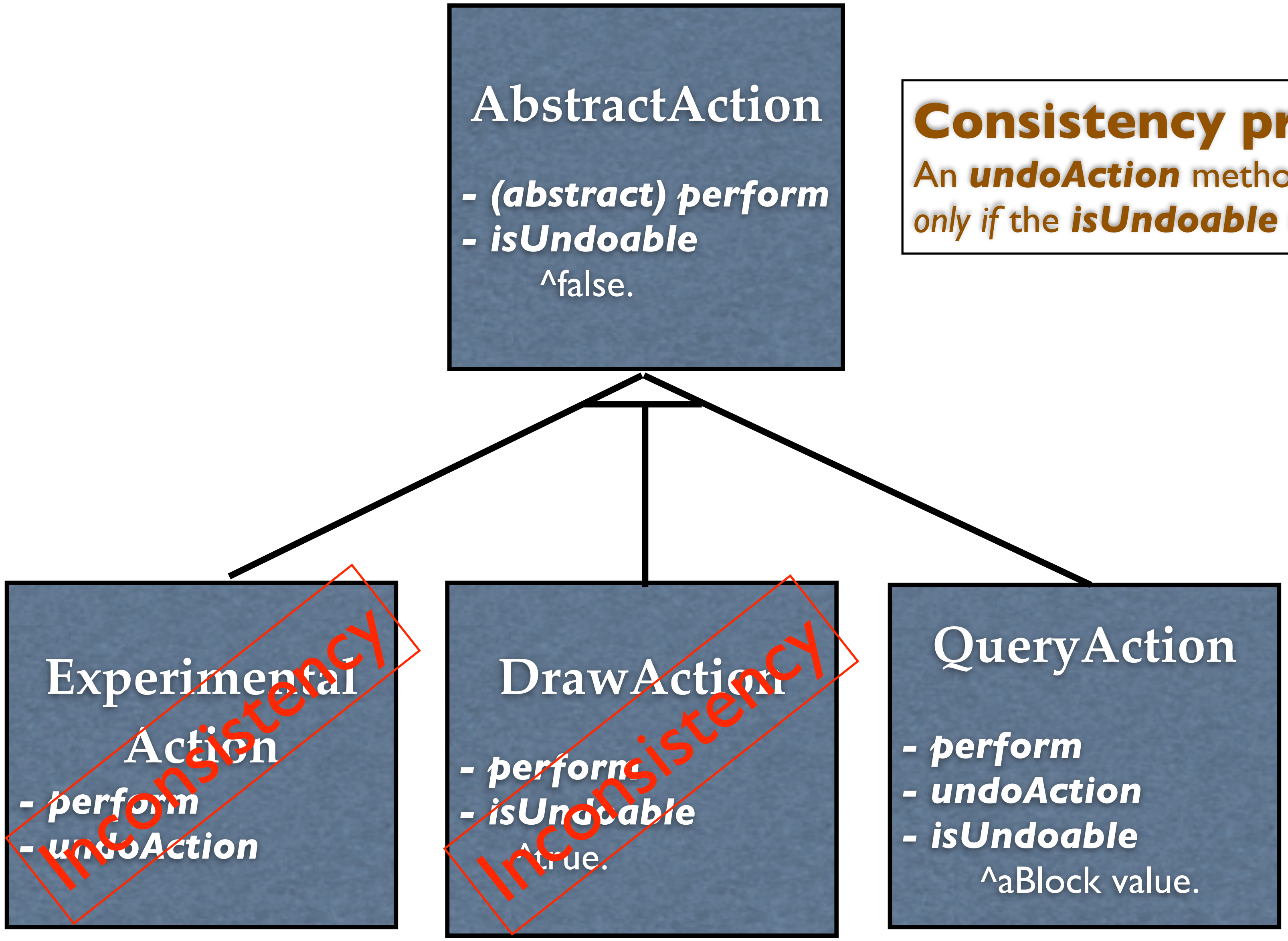

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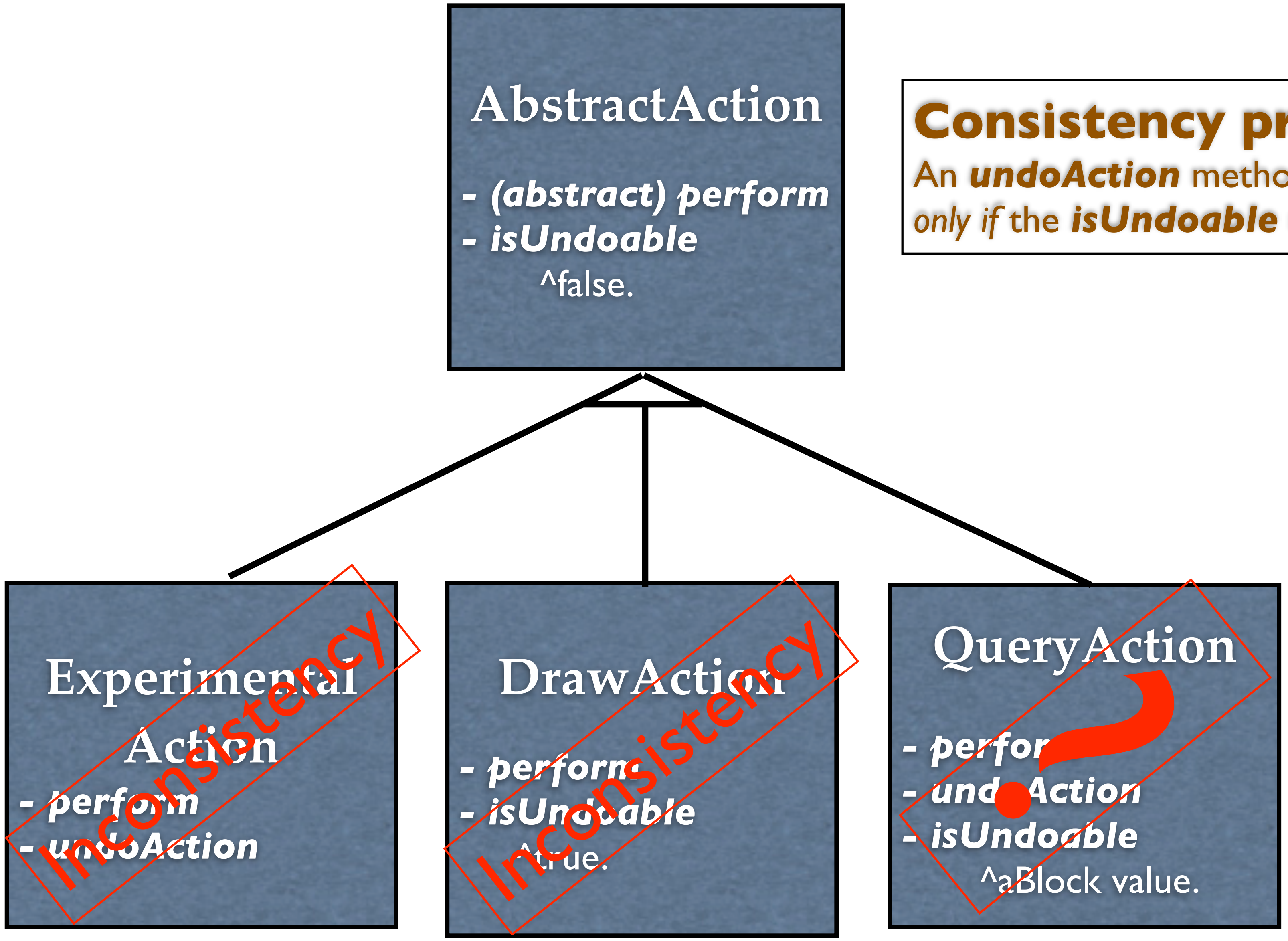
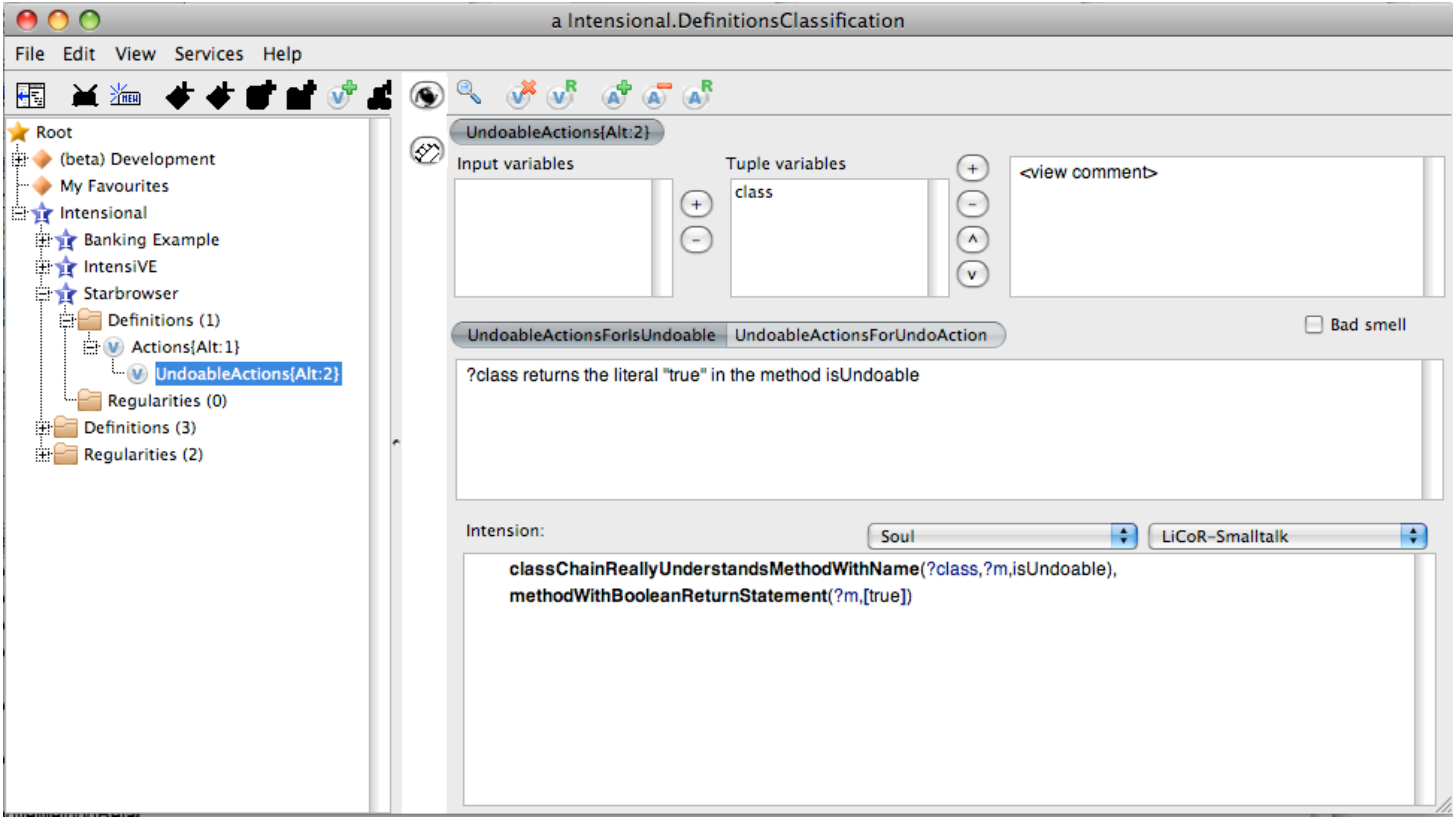


Consistency property:
An ***undoAction*** method should be provided *if and only if* the ***isUndoable*** method returns *true*

IntensiVE

(consistency definition)

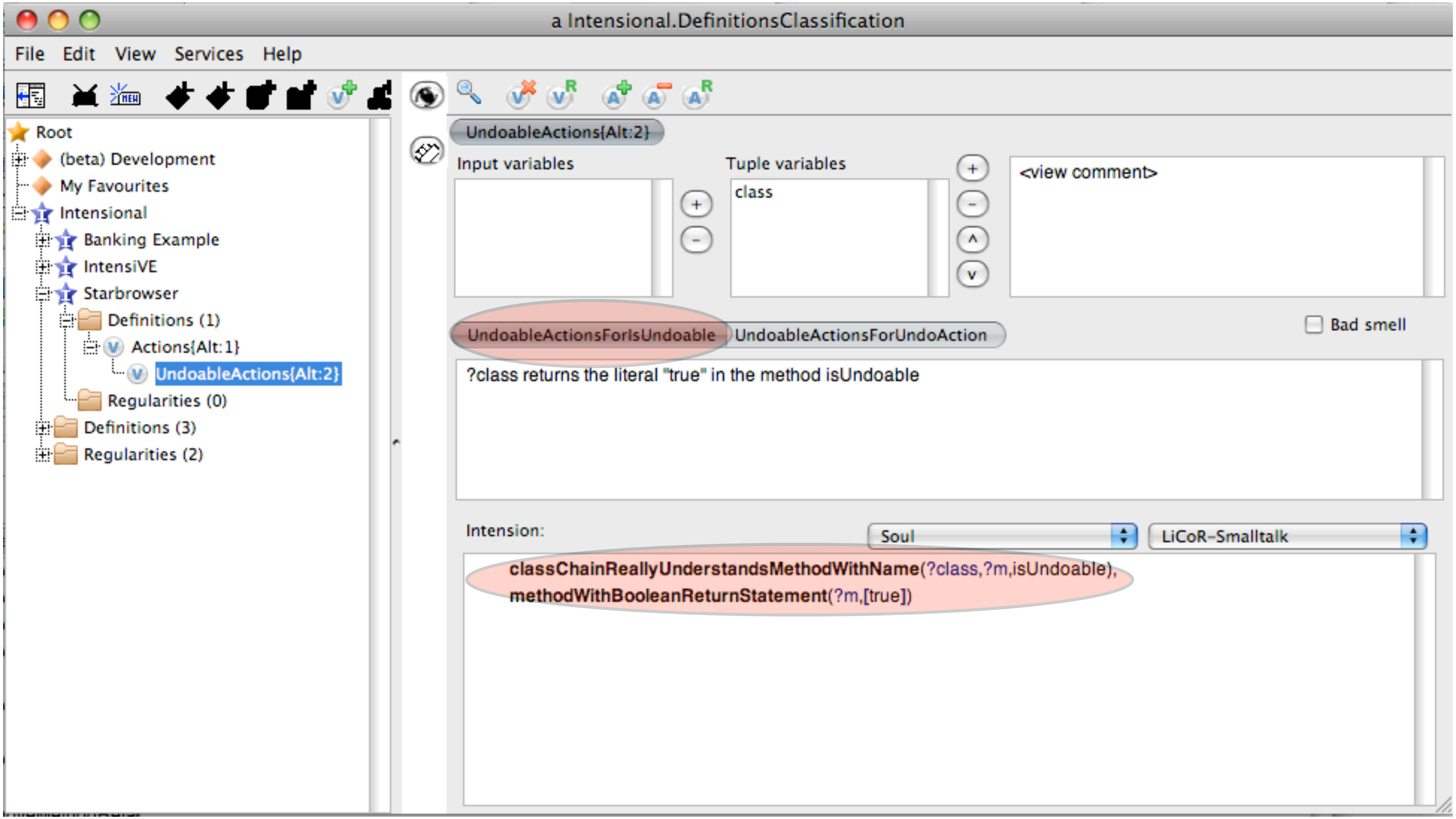


?class returns the literal "true" in the method isUndoable

```
classChainReallyUnderstandsMethodWithName(?class,?m,isUndoable),
methodWithBooleanReturnStatement(?m,[true])
```

IntensiVE

(consistency definition)



Tuple variables: class

<view comment>

□ Bad smell

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Intension: Soul | LiCoR-Smalltalk

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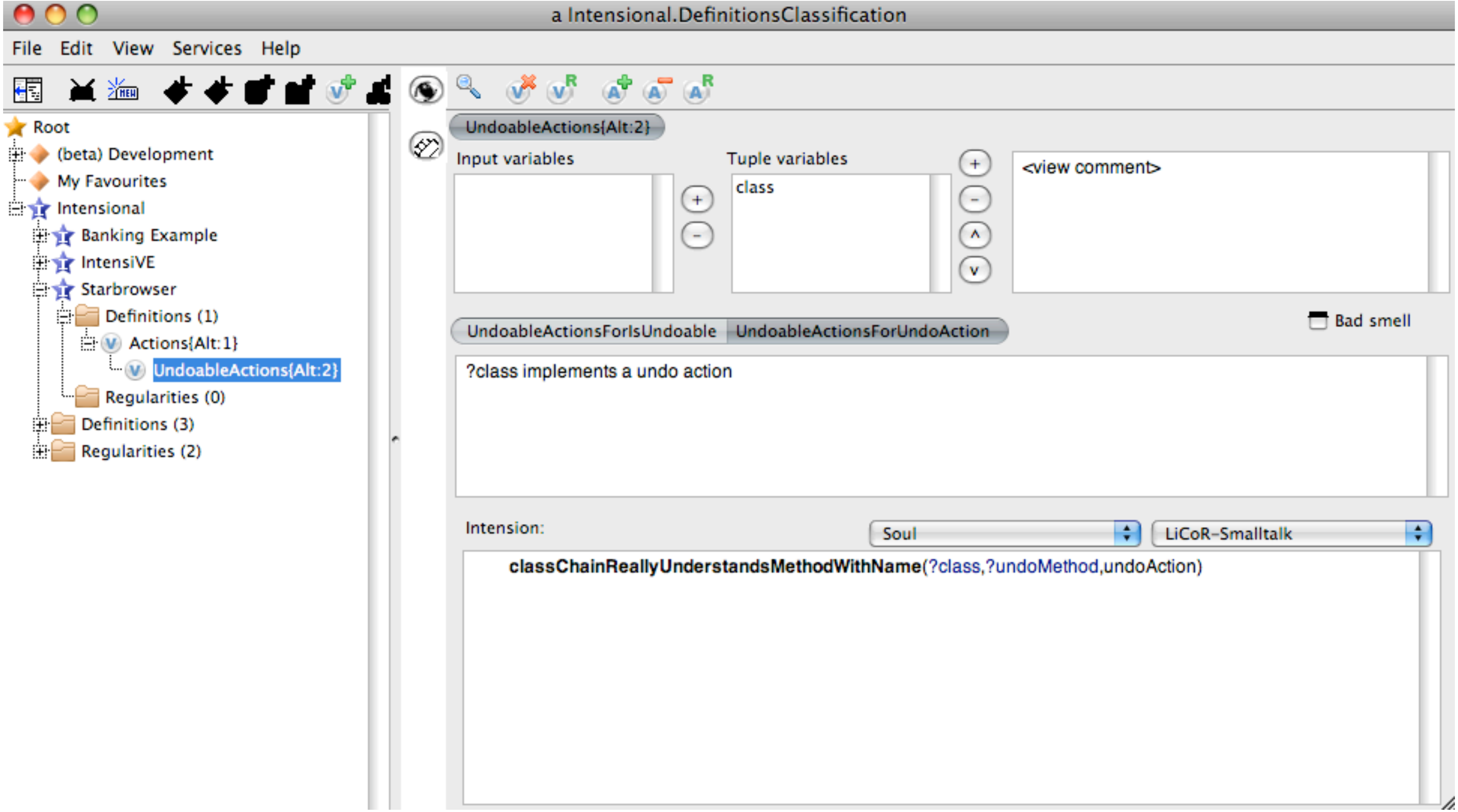

Tuple variables: class

<view comment>

?class implements a undo action

Soul

LiCoR-Smalltalk

```
classChainReallyUnderstandsMethodWithName(?class,?undoMethod,undoAction)
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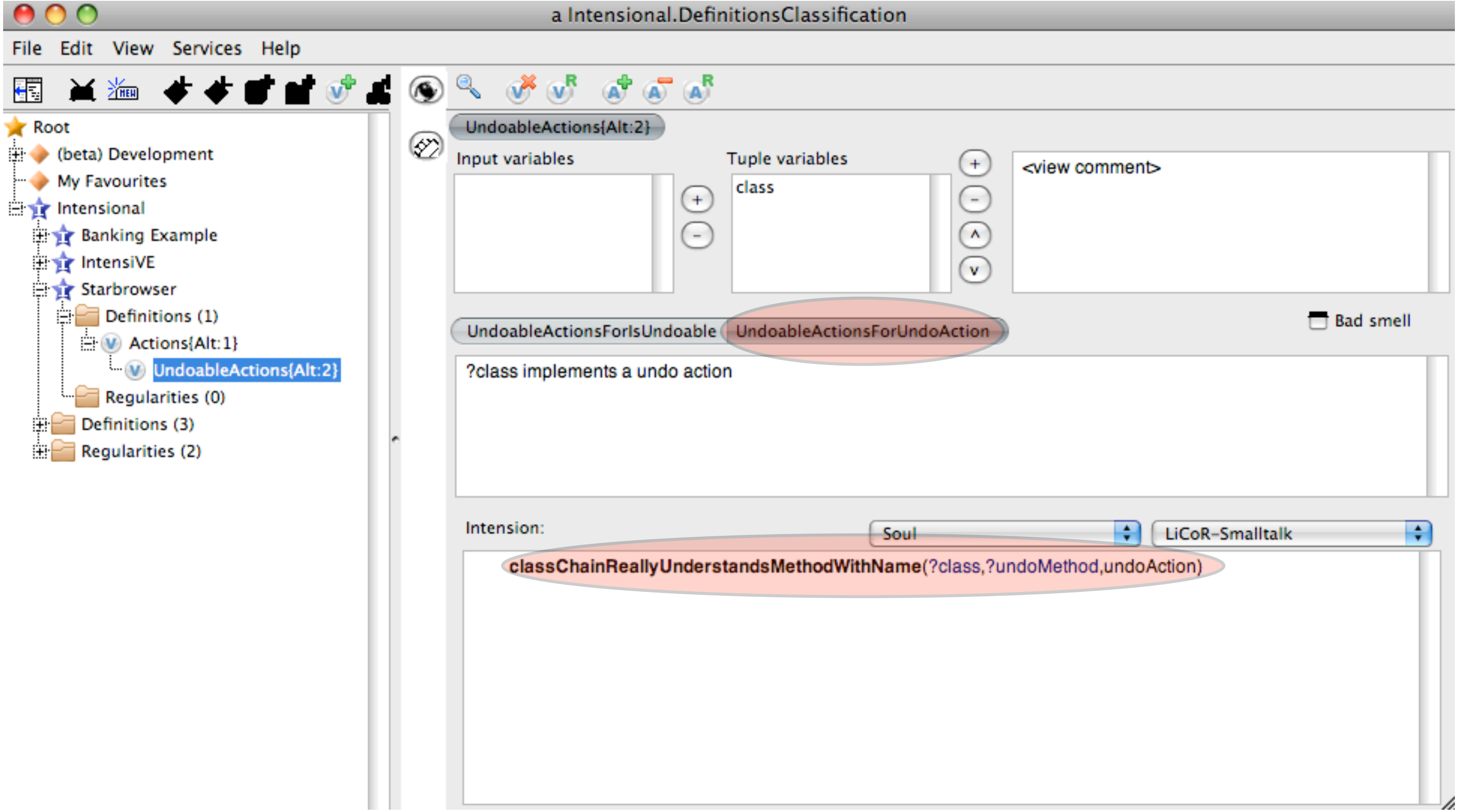

class

<view comment>

?class implements a undo action

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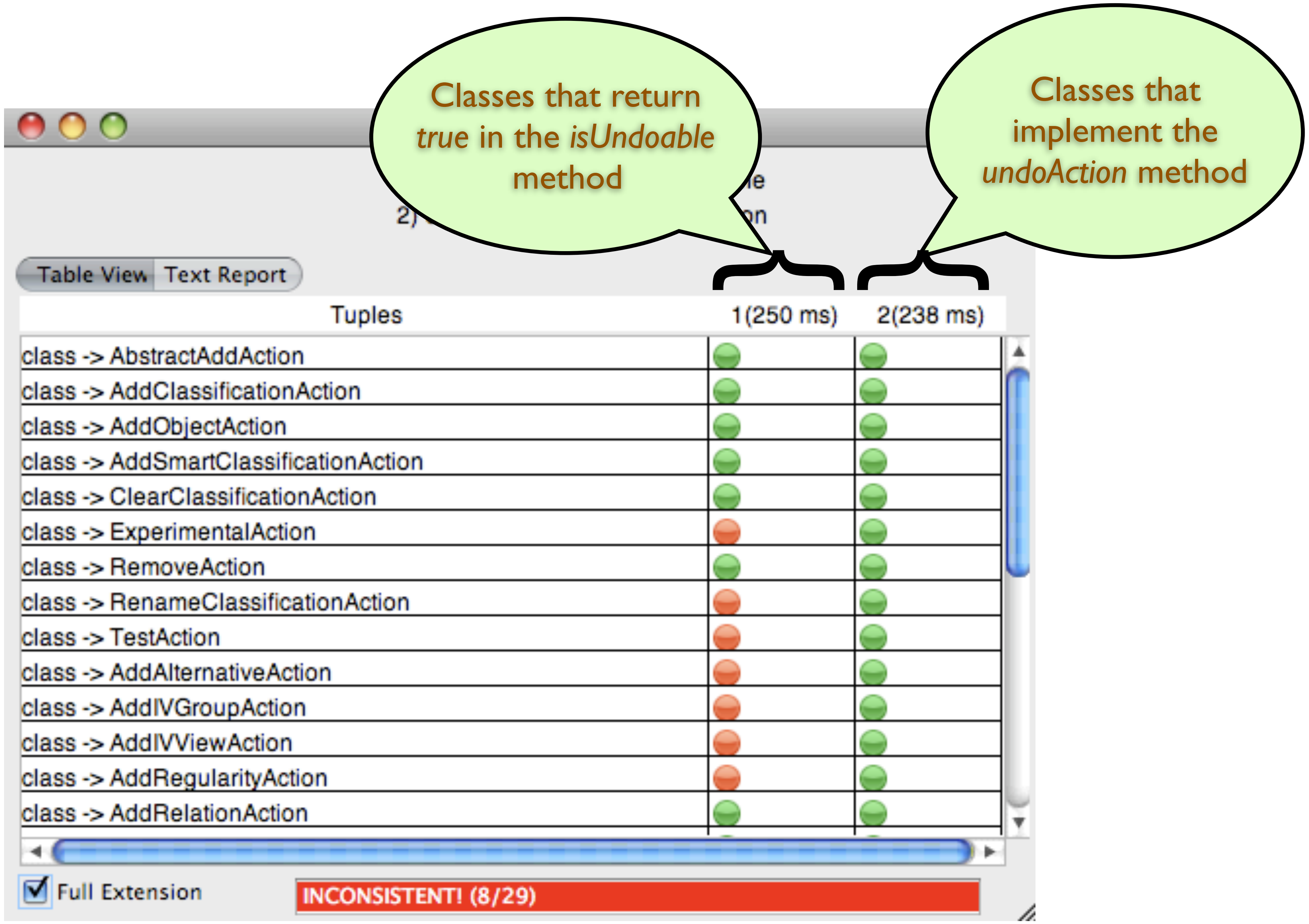
IntensiVE

(consistency checking)



Classes that return *true* in the *isUndoable* method

Classes that implement the *undoAction* method

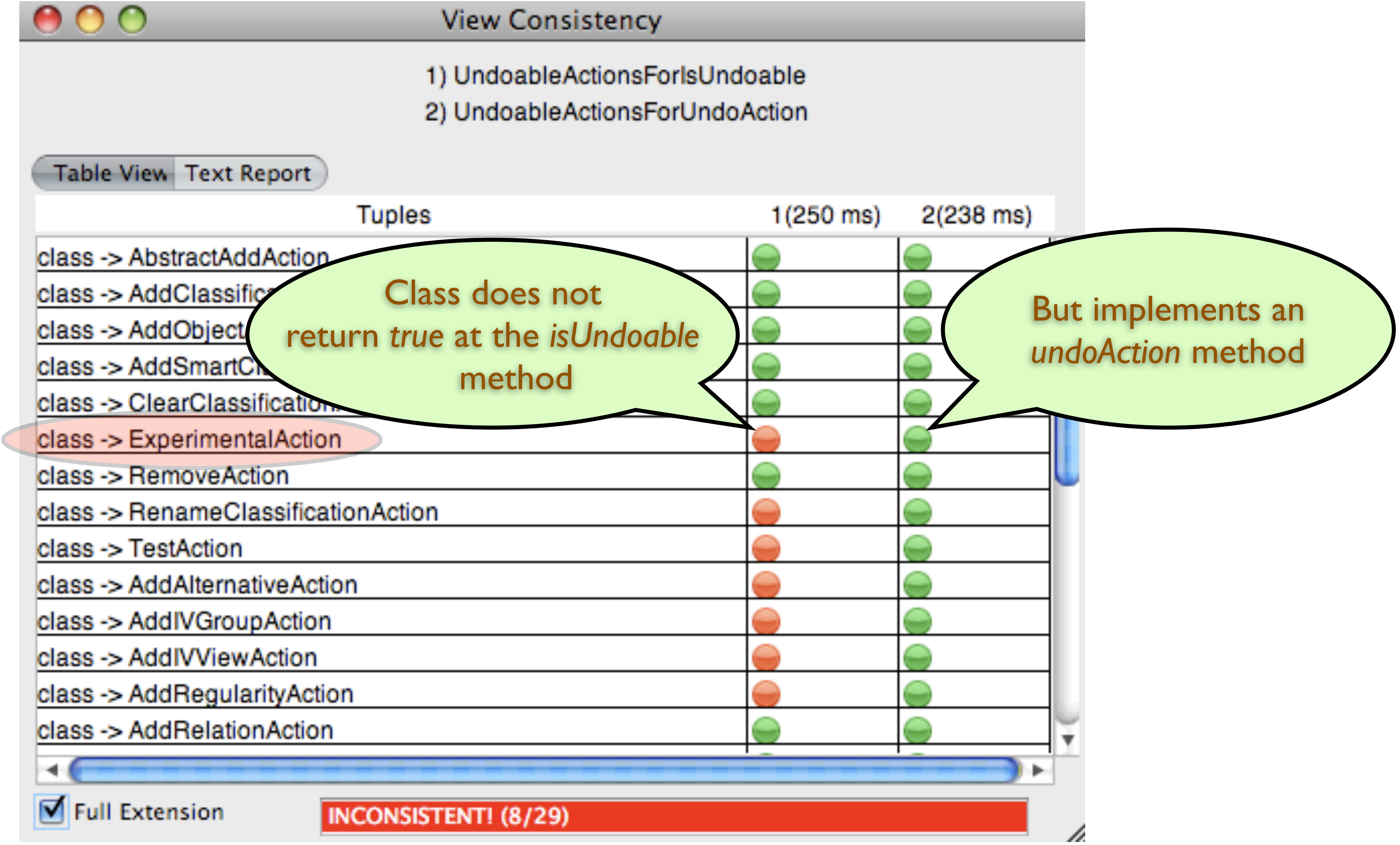
Tuples	1(250 ms)	2(238 ms)
class -> AbstractAddAction	🟢	🟢
class -> AddClassificationAction	🟢	🟢
class -> AddObjectAction	🟢	🟢
class -> AddSmartClassificationAction	🟢	🟢
class -> ClearClassificationAction	🟢	🟢
class -> ExperimentalAction	🔴	🟢
class -> RemoveAction	🟢	🟢
class -> RenameClassificationAction	🔴	🟢
class -> TestAction	🔴	🟢
class -> AddAlternativeAction	🔴	🟢
class -> AddIVGroupAction	🔴	🟢
class -> AddIVViewAction	🔴	🟢
class -> AddRegularityAction	🔴	🟢
class -> AddRelationAction	🟢	🟢

☑ Full Extension

INCONSISTENT! (8/29)

IntensiVE

(consistency checking)



View Consistency

1) UndoableActionsForIsUndoable
2) UndoableActionsForUndoAction

Table View | Text Report

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☑ Full Extension

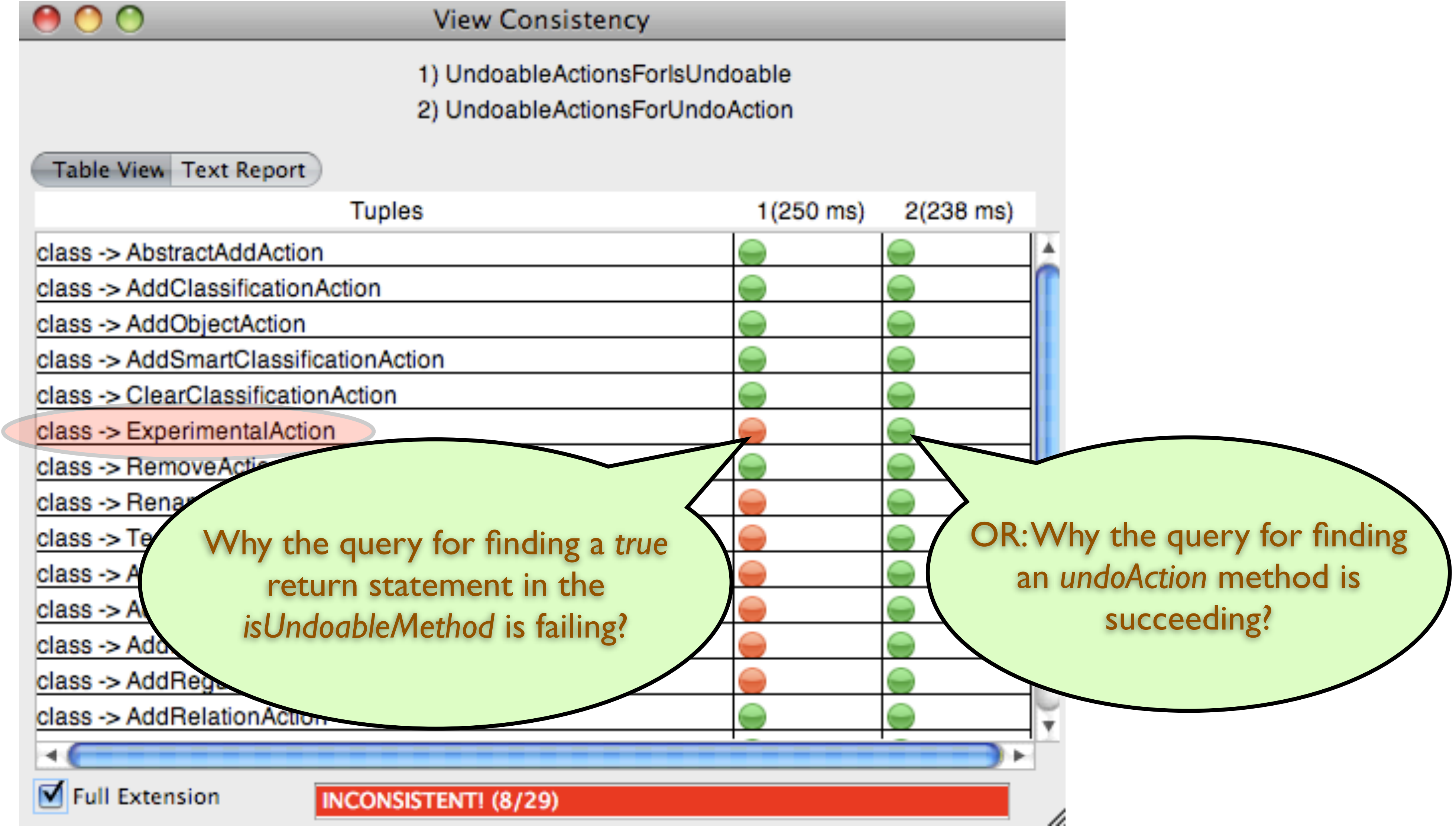
INCONSISTENT! (8/29)

Class does not return *true* at the *isUndoable* method

But implements an *undoAction* method

IntensiVE

(diagnosing inconsistencies)



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class -> RemoveActi	🟢	🟢
class -> Rena	🔴	🟢
class -> Te	🔴	🟢
class -> A	🔴	🟢
class -> A	🔴	🟢
class -> Add	🔴	🟢
class -> AddReg	🔴	🟢
class -> AddRelationAction	🟢	🟢

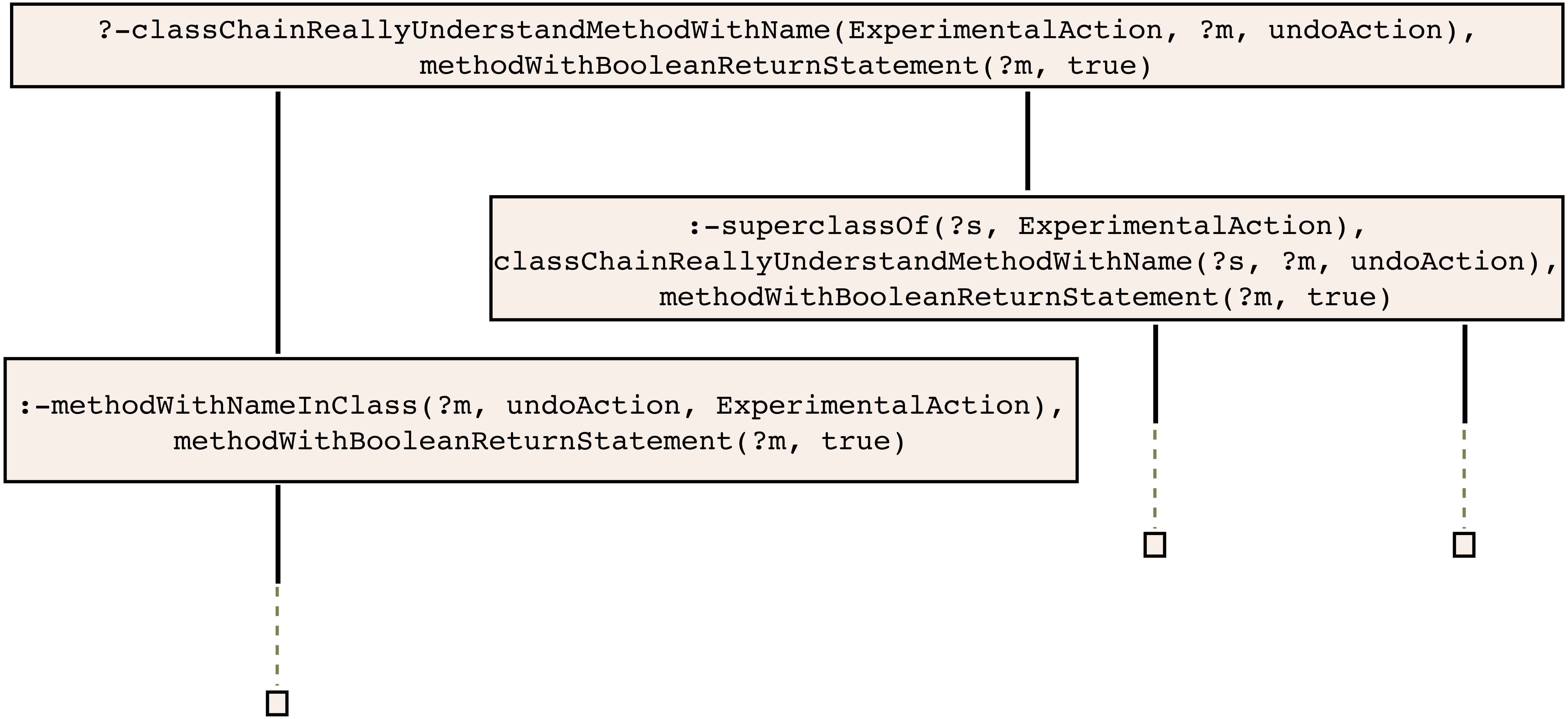
☑ Full Extension

INCONSISTENT! (8/29)

Why the query for finding a *true* return statement in the *isUndoableMethod* is failing?

OR: Why the query for finding an *undoAction* method is succeeding?

A *SLD-tree* for the failing query



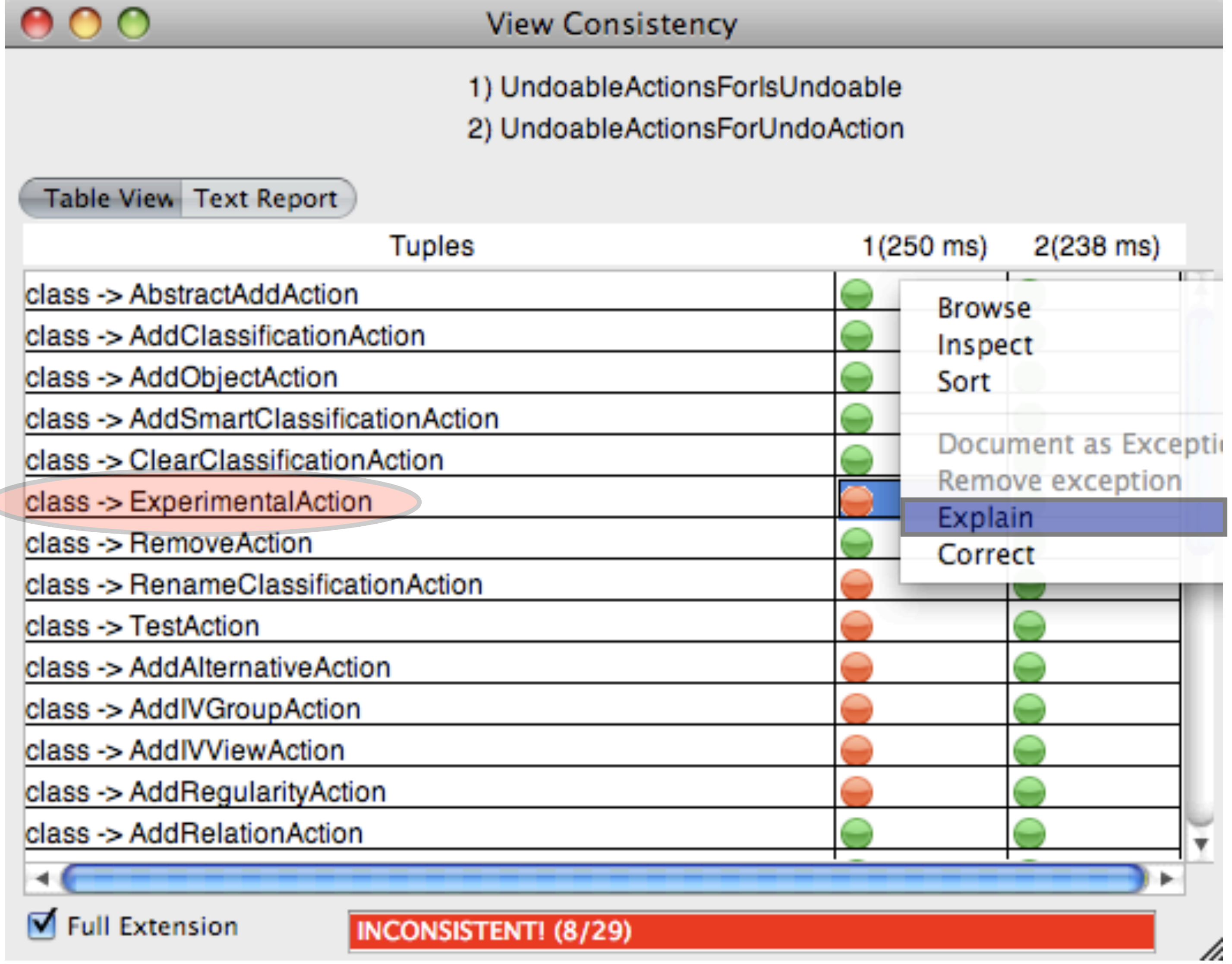
?-classChainReallyUnderstandMethodWithName(ExperimentalAction, ?m, undoAction),
methodWithBooleanReturnStatement(?m, true)

:-superclassOf(?s, ExperimentalAction),
classChainReallyUnderstandMethodWithName(?s, ?m, undoAction),
methodWithBooleanReturnStatement(?m, true)

:-methodWithNameInClass(?m, undoAction, ExperimentalAction),
methodWithBooleanReturnStatement(?m, true)

IntensiVE

(diagnosing inconsistencies)



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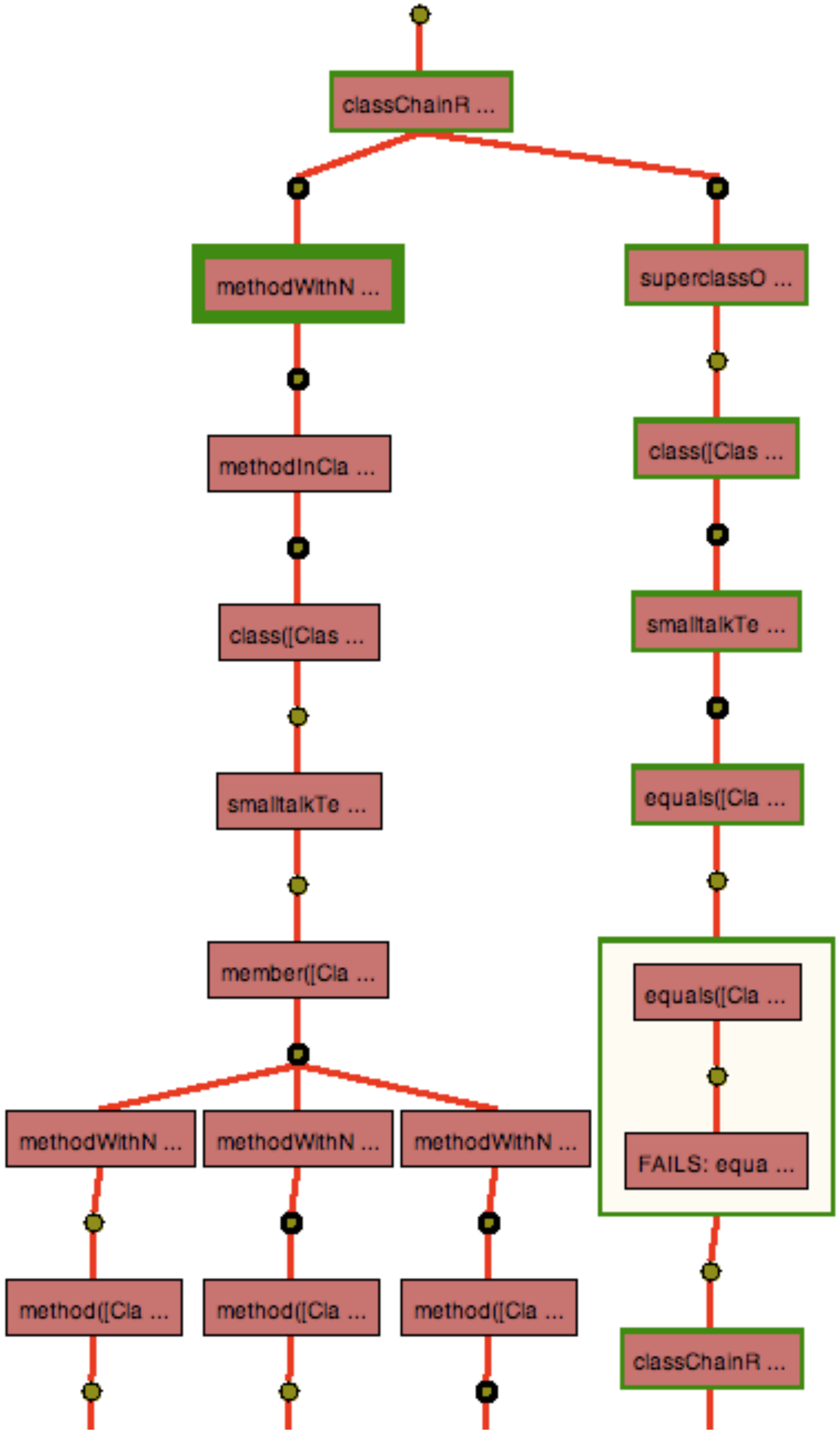
☑ Full Extension

INCONSISTENT! (8/29)

A proof tree with our tool



But …

What does a real SLD tree look like?

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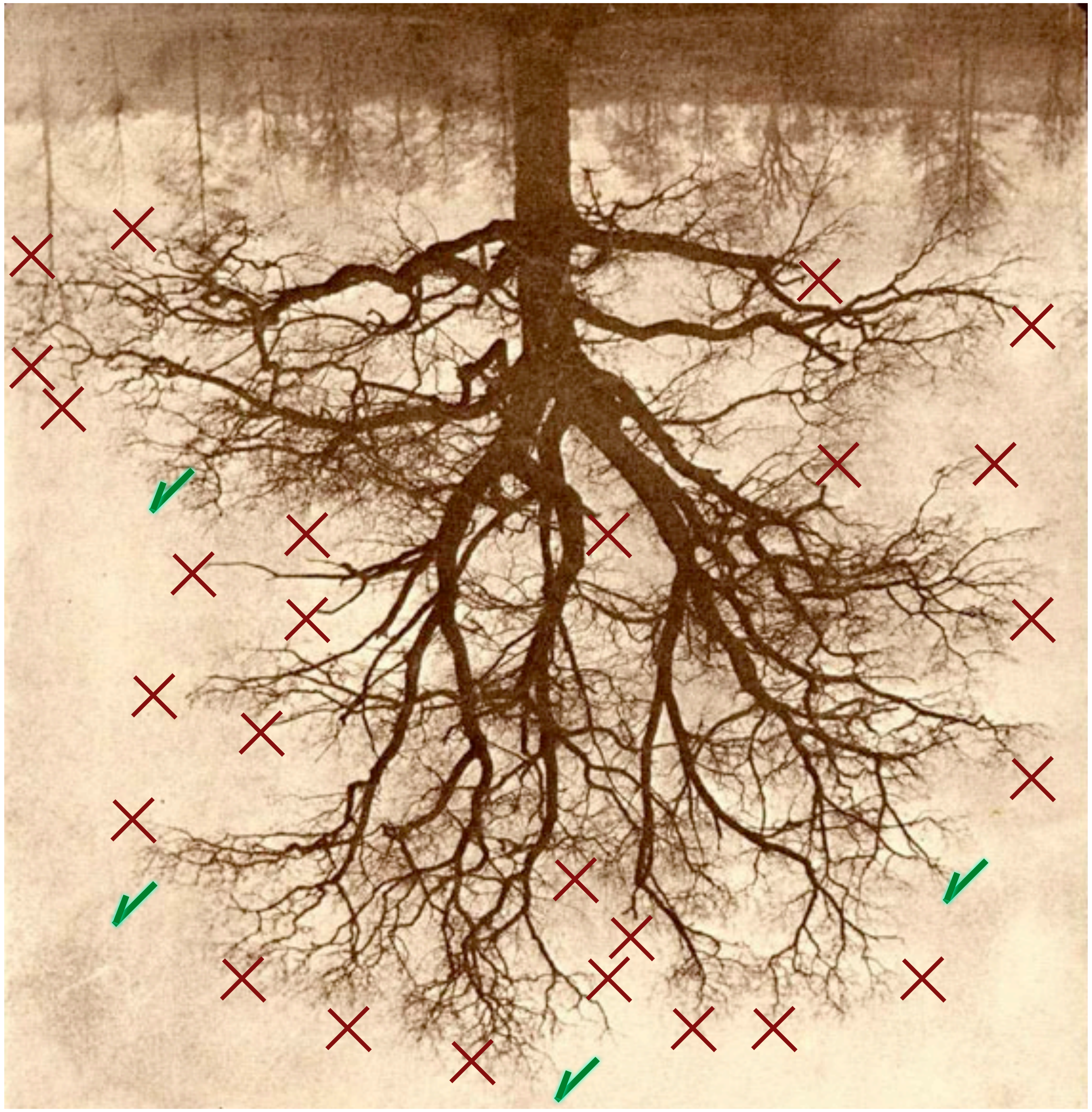

✓ Success

× Failure

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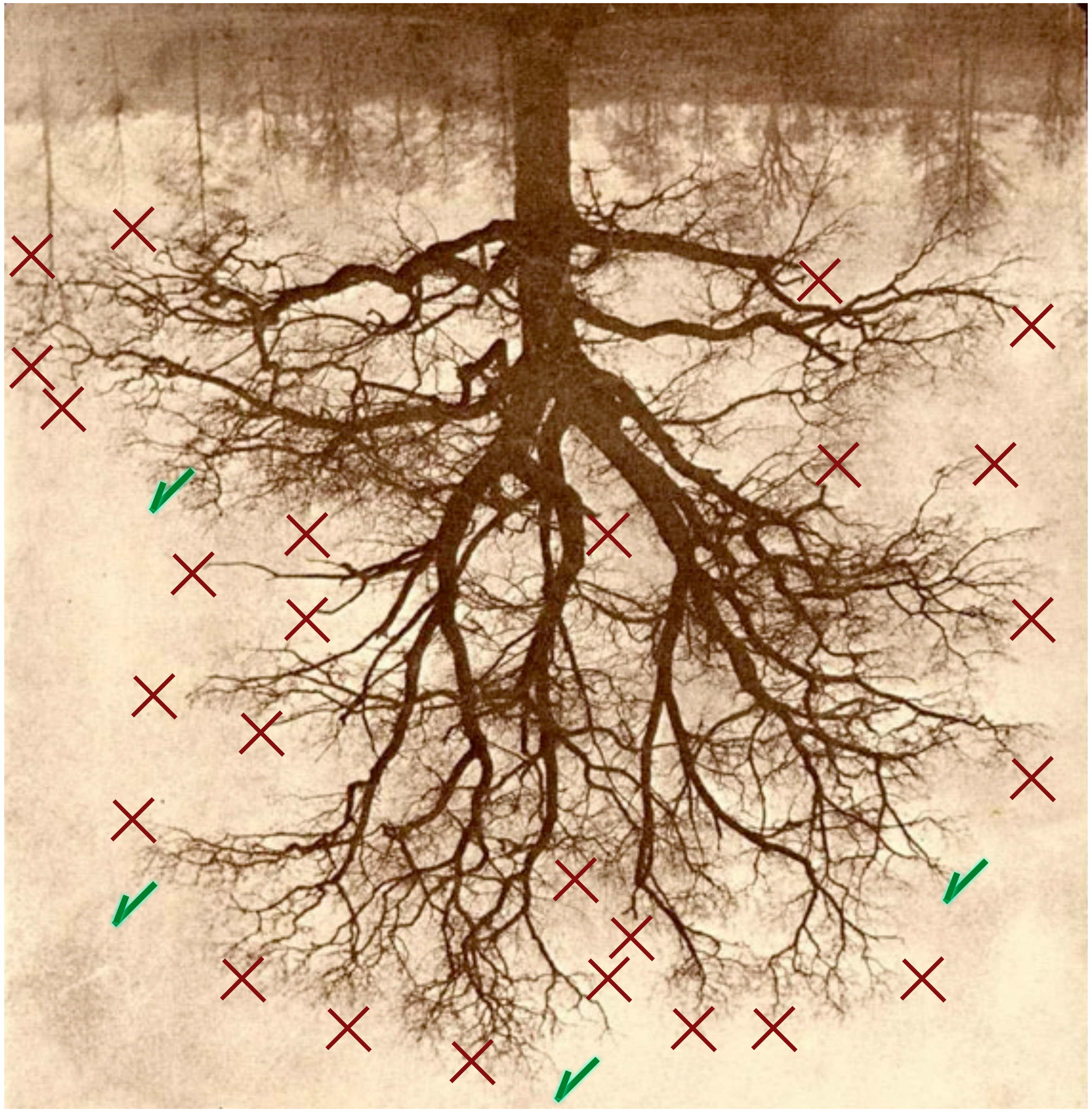

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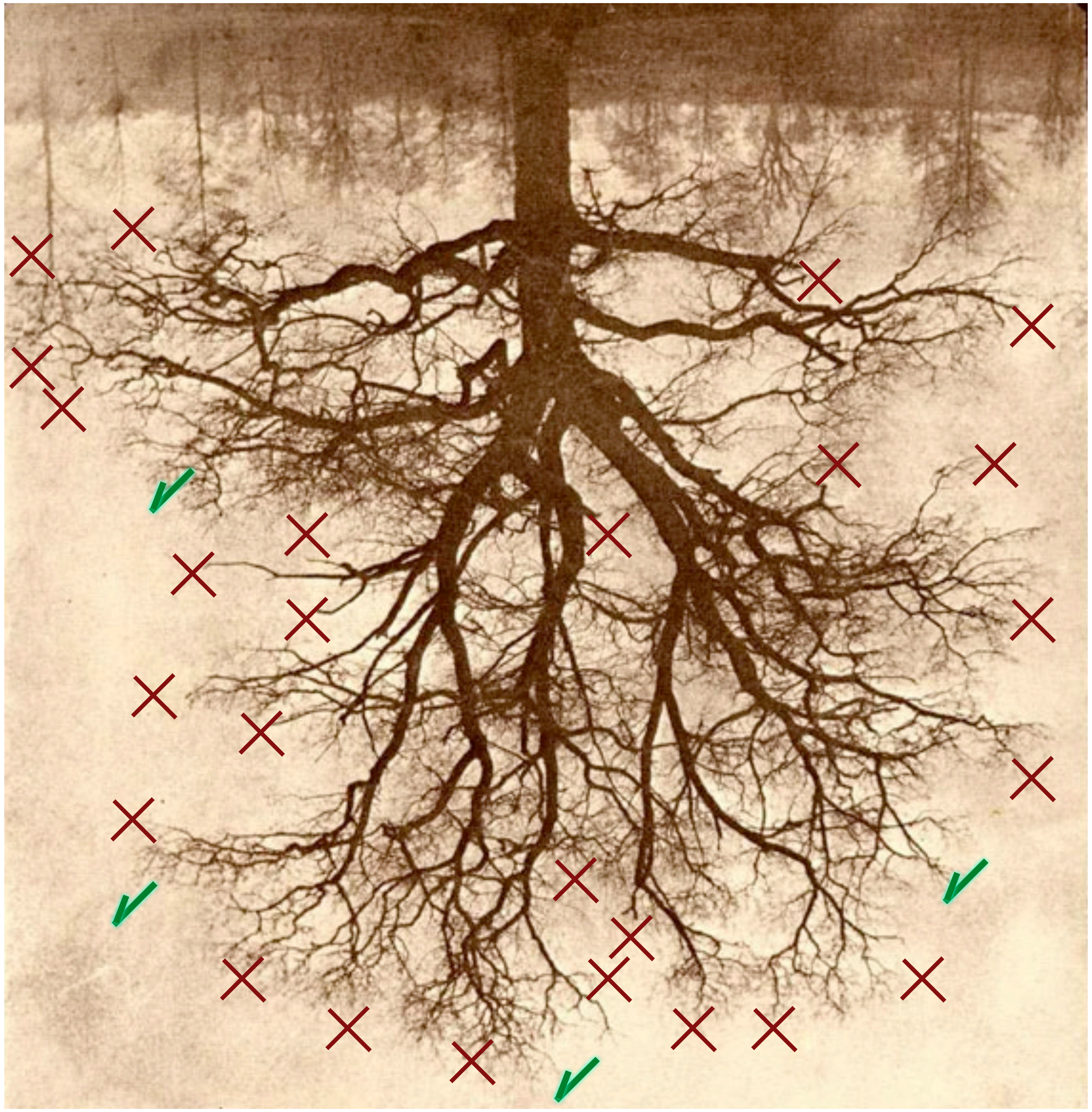
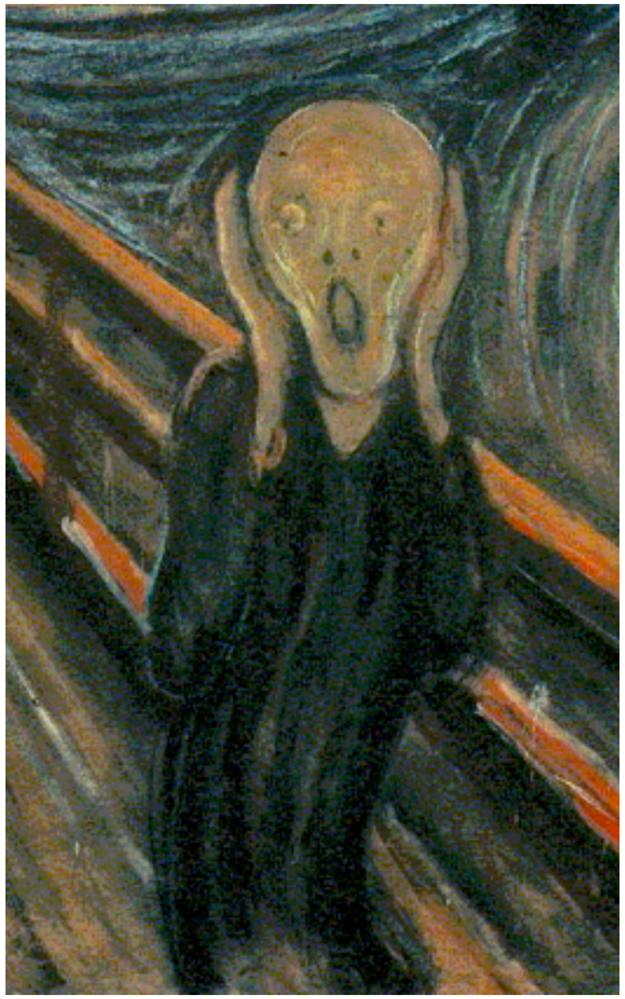
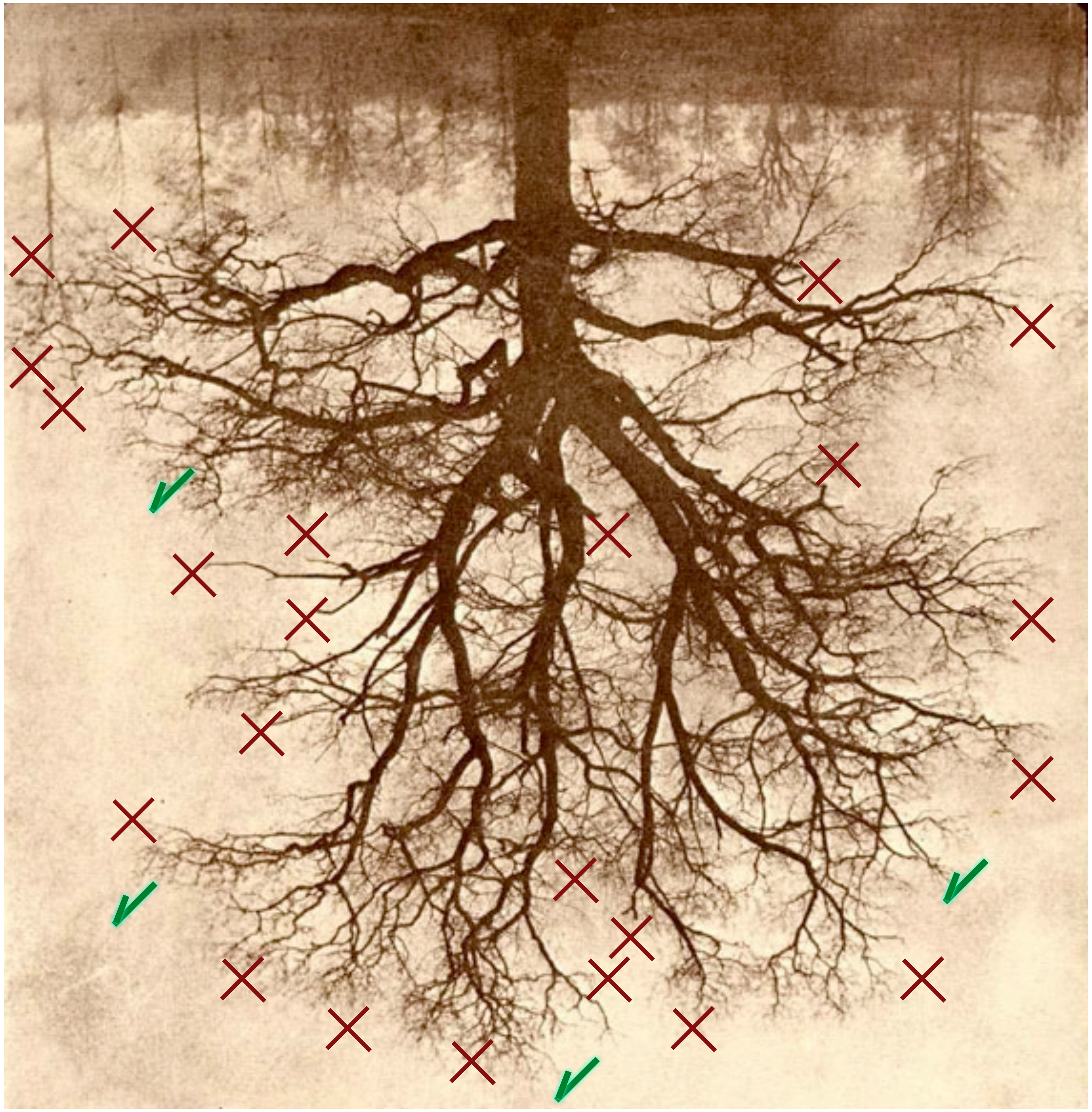


Where is the cause of the problem?



How to solve it?

The result of a query can be changed ...



Adding solutions → Transforming failure branches in success

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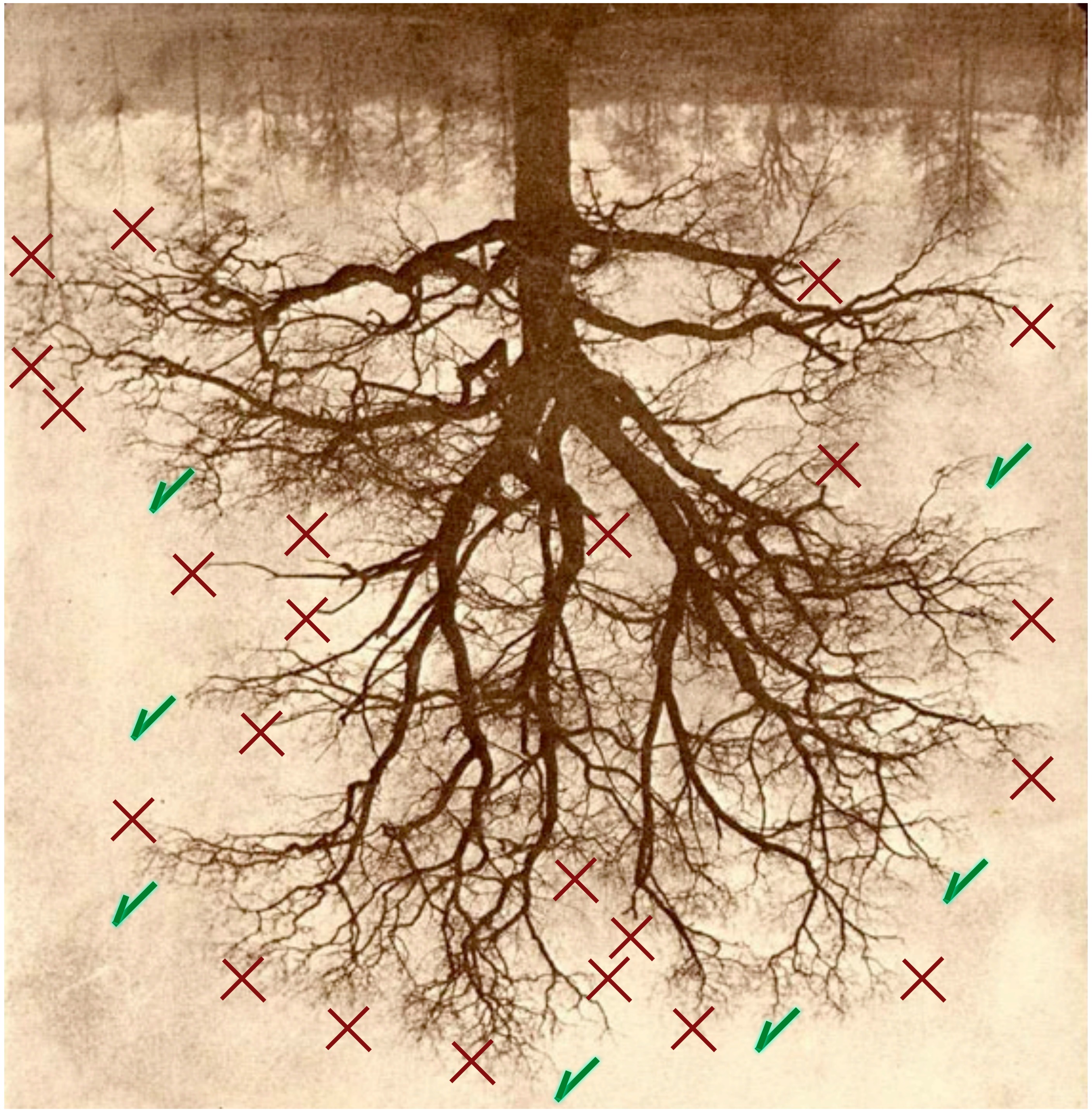

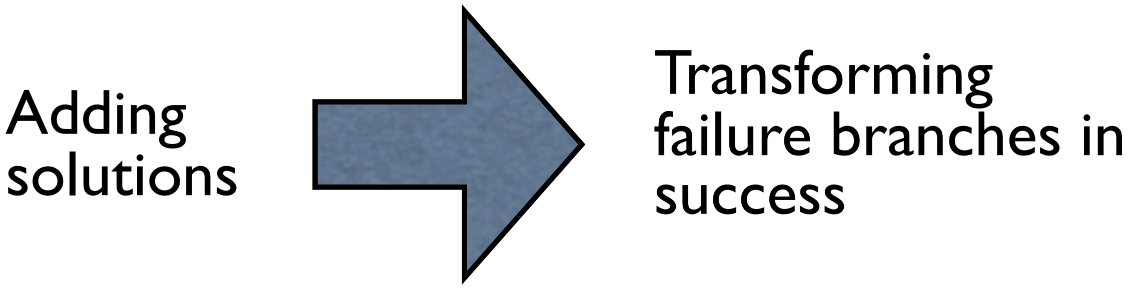

Adding solutions

Transforming failure branches in success

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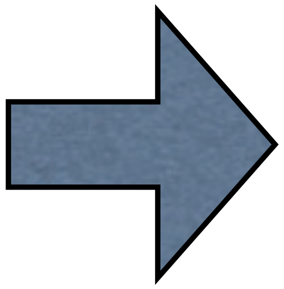
Suppressing Solutions



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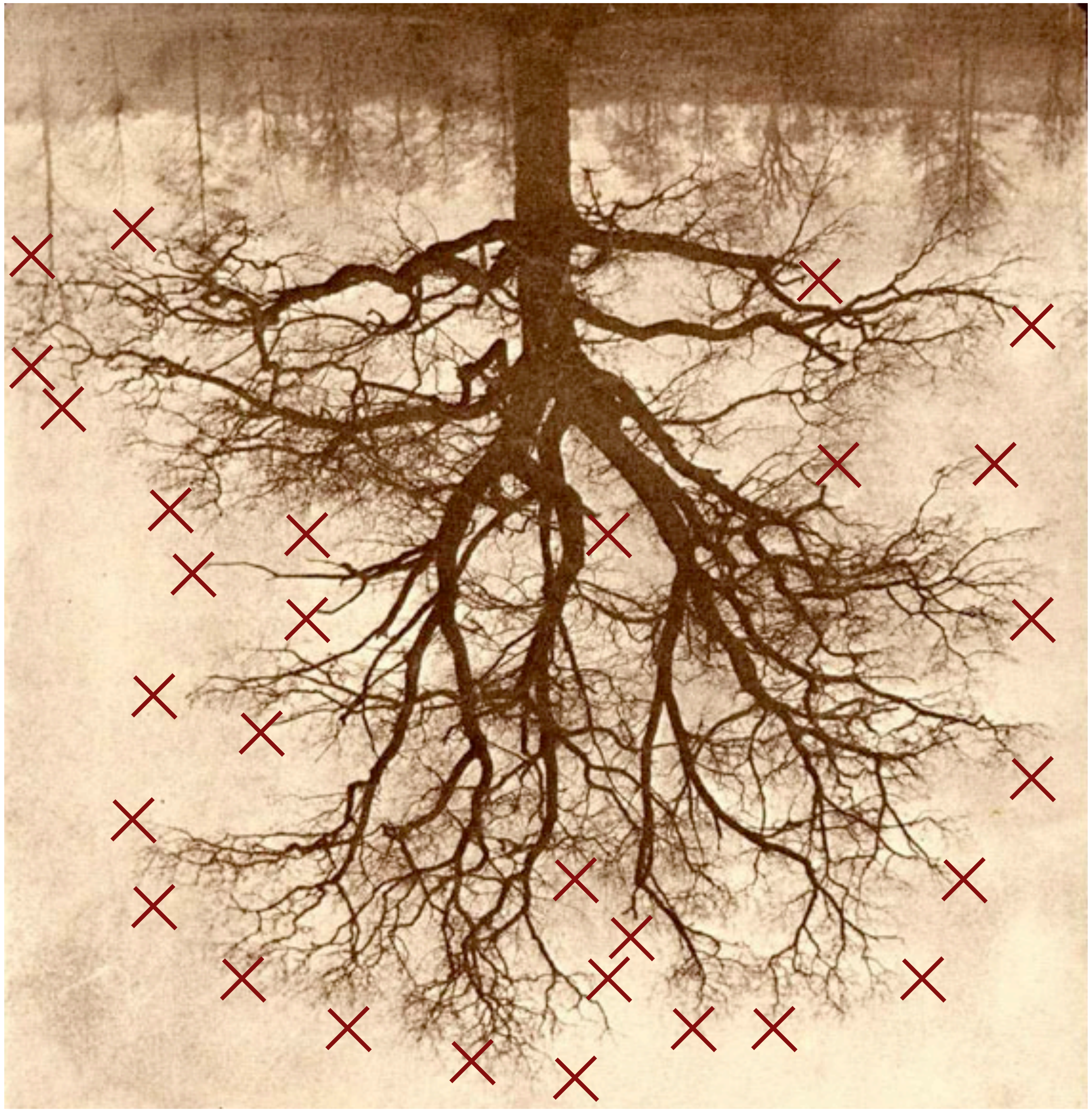
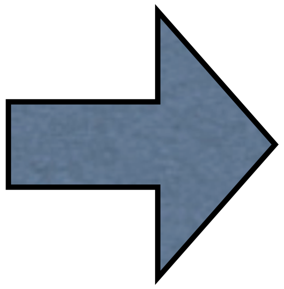




Suppressing Solutions

Transforming success branches in failures

Our solution

- Framework for defining small partial solutions that can be composed.
- The core of this is based on an *abductive meta-interpreter*.

What is Abduction?

One of the three forms of reasoning according to Pierce

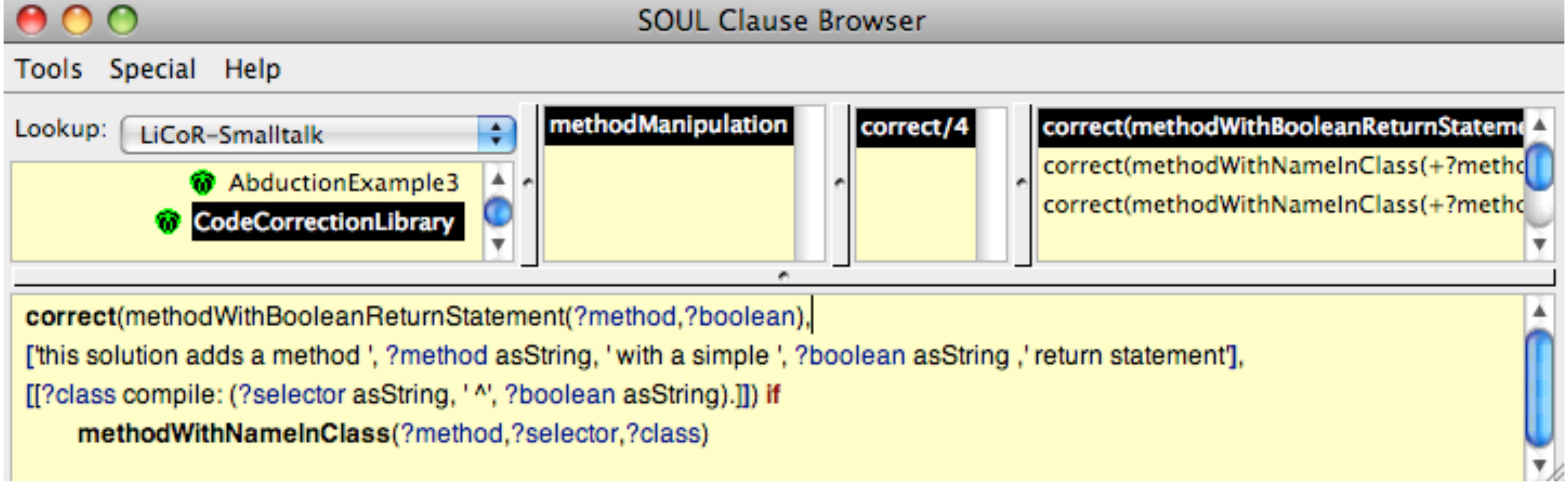
- Deduction
- Induction
- Abduction

Abduction is suitable for:

- Choosing the hypotheses that would, if true, **explain** an evidence.
- Alternatively, choosing currently true hypotheses that would, if false, explain an evidence (*extended abduction*).
- These explanations are expressed in terms of some predicates, declared before hand as *abducibles*.

Defining positive explanations

(*abducible* predicates)



```
correct(methodWithBooleanReturnStatement(?method,?boolean),
['this solution adds a method ', ?method asString, ' with a simple ', ?boolean asString ,' return statement'],
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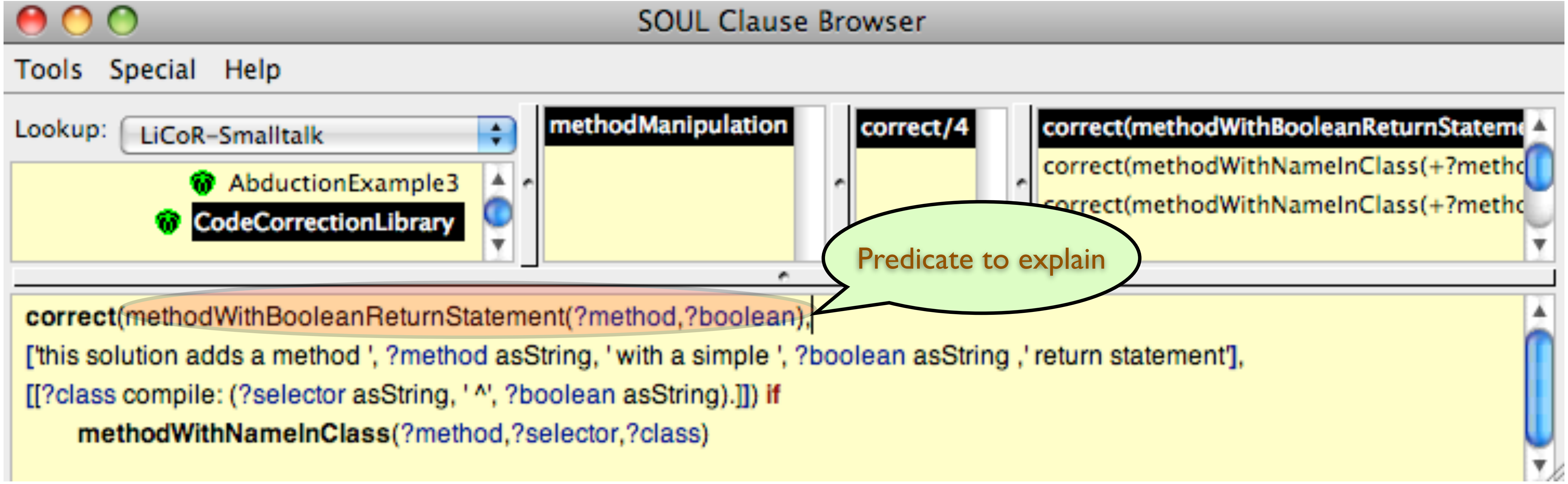
Defining positive explanations

(*abducible* predicates)



Predicate to explain

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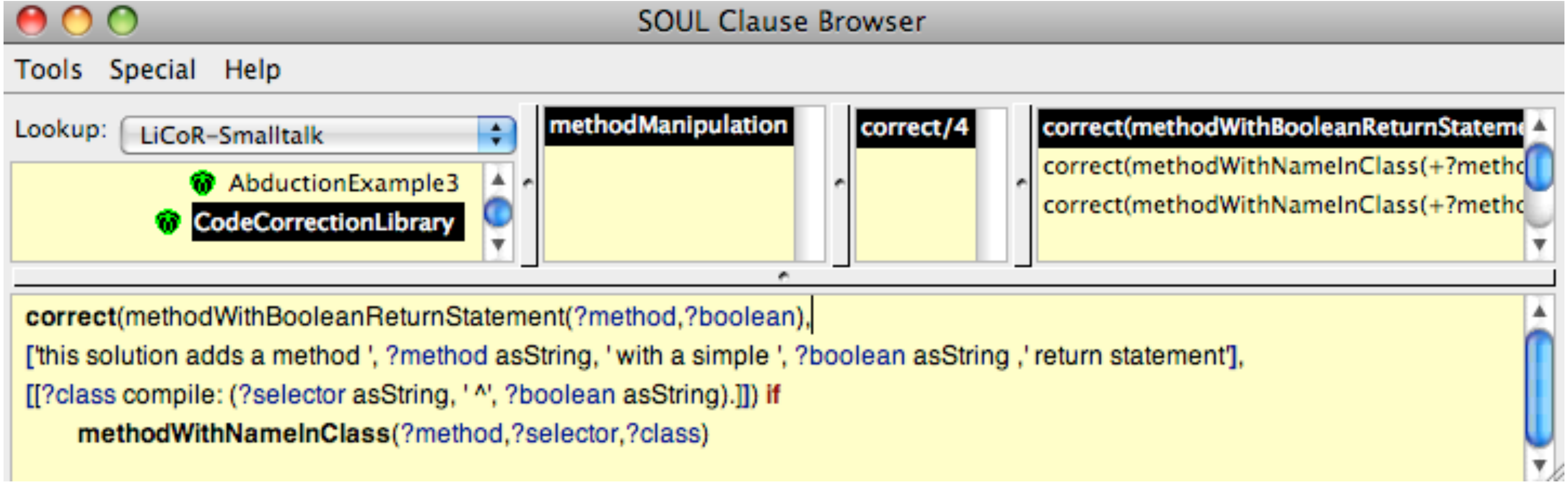

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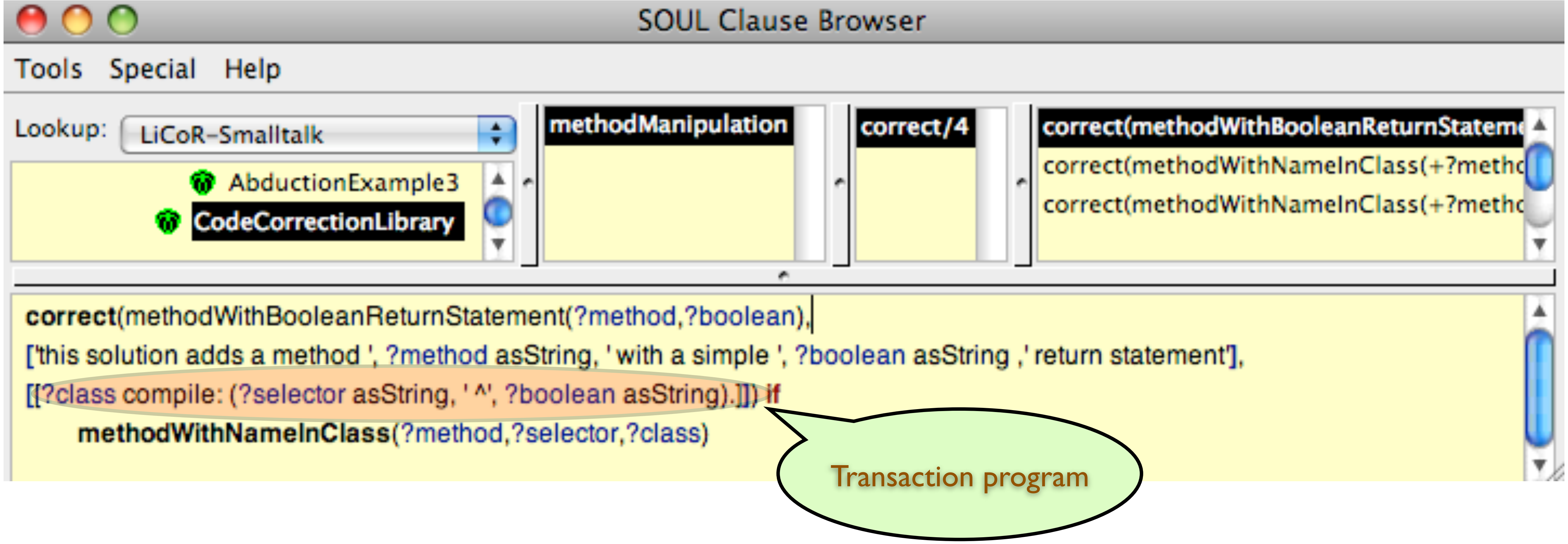

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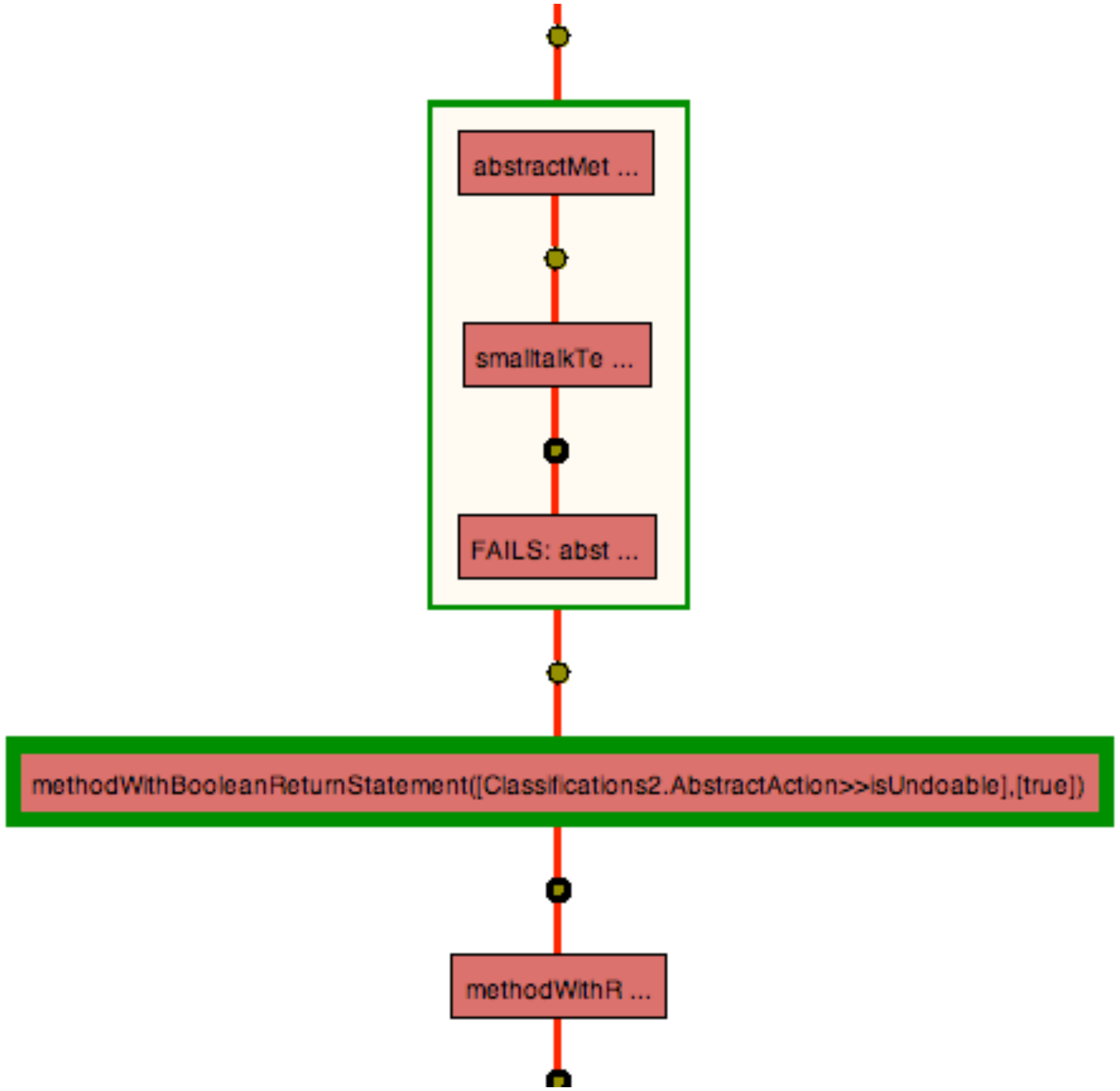
Transaction program

Diagnosing & correcting inconsistenies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smalltalkTe ...
FAILS: abst ...
methodWithBooleanReturnStatement([Classifications2.AbstractAction>>isUndoable],[true])
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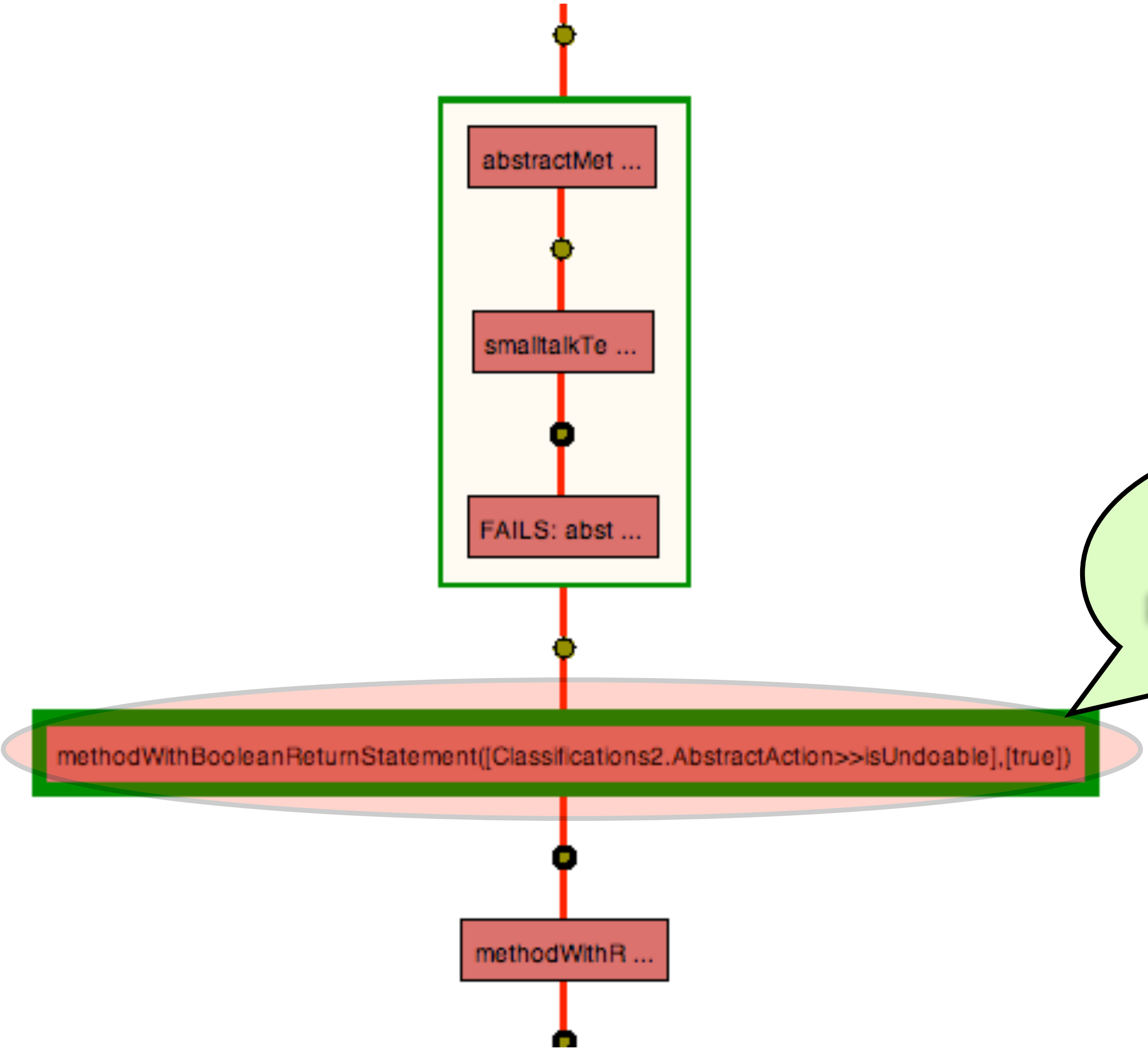
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Node marked with positive explanations

Future work

- Choosing a more complex case study (currently analyzing the *Starbrowser*).
- How to compose partial solutions.
- Filter solutions that will not cause new inconsistencies.
- How to choose among different solutions.

Many Thanks

- Questions?
- Feedback?