deep se

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Unweaving the Impact of Aspect Changes in AspectJ

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Problem Outline

- Small changes can have major and nonlocal effects in programs
- For Aspect Oriented software the problem is even more relevant, for the obliviousness of Aspect oriented programs
- Local changes are not really local
  - Changes in the base system Influence Aspects and vice versa!

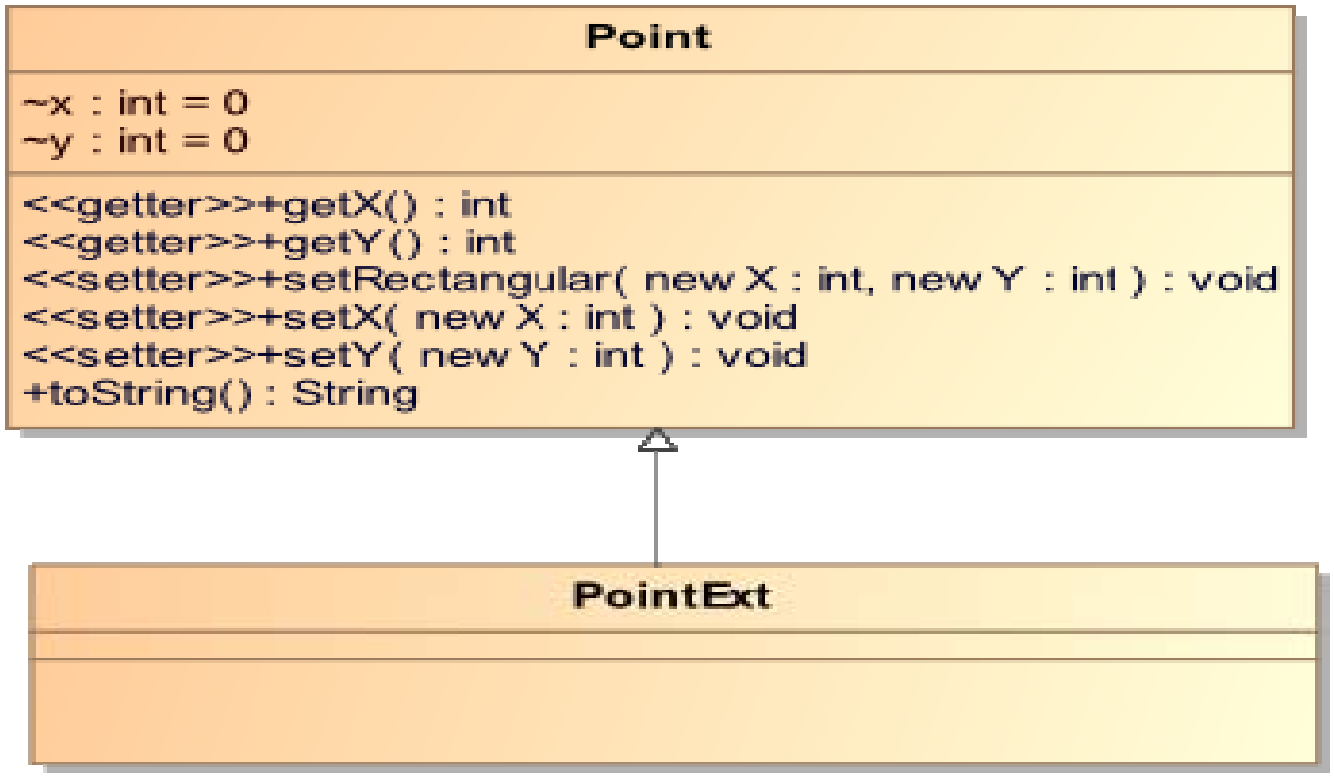
Problem solution: Change Impact Analysis

- We suppose to have two versions of the same program and a test suite
- We run tests on two versions of the program
- We compare source of two versions to find “atomic changes”
  - “Small” changes in program source
  - There are interdependencies between atomic changes
- We compare graph representation of the two program versions

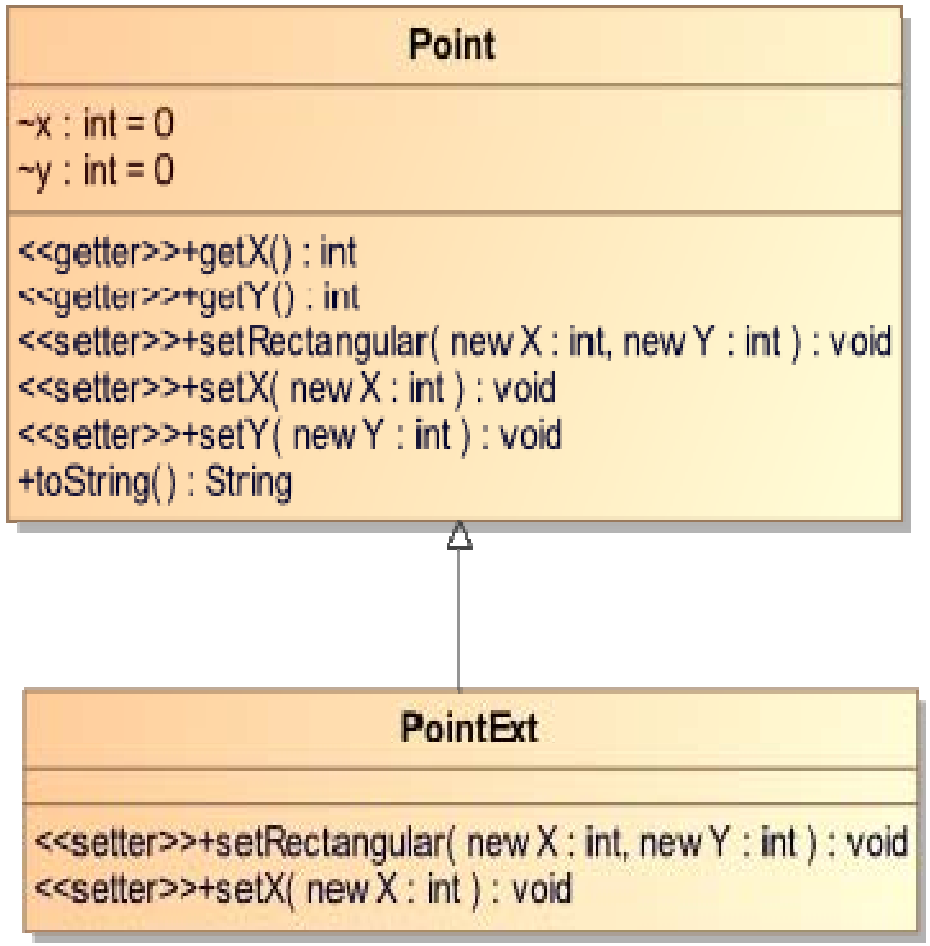
Change impact analysis overview

- We find dangerous paths and map them on atomic changes
- An atomic change
  - in dangerous paths is responsible for test result change
  - not mapped on dangerous edges do not to affect test result
  - not mapped on any test in the suite is not tested
- Deleting a set of AC in dangerous paths produces a version of the program giving previous test result

Running example



Running example



Running example

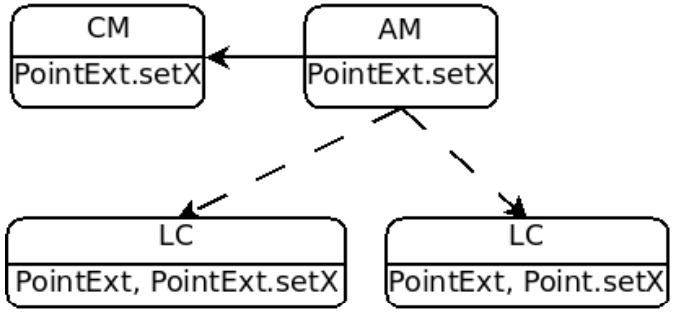
- Bound point aspect:
  - A pointcut to capture setX and methods that calls it
  - A pointcut to capture setX calls only
  - We add a field in modified version

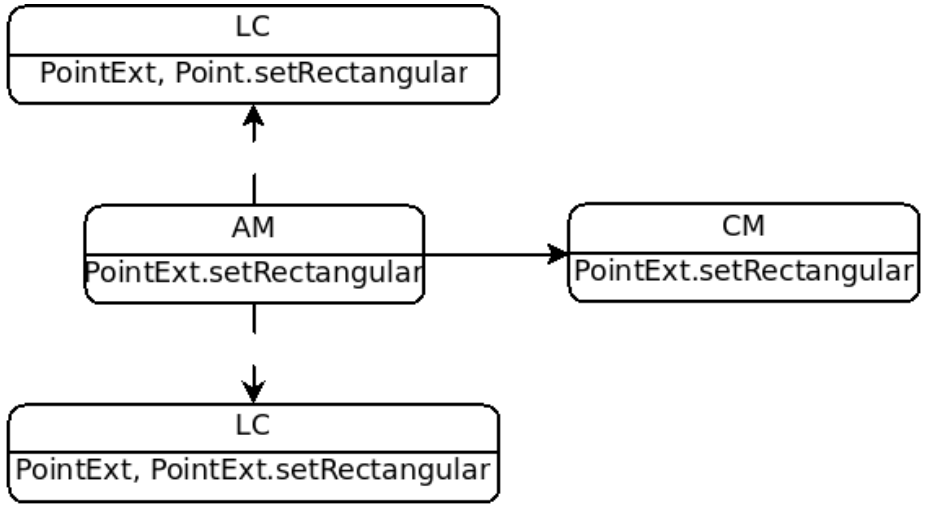
```
// ====== advices ======
   before(Point p, int x) throws
InvalidException:
   setterX(p) && args(x) { // before  }
   void around(Point p): setterX(p) {
//around1    }
   void around(Point p): setterXonly(p)
{ // around2}
   before (Point p): setterX(p){ //
before2
      //modified to use added field

   }
   after(Point p) throwing (Exception
ex):
   setterX(p) { // afterThrowing1   }
   after(Point p): setterX(p){ //
after1  }
```

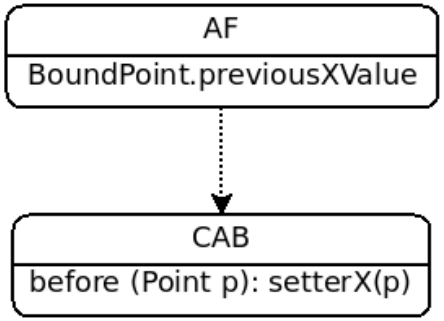
Test Case

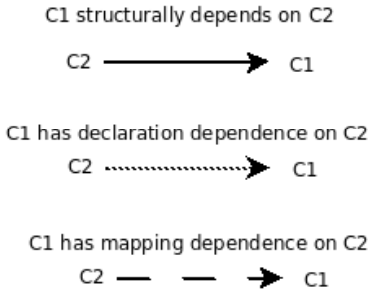
```
  public static void main(String[] a) throws Exception {
    Point p1 = new Point();
    p1.setRectangular(5,2);
    System.out.println("p1 = " + p1);
    if(p1.x> 5){
    p1.setX(6);
    p1.setY(3);
    System.out.println("p1 = " + p1);
    }
    else{
      System.out.println("p1 = " + p1);
    }
    Point p2 = new PointExt();
    p2.setRectangular(5,2);
    System.out.println("p2 = " + p2);
    p2.setX(5);
  }
}
```

Atomic changes example



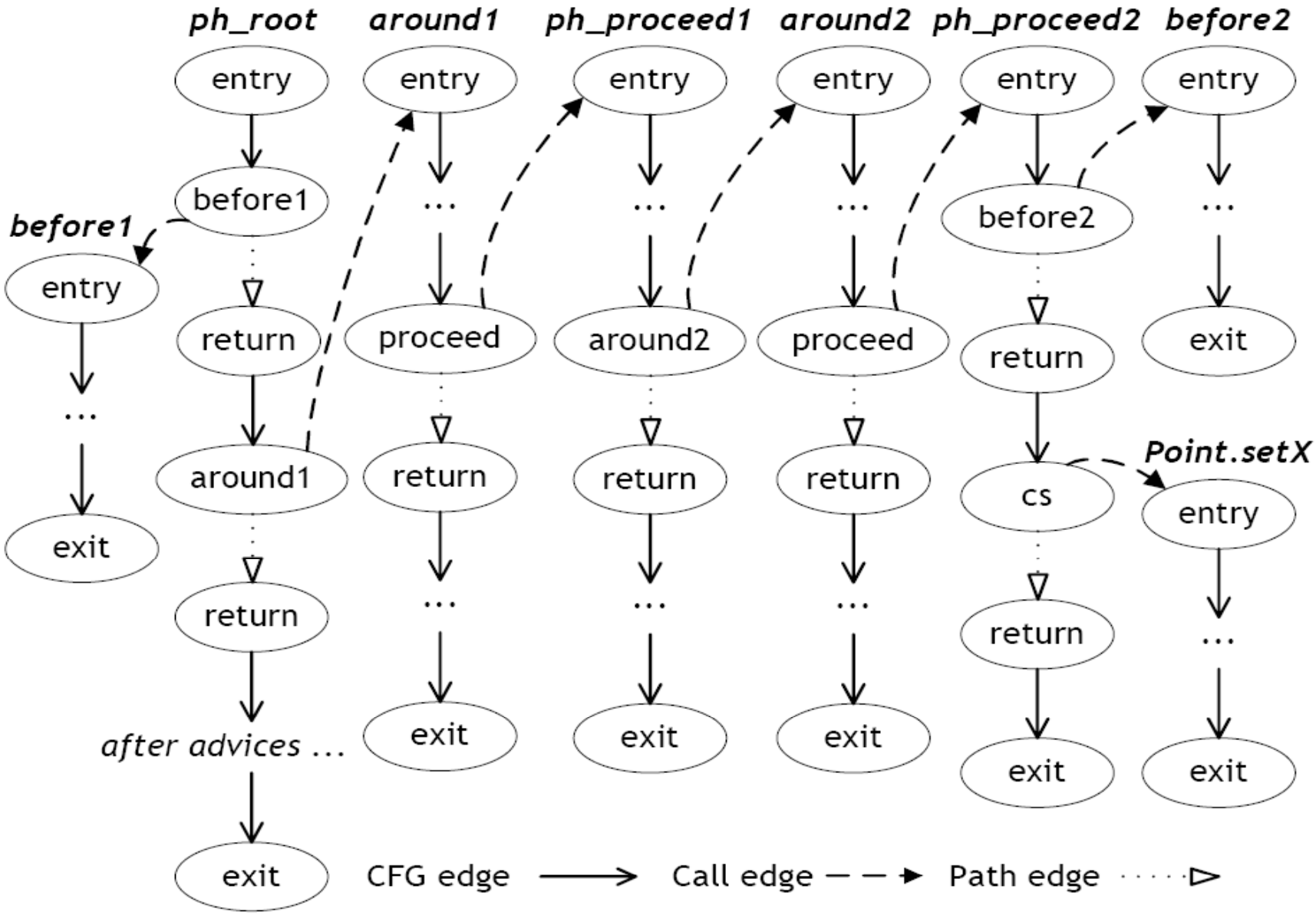






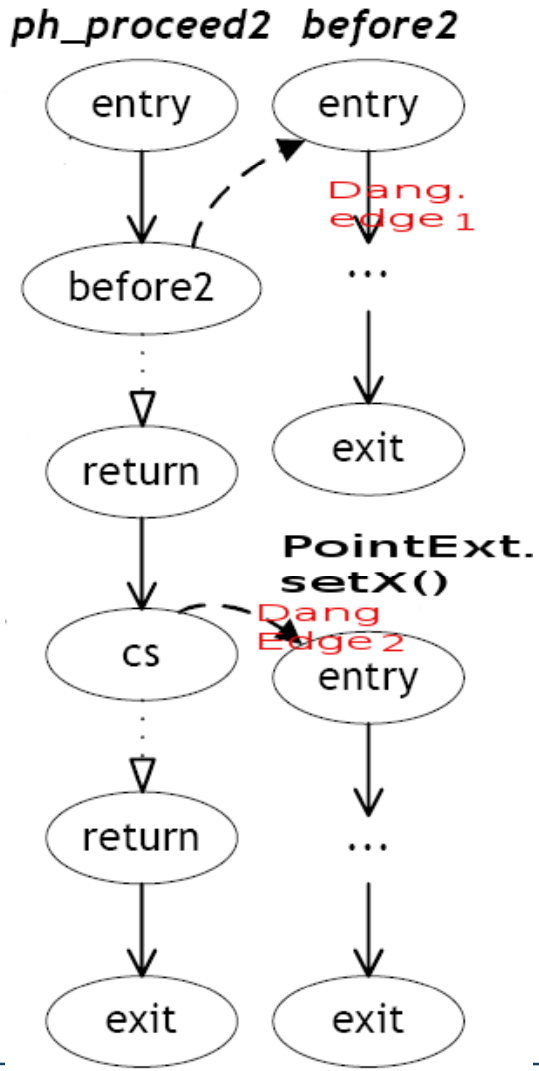
AspectJ interaction Graph

- We use the AspectJ Interaction Graph (AJIG) to represent program semantics
- Control flow representation of an AspectJ program
- Three main kinds of interactions:
  - Non-advice method calls
  - Interactions between advices and methods
  - Introductions and intertype declarations


ph_root
around1
ph_proceed1
around2
ph_proceed2
before2
before1
entry
before1
return
around1
after advices ...
exit
proceed
around2
cs
Point.setX
CFG edge
Call edge
Path edge

Example

- Dangerous edge1 is due to CAB of Before2
  - It is mapped on CBM and AF
- Dangerous edge 2 is due to the LC PointExtm Point.setX()
  - It is mapped on two AC: LC, AM



Implementation

- We implemented change impact analysis for AspectJ on top of *abc* and *Ajana*
- *abc* is an extensible AspectJ compiler
  - Built on top of *Soot* and *Polyglot*
  - Allows to access program AST and to implement analysis
  - Due to two phases weaving we could analyze AspectJ programs without considering instructions added by the compiler
- *Ajana* is a framework for AspectJ analysis
  - Provides AJIG representation

Future work

- We produced and implemented an approach that helps the programmer maintaining code
  - Source code changes are decomposed into atomic changes and are related
  - Change in tests results are mapped on source code changes
- For future work we plan to rise abstraction level
  - Build changes classifiers
  - Classify possible changes following anti-patterns classification
  - Several work try to build metrics for changes in AO programs