

Flexible Model Element Introduction Policies for Aspect-Oriented Modeling

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Background

→ Aspect-Oriented Modeling

- Separation of Concerns
- (De)Composition

→ 2 main types of AOM

- Merge-based: Kompose (France, Fleurey et al.), etc
- **Pointcut-based**: MATA (Whittle et al.), Smartadapters, GeKo, etc

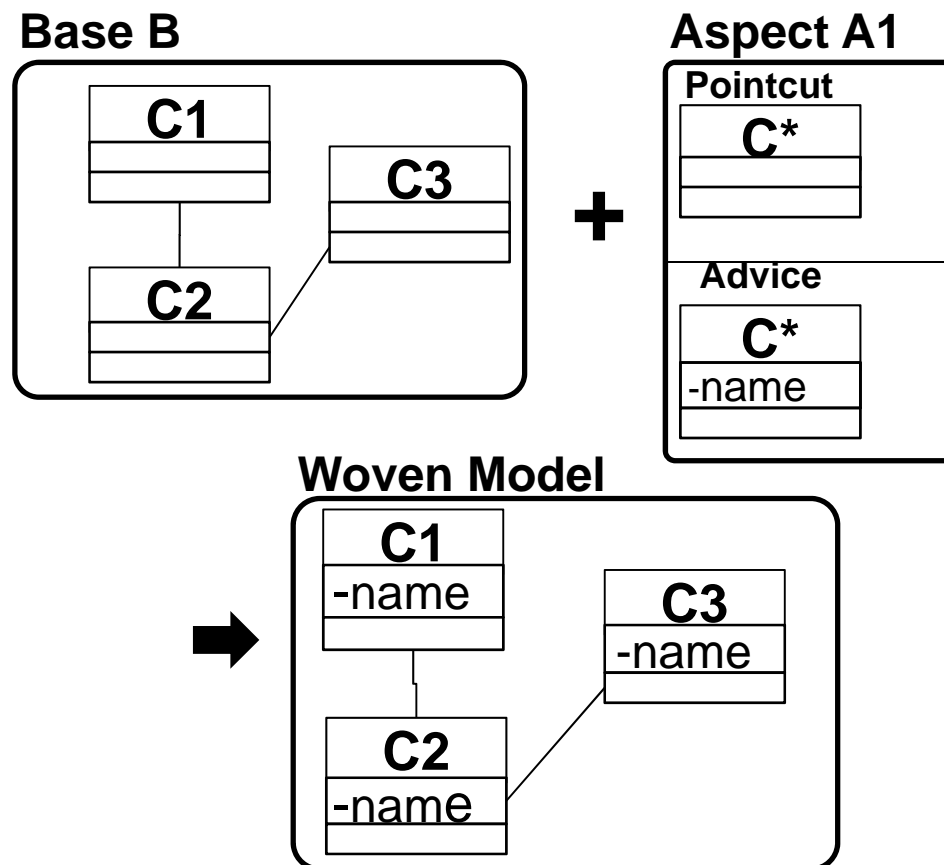
→ Pointcut-based weavers

- Very few prototypes publicly available
- Very few evidences of PB-AOM in industrial context
- Noticeable exceptions
 - Motorola WEAVR
 - SmartAdapters (used by industrial partners of the DiVA project)

Background: Pointcut-Based Weaving

→ The weaving process is two-phased.

1. Detect the join points corresponding to the Pointcut
2. Compose the advice model into the base model at each JP



Context: Pointcut-based AOM

→ Pointcut

- Model fragment (or a predicate over the model)
- Can match several join points of a base model

→ Problem

- How to weave the advice in case of multiple join points?
- Per join point? Once? Other strategy?

→ Some solutions (related work)

- Morin et al., 2007
 - per join point and global advice element
- Grønmo et al., 2008
 - collection operator on the pointcut elements
- AspectJ
 - Per type, per instance

Agenda

→ Background and Context

→ **Simple example**

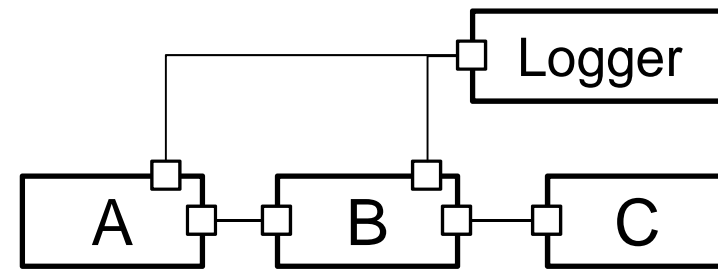
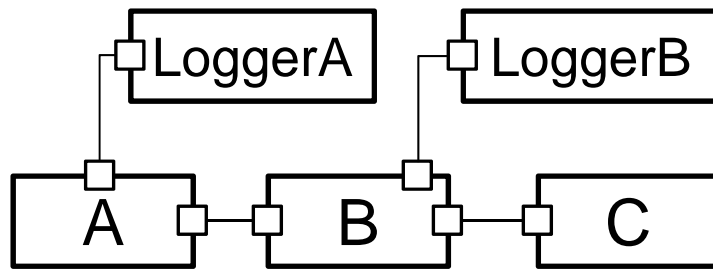
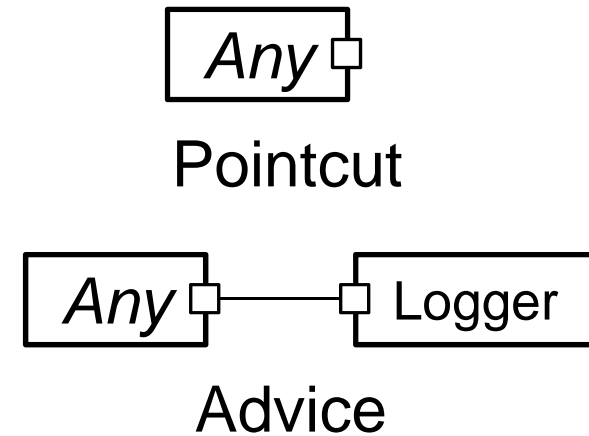
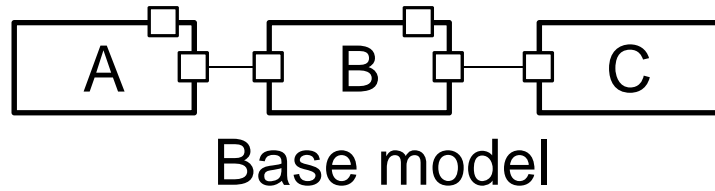
→ Our Solution: Several Instantiation Strategies

- Per Pointcut Match
- Global
- Per Role Match
- Per Element Match

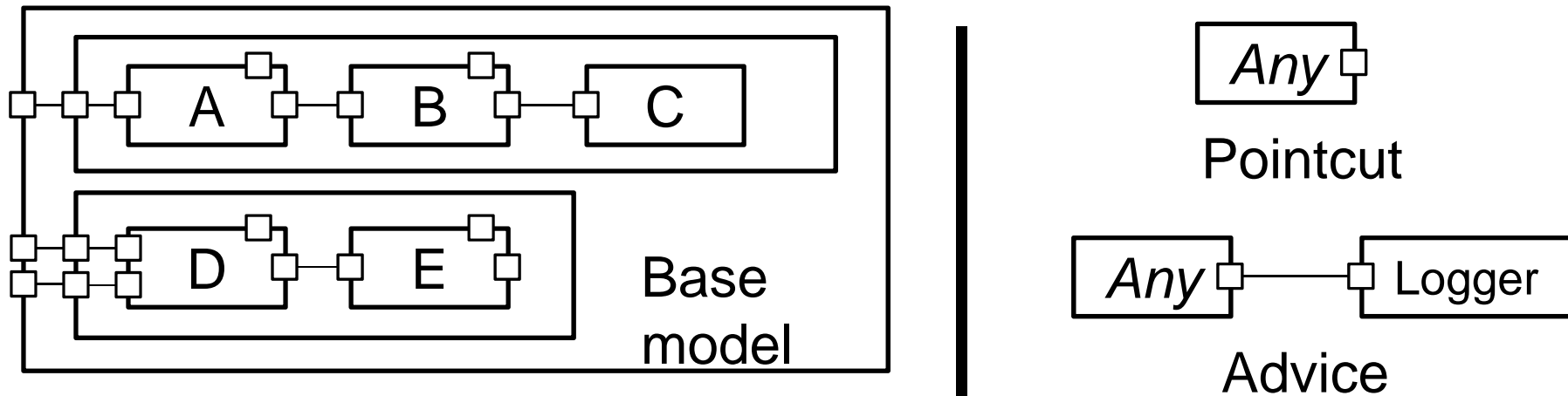
→ Complex Example

→ Conclusion

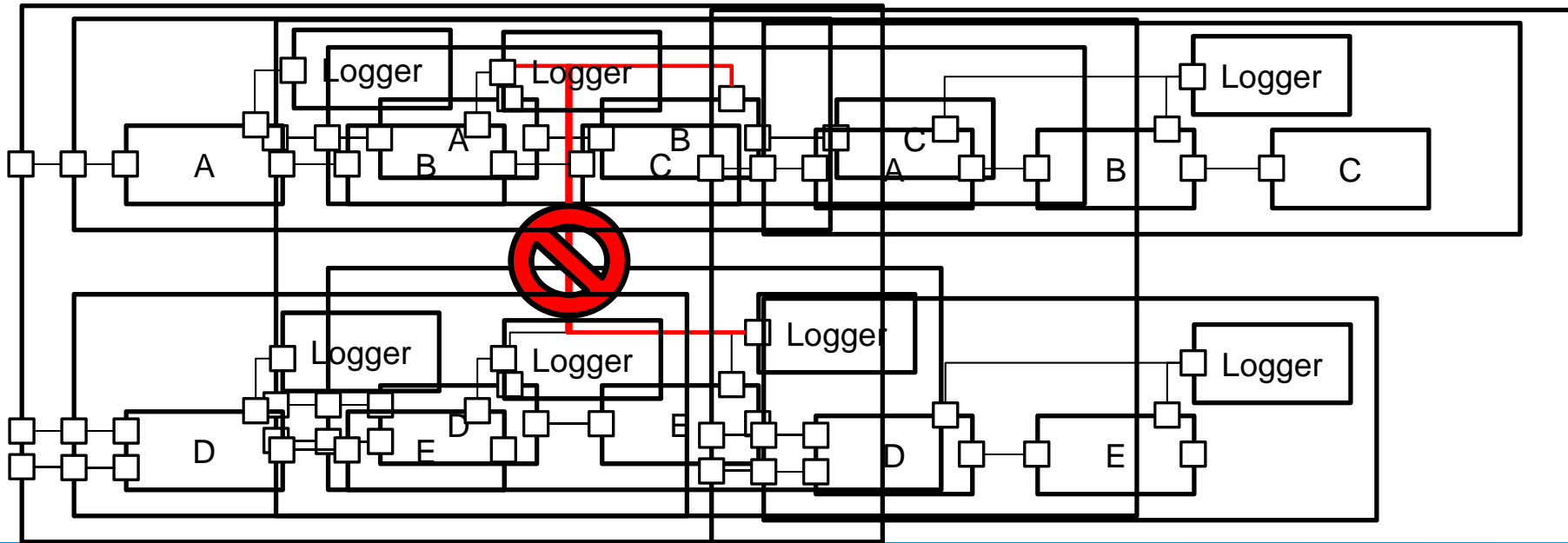
A (not so) Simple Log Aspect



A (not so) Simple Log Aspect (with another Base)



How to weave one logger component inside each composite?



Agenda

→ Background and Context

→ Simple example

→ **Solution: Several Instantiation Strategies**

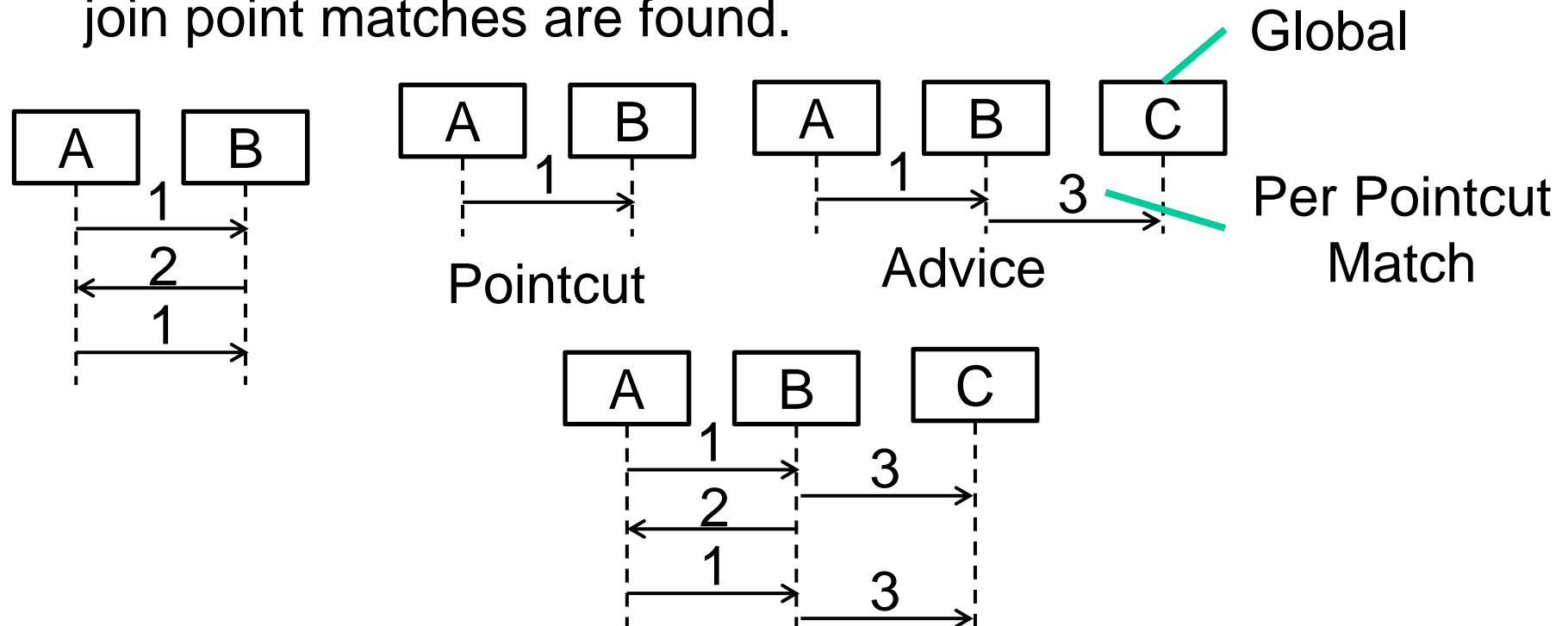
- **Per Pointcut Match**
- **Global**
- **Per Role Match**
- **Per Element Match**

→ Complex Example

→ Conclusion

Several Instantiation Strategies

- **Per Pointcut Match:** A new instance of the advice element is introduced for each pointcut match.
- **Global:** A single instance of the model element is introduced into the base model, regardless of how many join point matches are found.



Several Instantiation Strategies: Per Role Match

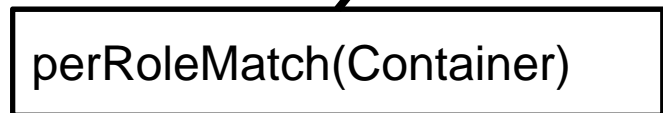
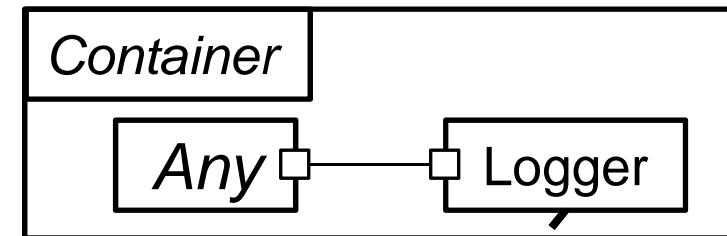
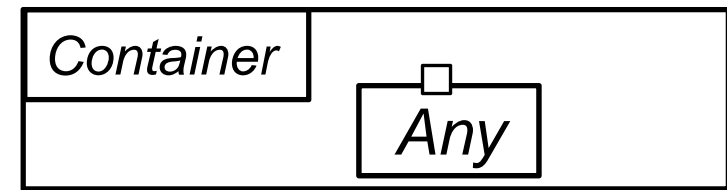
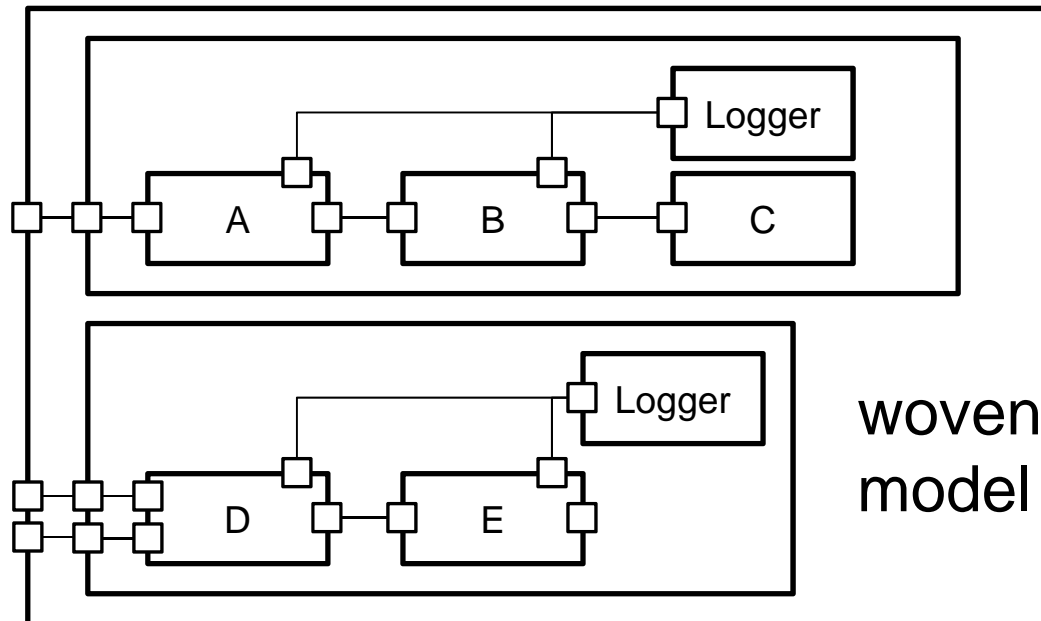
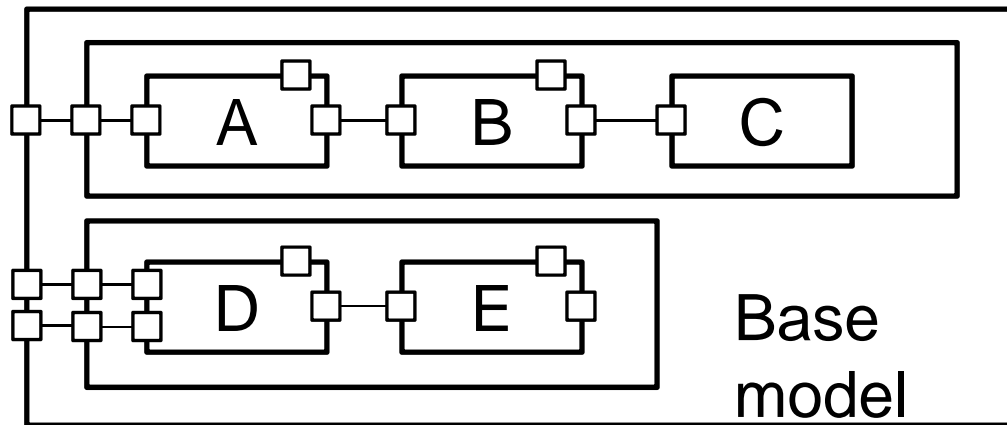
→ Per Role Match: $\text{scope}(PC1, \dots, PCn)$

- The same instance is reused for the equivalent bindings
- Binding: $\{Pi \rightarrow Bi\}$

→ Example: per role match (PC1, PC2)

- **PC1** → **B1**, **PC2** → **B2**, PC3 → B3
 - **PC1** → **B1**, **PC2** → **B2**, PC3 → B4
 - **PC1** → **B2**, **PC2** → **B1**, PC3 → B5
- Bindings are equivalent w.r.t. the scope defined by PC1 and PC2
- This binding is different

Several Instantiation Strategies: Per Role Match



Several Instantiation Strategies: Per Element Match

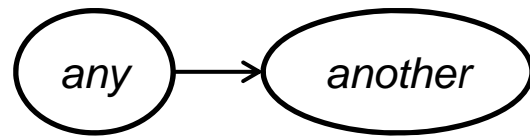
→ Per Element Match: $f(PC1, \dots, PCn)$

- The same instance is reused for the equivalent projections
- Projection: $\{Pi\} \rightarrow \{Bi\}$

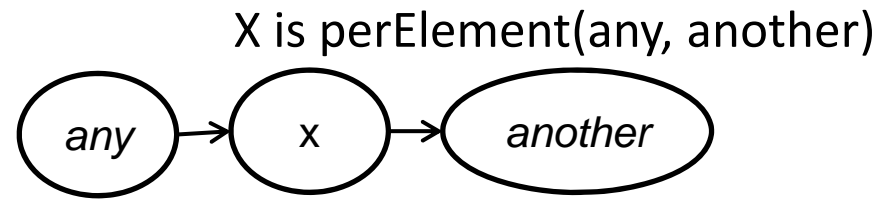
→ Example: per element match (PC1, PC2)

- **PC1→B1, PC2→B2, PC3→B3**
 - **PC1→B1, PC2→B2, PC3→B4**
 - **PC1→B2, PC2→B1, PC3→B5**
- Projections are equivalent w.r.t. the scope defined by PC1 and PC2
- This projection is also equivalent

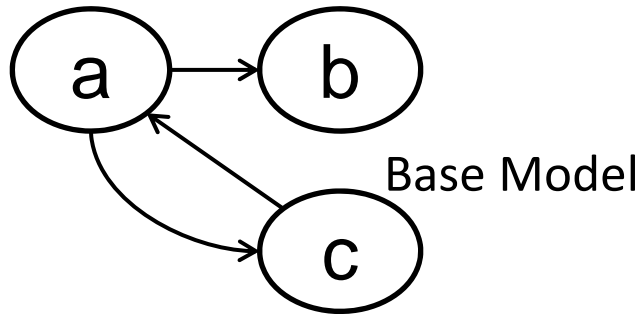
Several Instantiation Strategies: Per Element Match



Pointcut Model



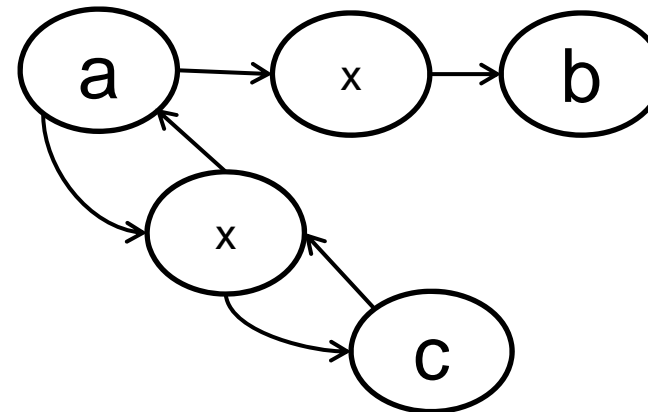
Advice Model



Base Model

3 join points:

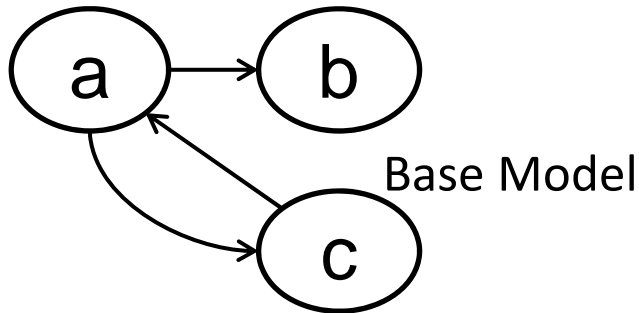
- a → b
- a → c
- c → a



2 projections:

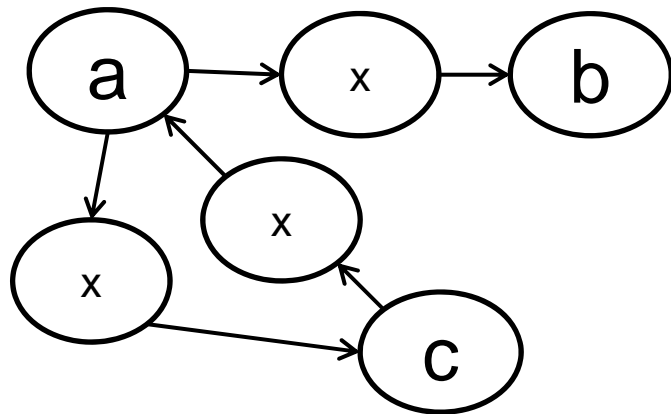
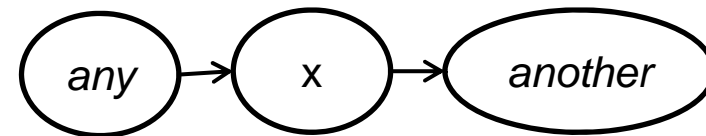
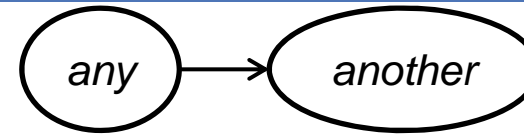
- {any, another} → {a, b}
- {any, another} → {a, c} = {c, a}

Difference between Per Role and Per Element



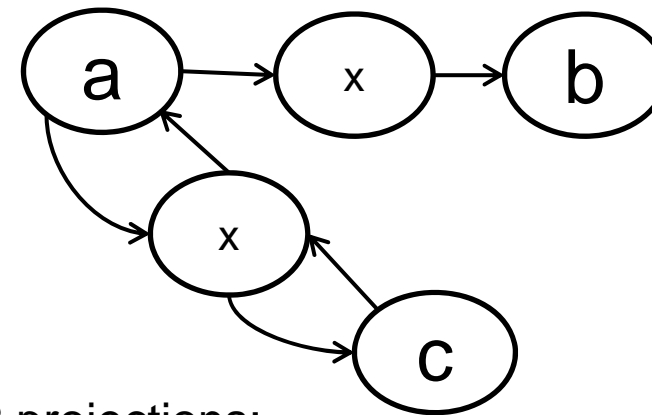
3 join points:

- $a \rightarrow b$
- $a \rightarrow c$
- $c \rightarrow a$



3 bindings:

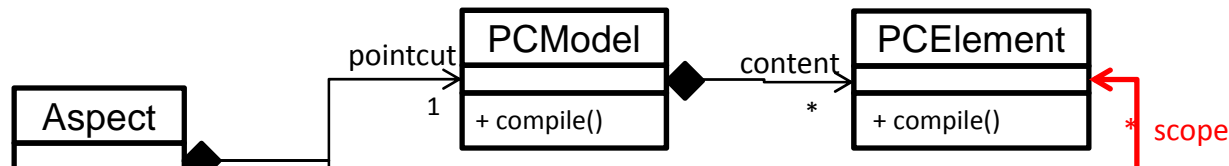
- $\{any \rightarrow a, another \rightarrow b\}$
- $\{any \rightarrow a, another \rightarrow c\}$
- $\{any \rightarrow c, another \rightarrow a\}$



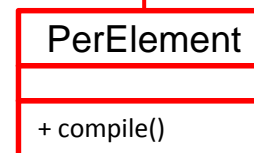
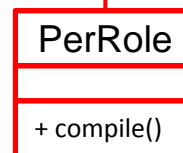
2 projections:

- $\{any, another\} \rightarrow \{a, b\}$
- $\{any, another\} \rightarrow \{a, c\} = \{c, a\}$

Several Instantiation Strategies: Metamodel Modification



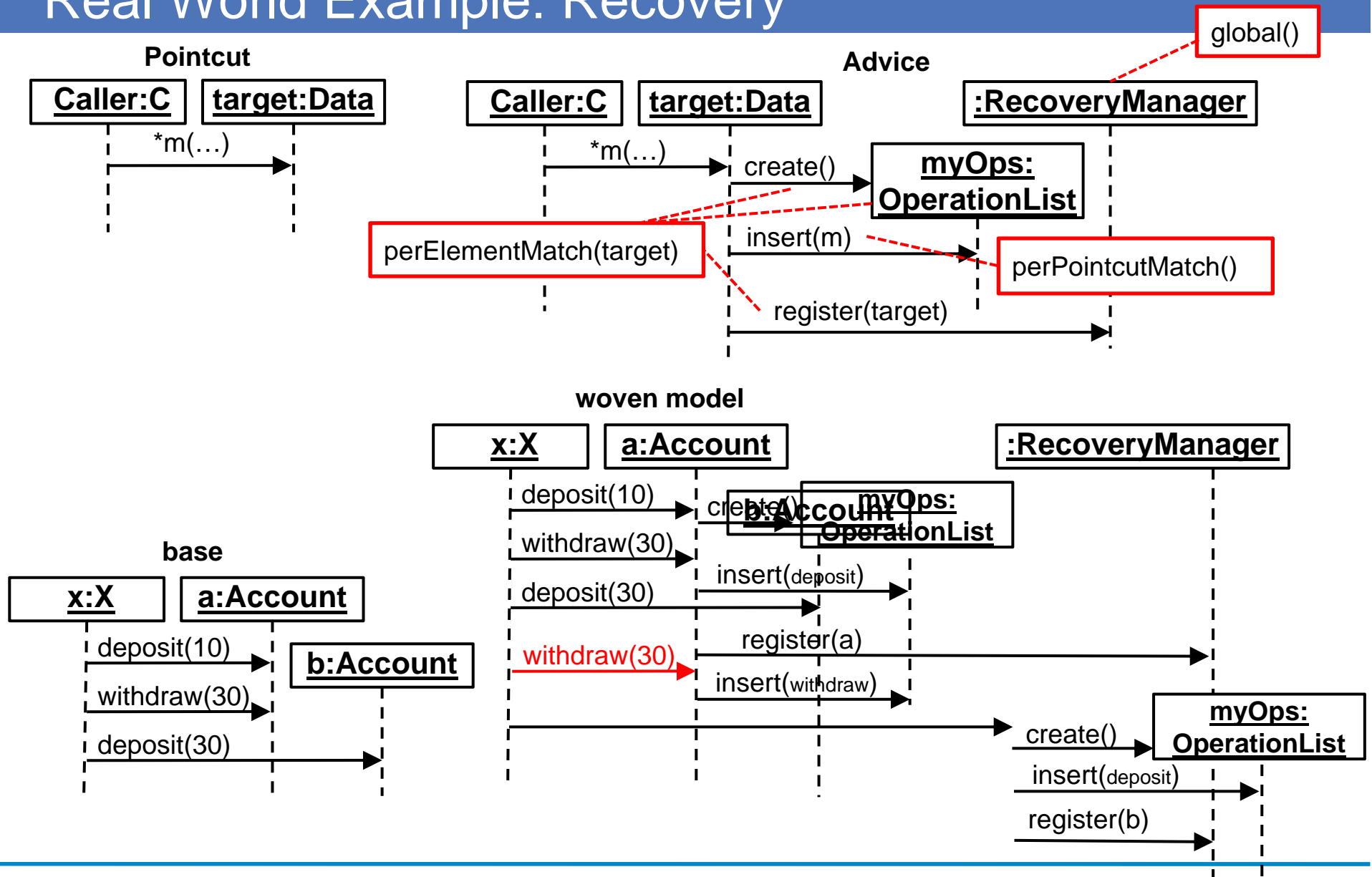
Aspects are compiled to Java/EMF code using Kermeta/KET



Agenda

- A motivating Example
- Background on Weaver
- Our Solution: Several Instantiation Strategies
 - Per Pointcut Match
 - Global
 - Per Role Match
 - Per Element Match
- **Real World Example**
- Conclusion

Real World Example: Recovery



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- **Conclusion**

Conclusion

- 4 strategies addressing the problem of multiple join points
 - Per join point
 - Global
 - Per Role Match
 - Per Element Match

- Allows expressive weaving in the context of Poincut-based AOM

- Tested (and needed) by the industrial partners of the DiVA project

Questions?

