

Software product lines

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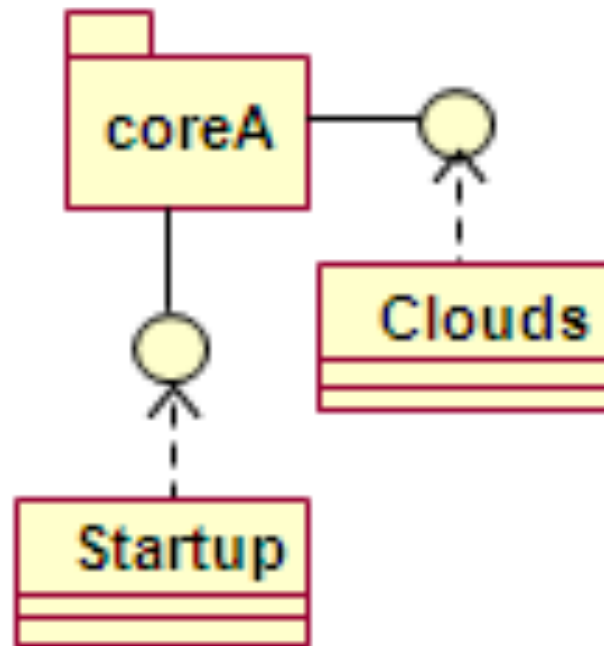
Models for software product lines

Paulo Borba

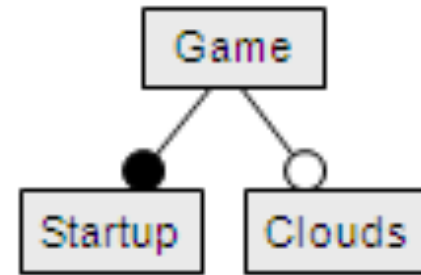
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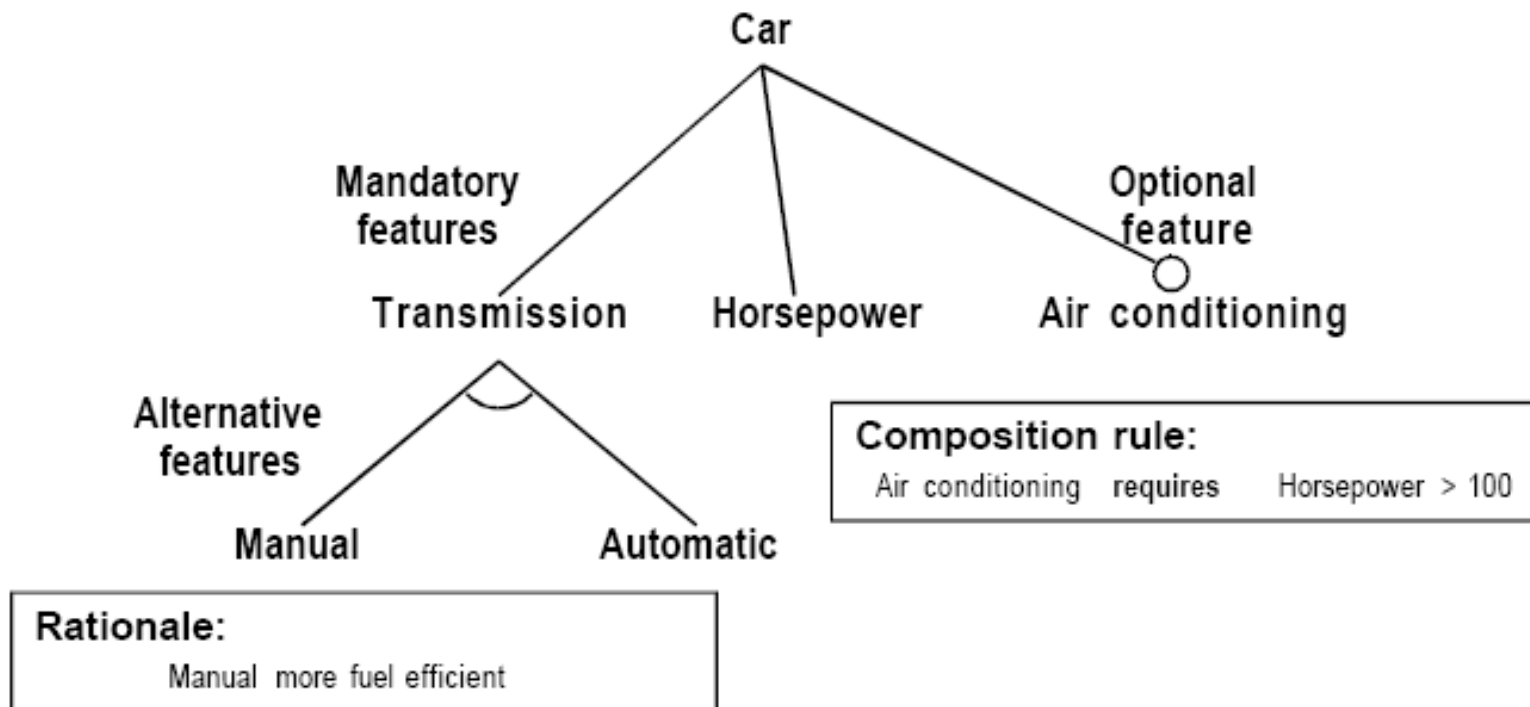
The code shows possible variation points and variations...



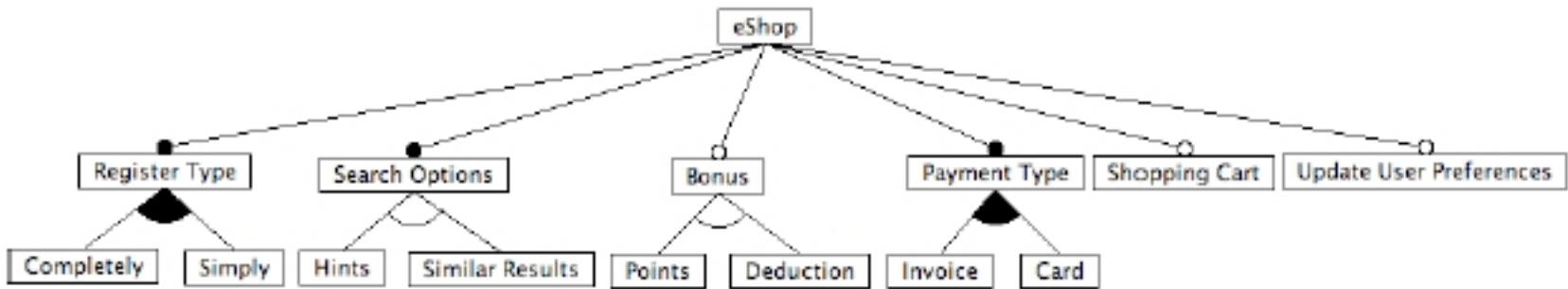
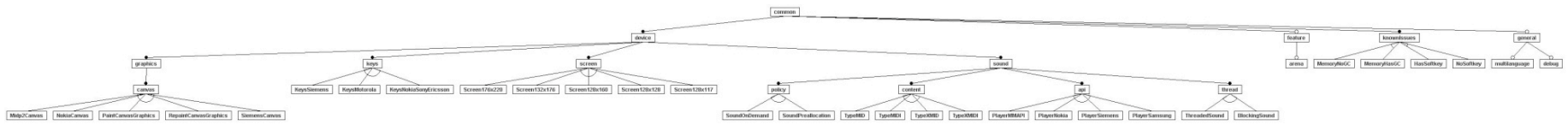
but **feature models** show more...



and help visualize and manage variations...

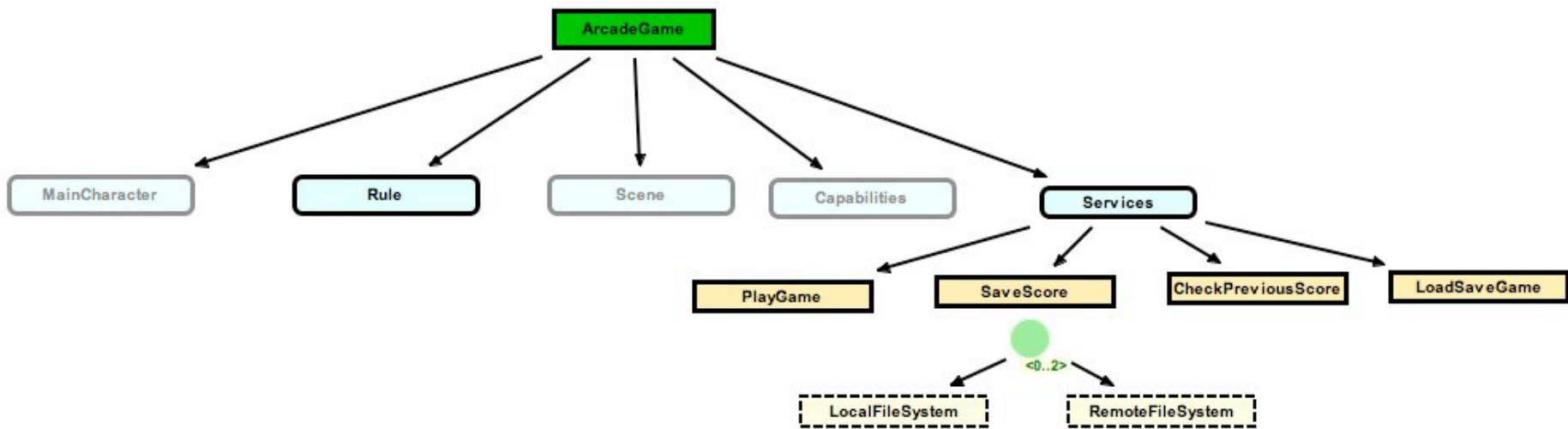


for non trivial product lines

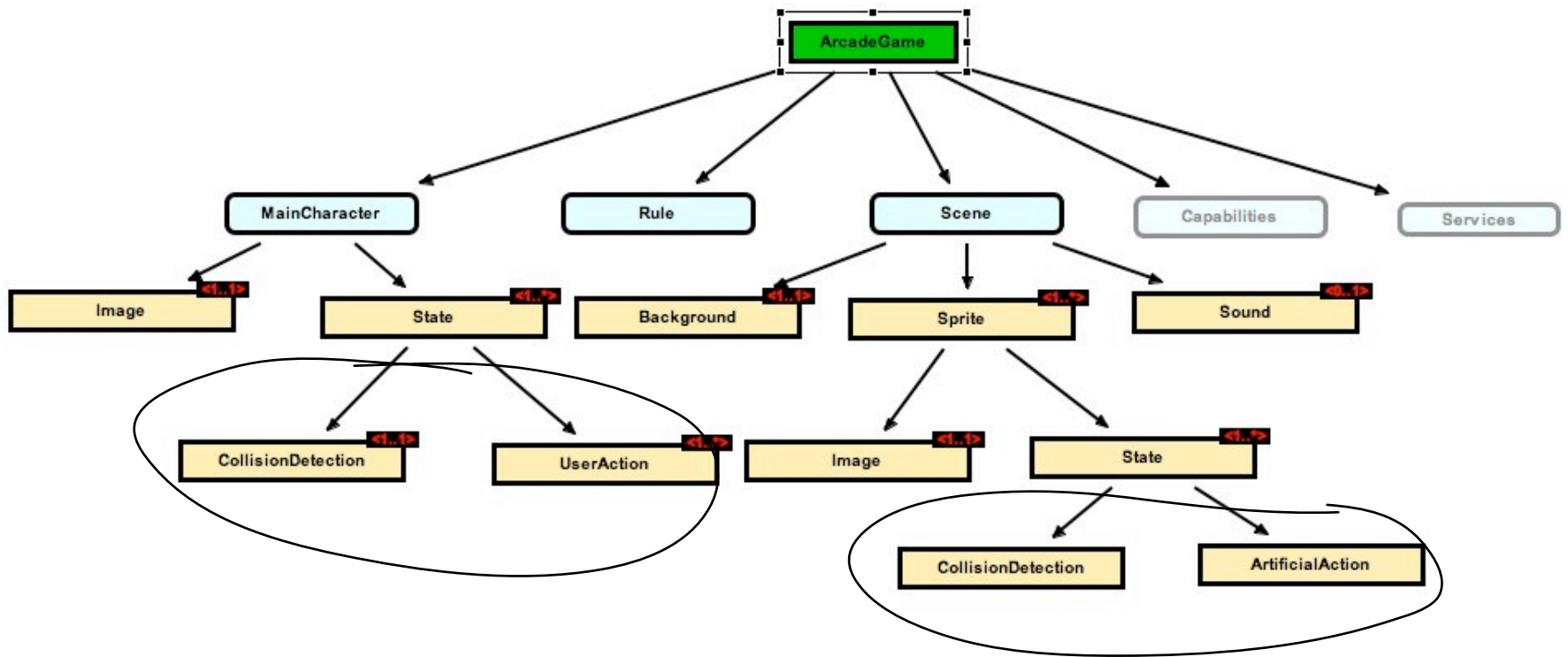


Based on <http://gp.uwaterloo.ca/files/2006-lau-masc-thesis.pdf>

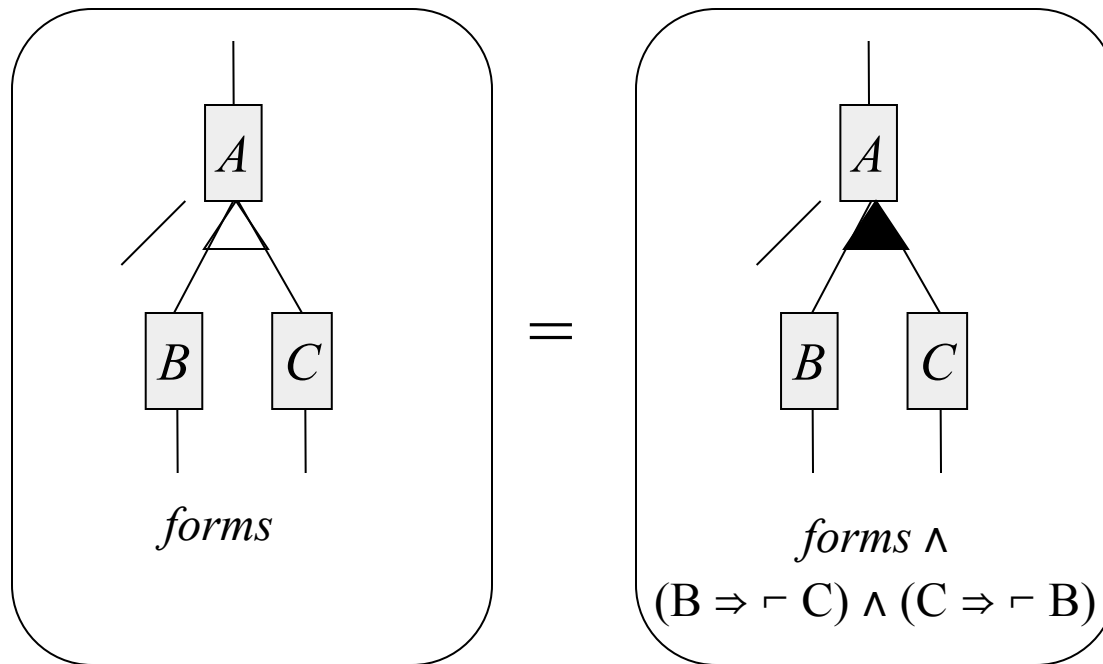
Cardinalities and attributes yield the power of DSLs...



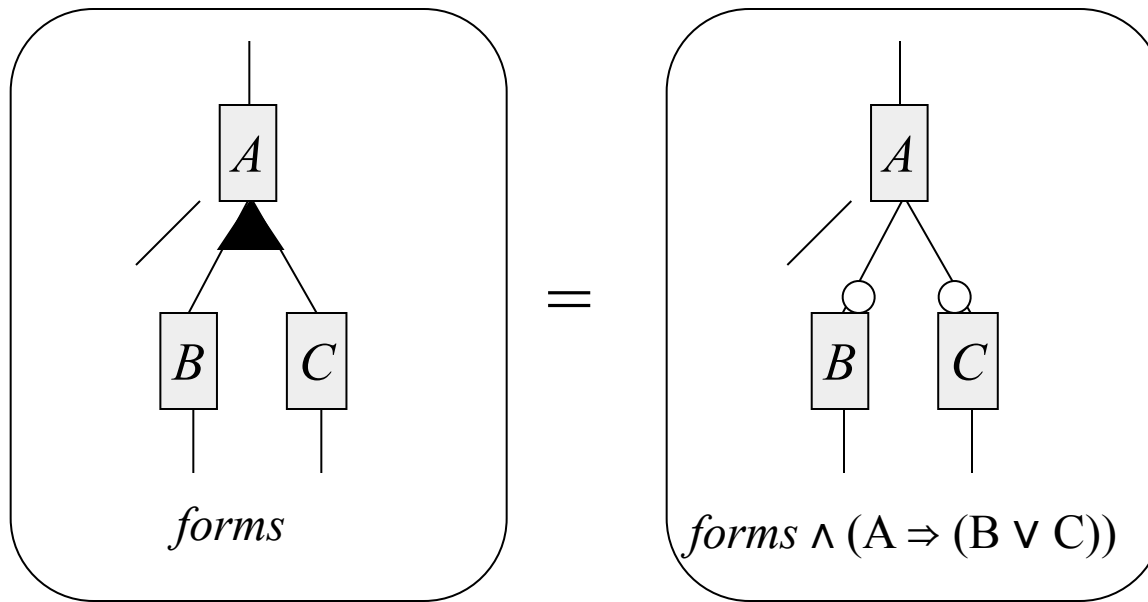
when model is targeted at configuration



Feature model transformational semantics

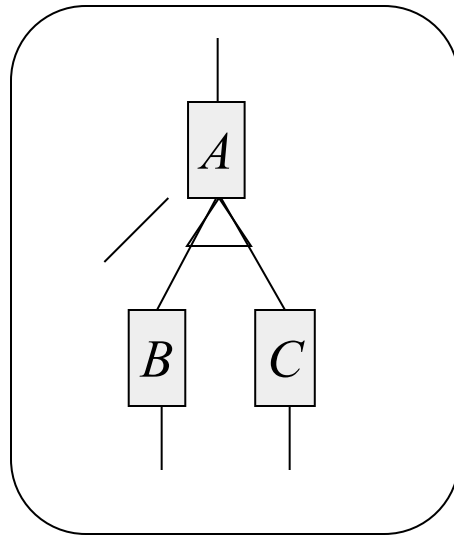


Reduction strategy to features and formulae language



Valid configurations semantics

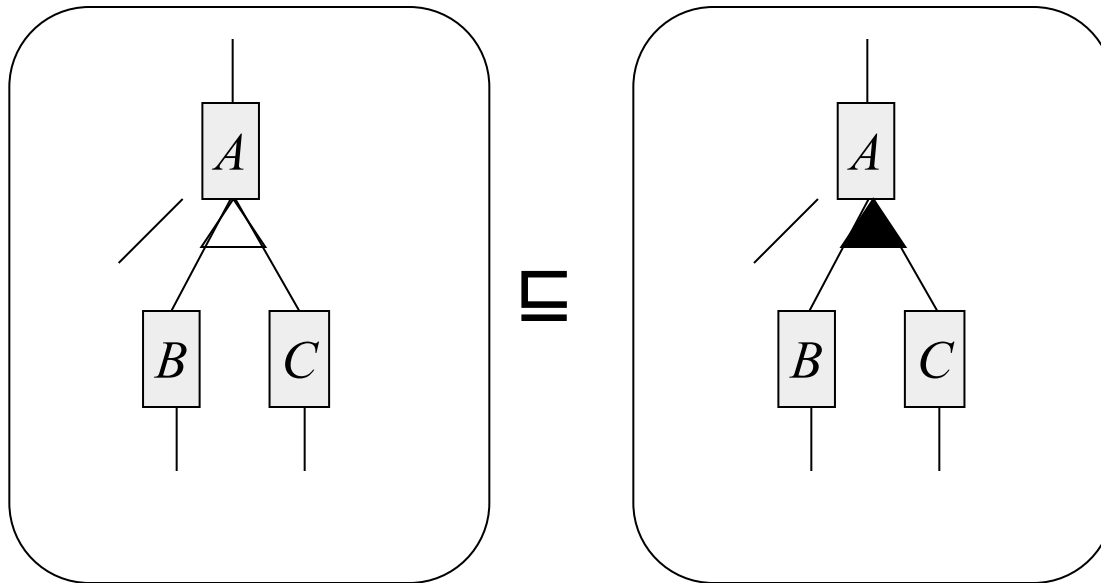
semantics(



) =

{A,B}
{A,C}
...

Feature model refactorings as improved configurability



$\{A, B\}$
 $\{A, C\}$
...

\subseteq

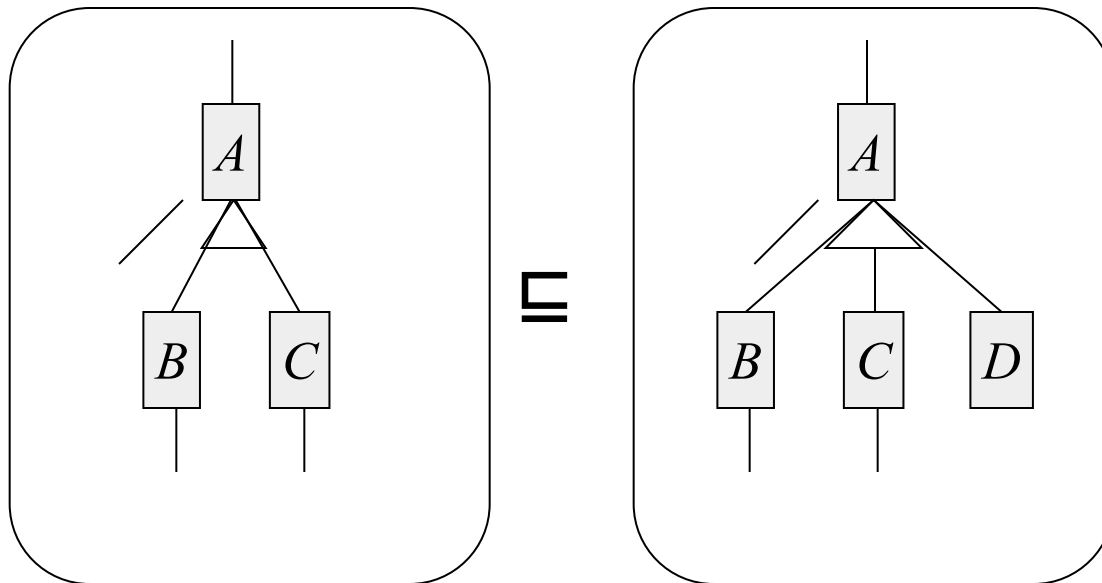
$\{A, B\}$
 $\{A, C\}$
 $\{A, B, C\}$
...

Feature models and configurability improvement

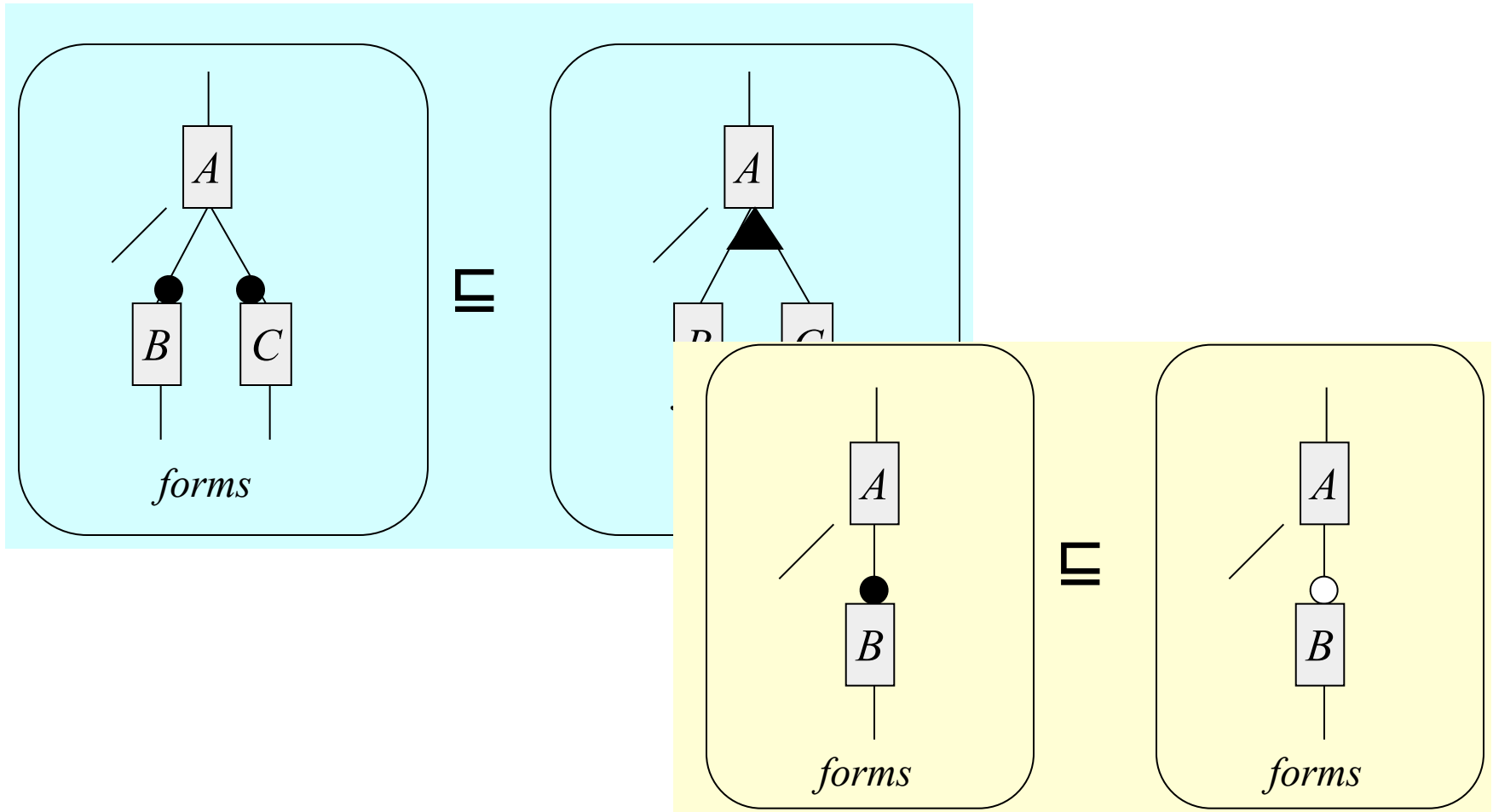
$$\mathit{semantics}(fm) = \{c:Config \mid \mathit{satConstraints}(fm,c)\}$$

$$fm \sqsubseteq ifm = \mathit{semantics}(fm) \subseteq \mathit{semantics}(ifm)$$

But no need to think about semantics directly: add alternative node

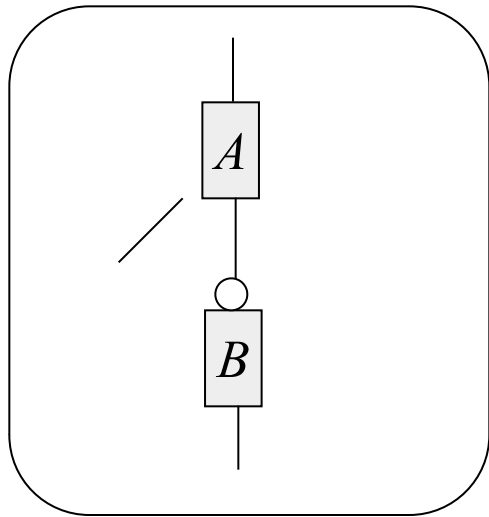


Refactoring catalog



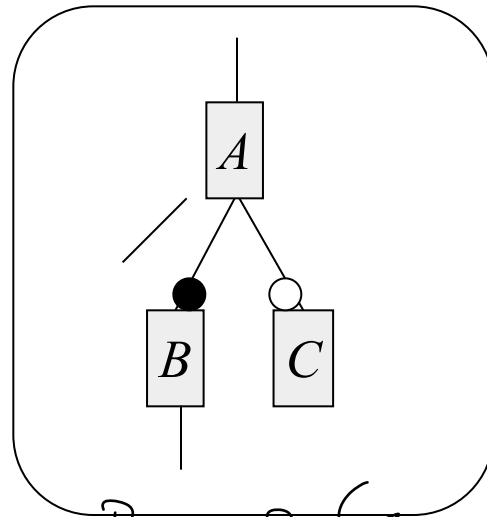
Refactoring populations and families: feature models

FM1



A
A, B

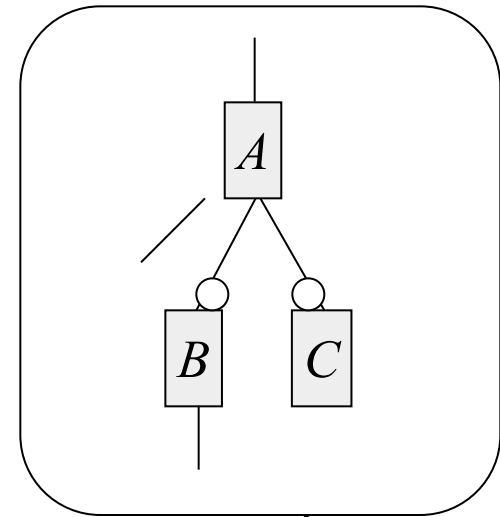
FM2



A, B A, B, C

\sqsubseteq

FM3

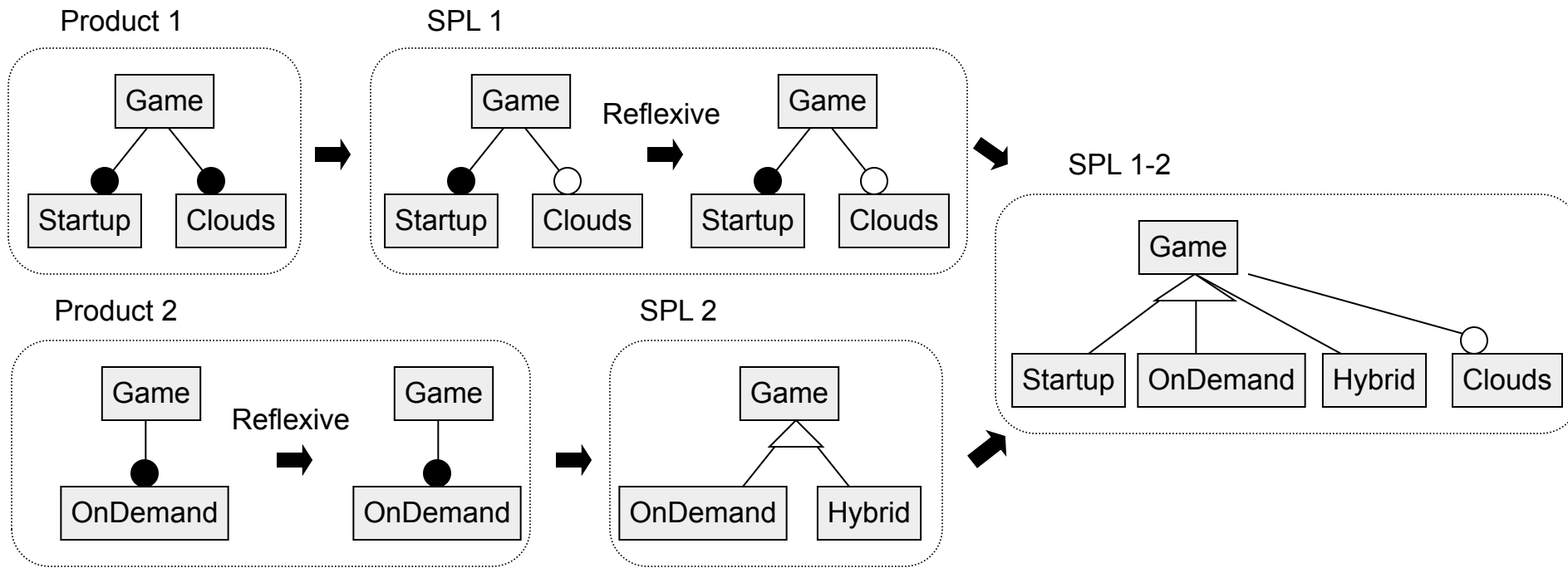


A
A, B C
A, B, C

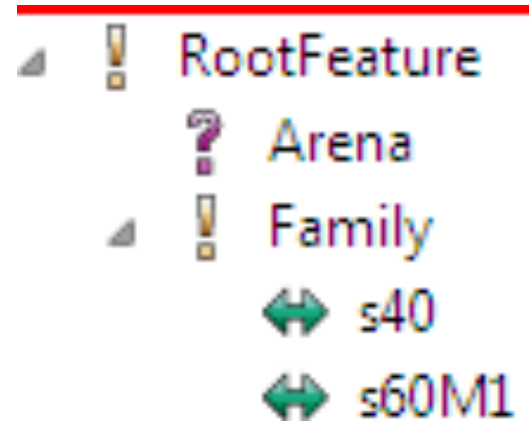
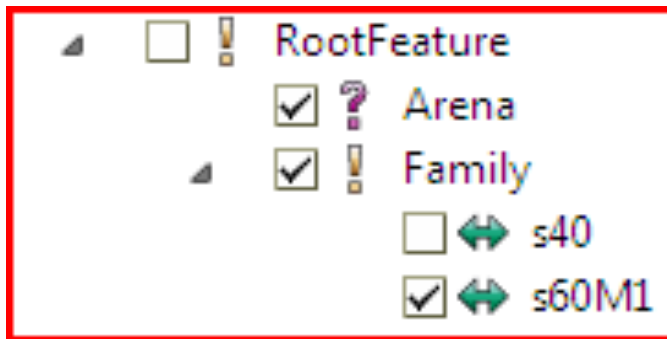
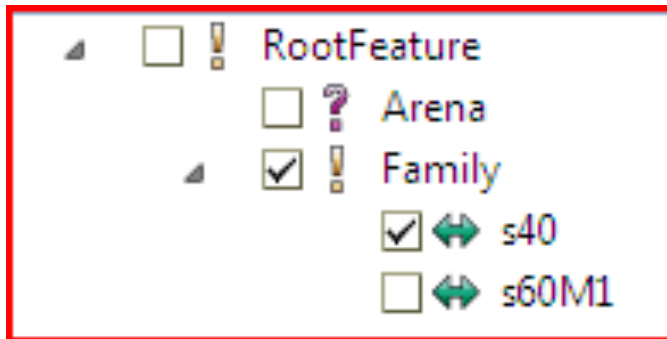
$$fm1 \sqsubseteq fm2 \sqsubseteq fm =$$

$$fm1 \sqsubseteq fm \wedge fm2 \sqsubseteq fm$$

Case study: feature model refactoring



Instance models define products



Feature model instantiation might be...

- Manual, defined by developers
- Automatic, inferred from context

Instance models as equations

$$p1 = \text{base} + s40 + \text{Screen}128 \times 128$$

$$p2 = \text{base} + \text{Arena} + s60M1 \\ + \text{Screen}128 \times 128$$

$$p3 = \text{base} + s60M1 + \text{Screen}128 \times 160$$

Doesn't work for
feature interaction

Configuration knowledge builds products

- BuildProperties
 - PropertiesFiles
 - ps:object: Properties
 - ps:fragment: S40
 - ps:fragment: S60M1
 - ps:fragment: Enable Aspects
 - VariationsRepository
 - ps:object: VariationsList
 - ps:fragment: com_meantime_j2me_gui_menu_Arena
 - ps:fragment: com_meantime_j2me_gui...
 - ps:object: MBSProperties
 - ps:fragment: ModelBuildSpecification
 - ps:object: AJProperties
 - ps:fragment: ActiveBuildSpecification
 - ps:fragment: ActiveBuildSpecificationA

Edit Source ps:fragment: com_meantime_j2me_gui_menu_Arena

Edit

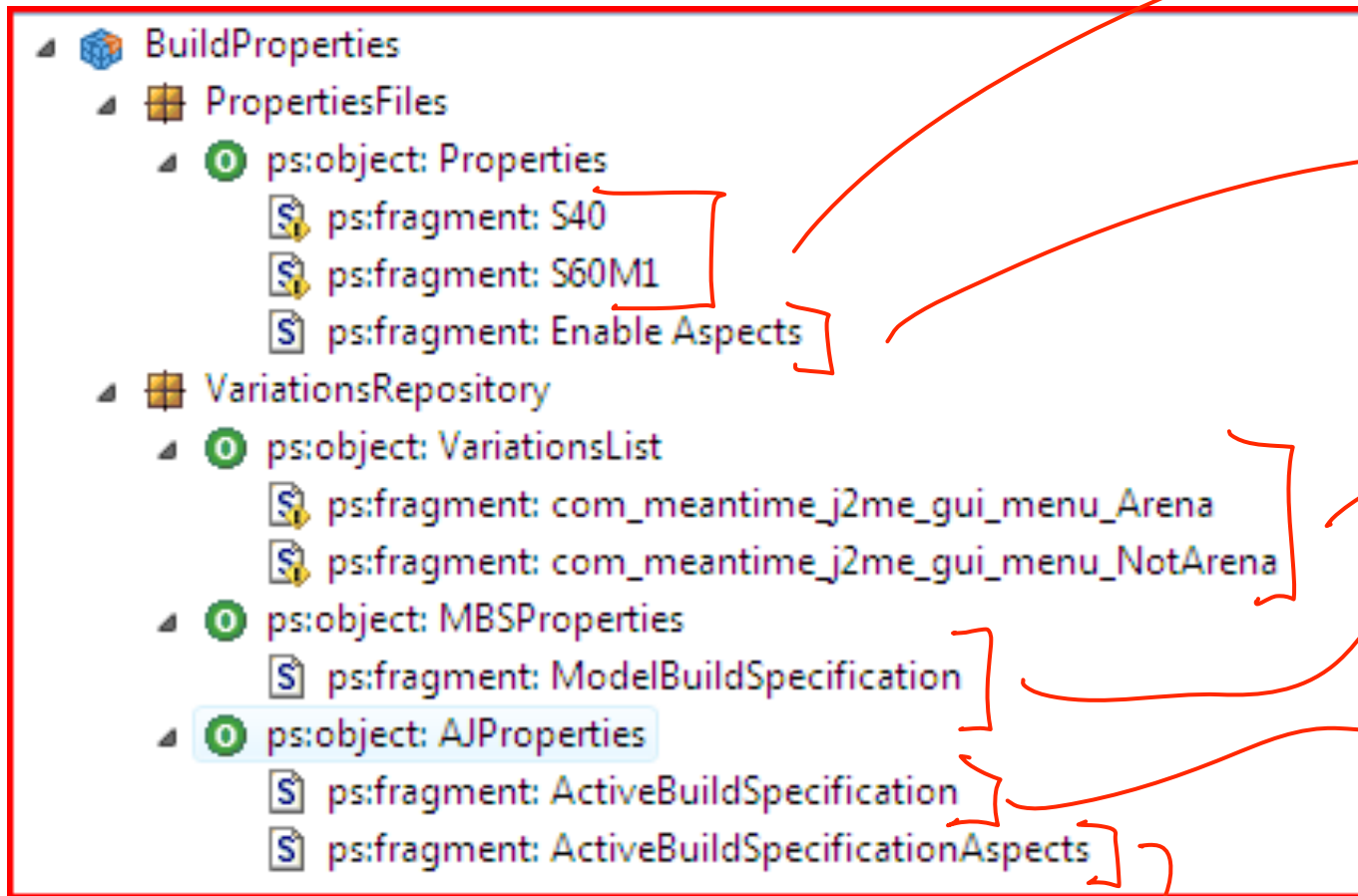
Edit Restrictions...

General Relations Attributes Restrictions Constraints

#	Restriction
1.	Arena

Add Remove Move up

In this case, property files...



properties header

properties end

ajlist

properties <<ajlist

ajproperties header

ajproperties <<ajlist

that are used to build products

```
ppsymbols = device_screen_128x128, device_keys_nokia, device_S40.properties

wtk.cldc.version = 1.0
wtk.midp.version = 1.0

obfuscator.options = -dontusemixedcaseclassnames -overloadago

midlet.icon.dir = res/icons/16x16
midlet.res = res/texts/${build.lang} res/levels res/sounds/ot
midlet.res.includes = lang*.txt *.ott *.bvg aS40.dat 1.dat

midlet.jad.entriesfile = build/properties/S40.jad.entries

wtk.emulator.device = Nokia_7210_MIDP_SDK_v1_0
aspects.enabled = true
aspects.compiler = abc
aspects.list = src/com/meantime/j2me/gui/menu/NotArena.aj \
```

S40.ajproperties

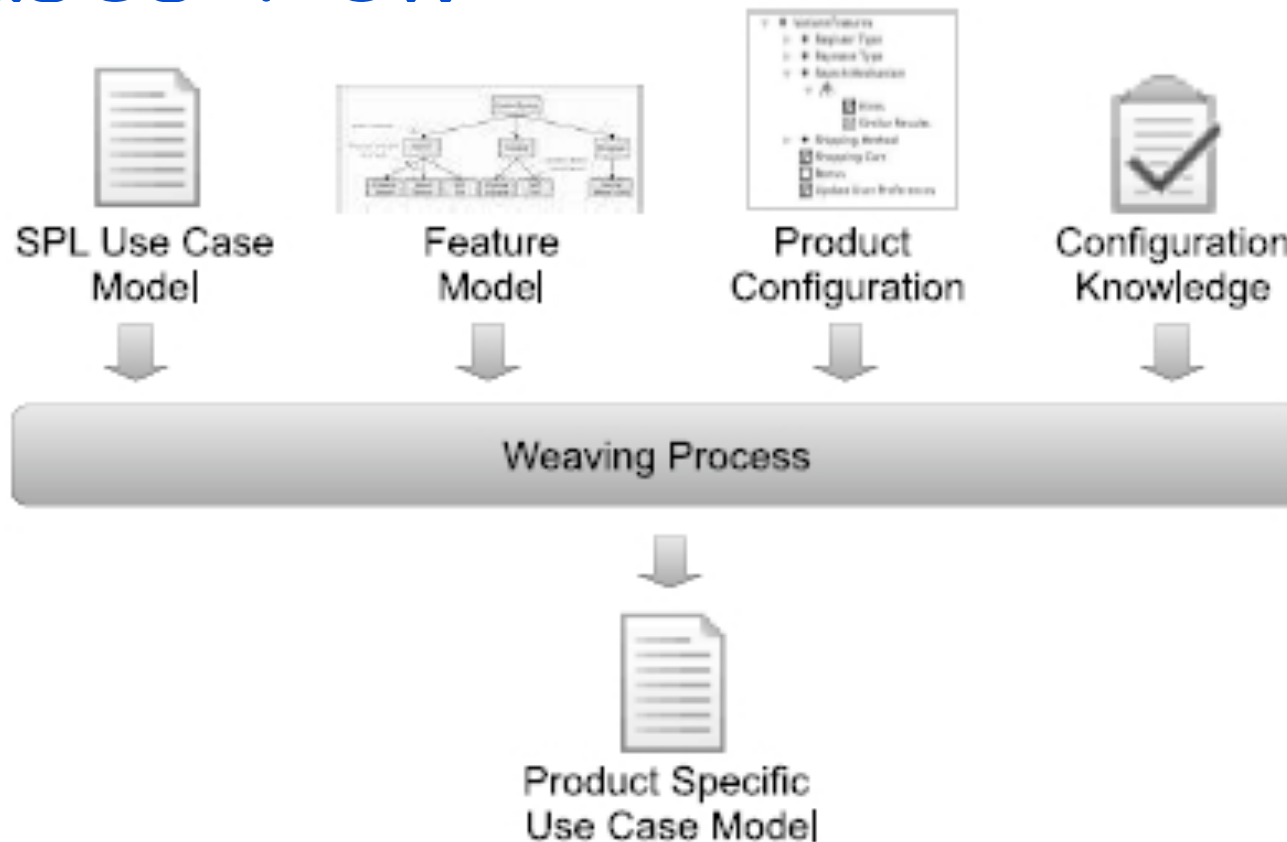
```
src.includes = src/
src.inclusionpatterns = src/*.java, \
src/com/meantime/j2me/gui/menu/NotArena.aj \
```

Configuration knowledge essentially is...

a mapping from feature expressions to core assets

Expression	Required Artifacts
eShop	Proceed to Purchase Search for Products ...
not (Cart and Bonus)	Buy a Product
Cart and Bonus	Buy Products with Cart
Update Preferences	Register user Preferences
...	...

Product generation, use cases view



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