SPL Refactoring

Leopoldo Motta Teixeira

Advisor: Paulo Borba
Co-Advisor: Rohit Gheyi

CAPES

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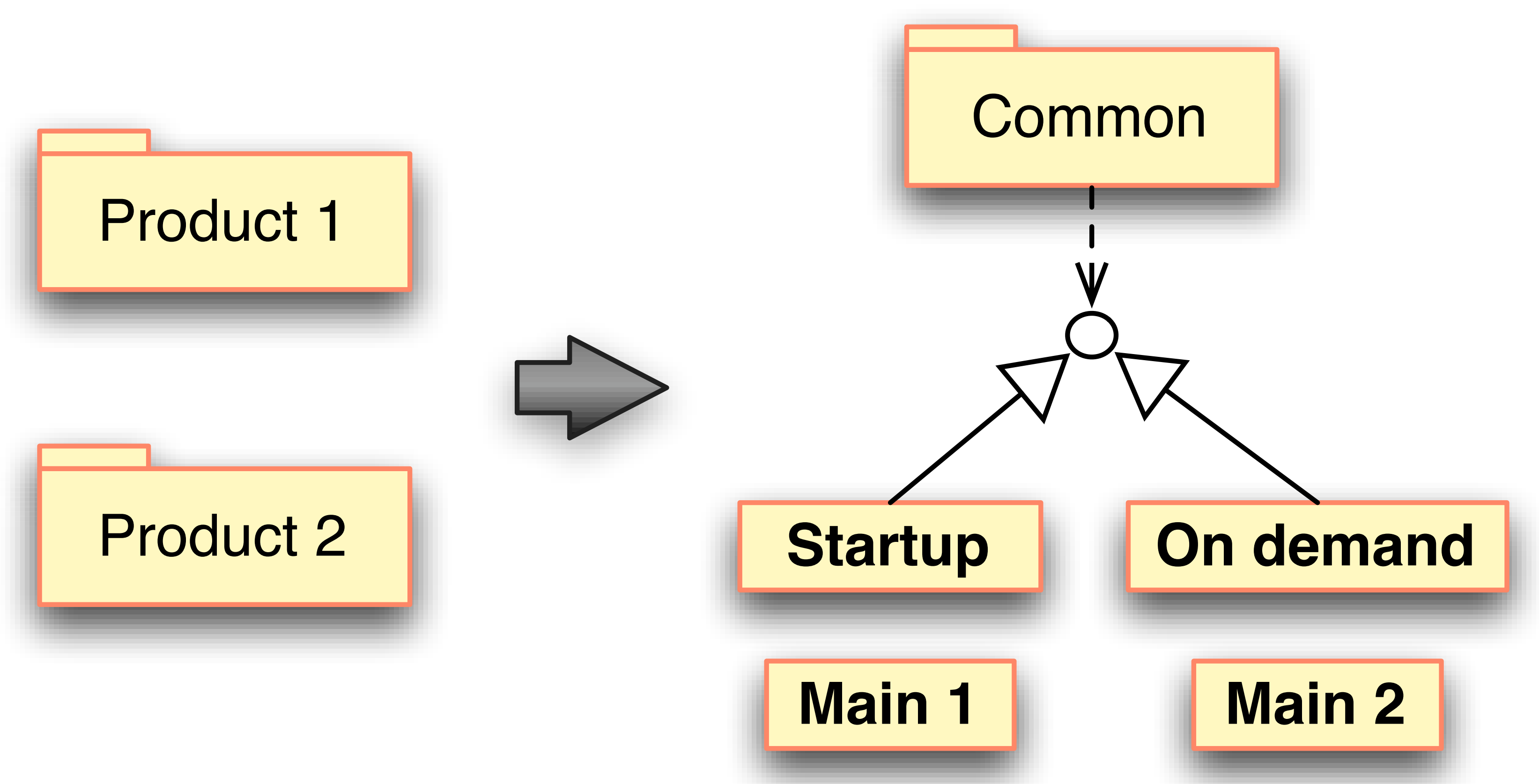
PL Bootstrapping



Manual extraction...

- tedious
- risky
- compromises promised benefits on other dimensions of cost and risk

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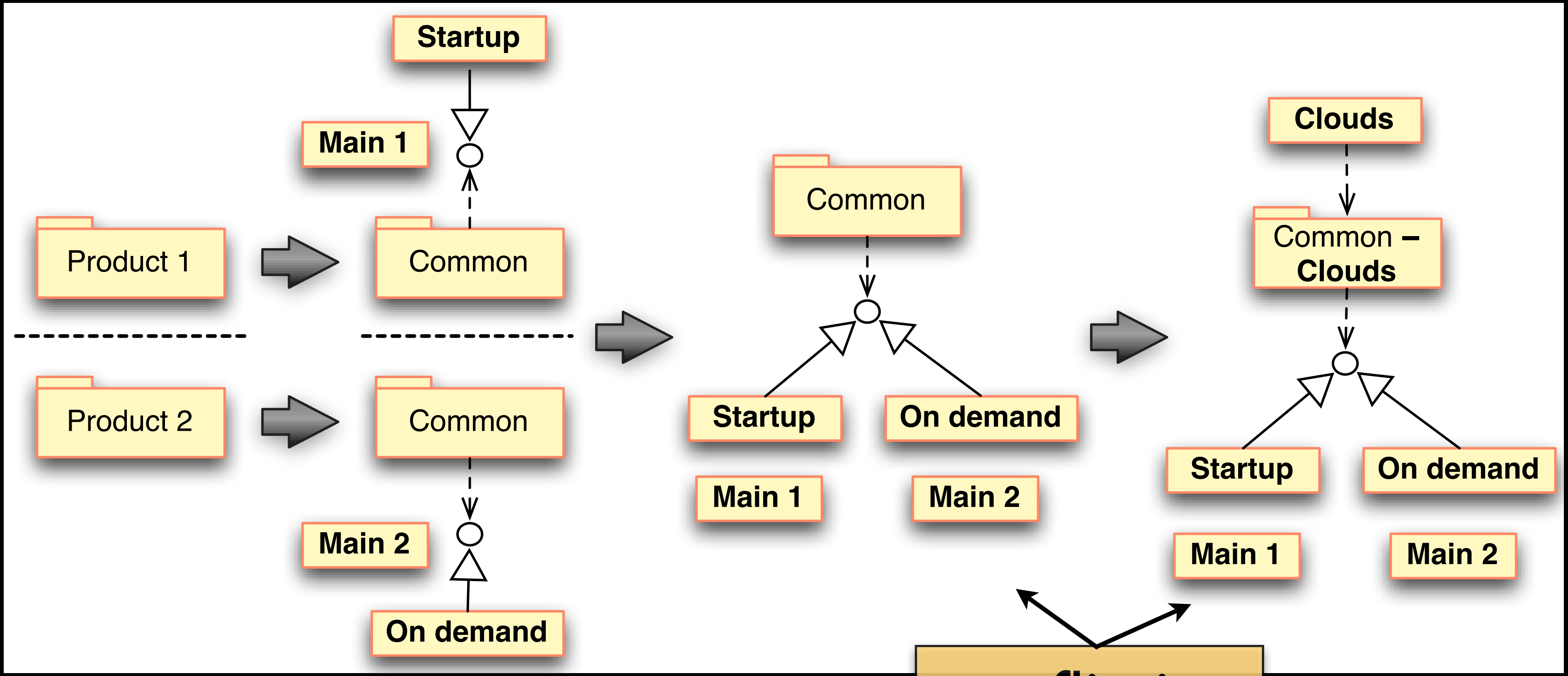
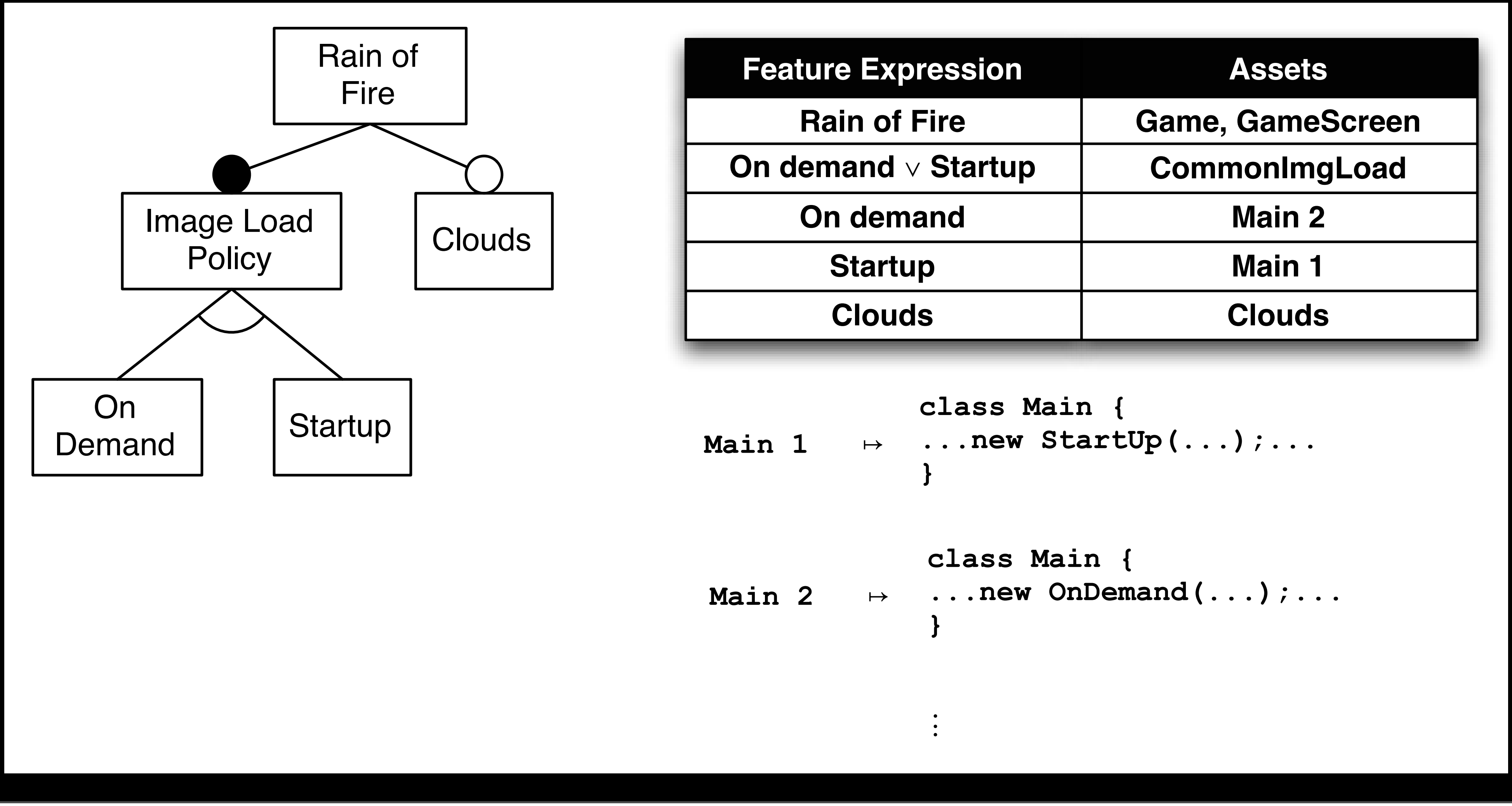
PL extraction and evolution can benefit from refactorings...

Program refactoring is not enough!



conflicting assets

and does not deal with specific PL artifacts



Feature Expression	Assets
Rain of Fire	Game, GameScreen
On demand ∨ Startup	CommonImgLoad
On demand	Main 2
Startup	Main 1
Clouds	Clouds

```
                 class Main {
Main 1     ↦     ...new StartUp(...);...
                 }


                 class Main {
Main 2     ↦     ...new OnDemand(...);...
                 }


                 ⋮
```

So, we need PL refactoring...

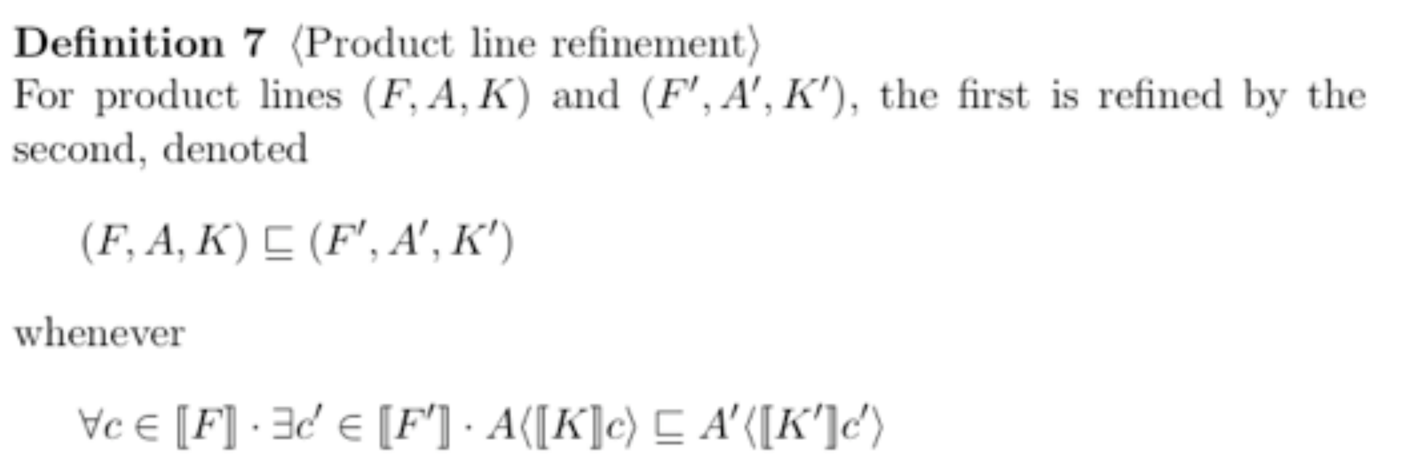
- notion
- templates (catalogue)
- checkers

PL refactorings

behavior-preserving
source-FM-CK
transformations that
improve some quality factors

A General Theory of SPL Refinement

- Independent of FM-CK-AM languages
- Properties that justify stepwise and compositional SPL development and evolution
- Formalized and proved sound using PVS



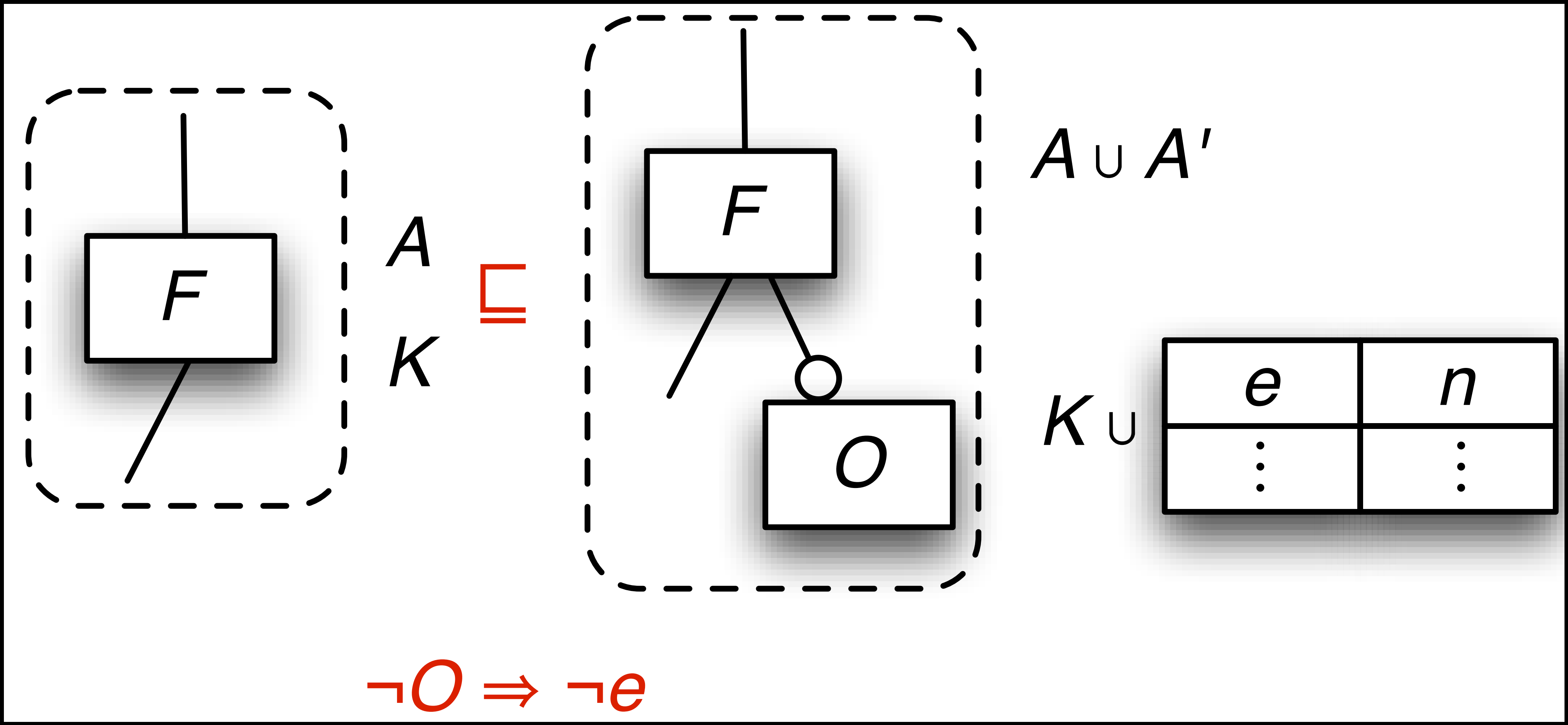
Definition 7 ⟨Product line refinement⟩
For product lines (F, A, K) and (F', A', K'), the first is refined by the second, denoted

$$(F, A, K) \sqsubseteq (F', A', K')$$

whenever

$$\forall c \in [\![F]\!] \cdot \exists c' \in [\![F']\!] \cdot A\langle [\![K]\!] c \rangle \sqsubseteq A' \langle [\![K']\!] c' \rangle$$

Applications: laws



A

K

$\sqsubseteq$

$A \cup A'$

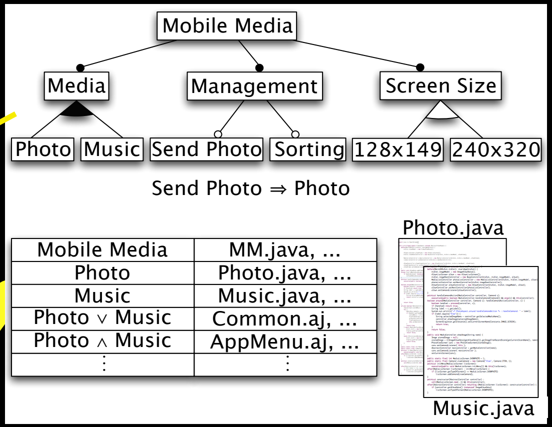
$K \cup$

e	n
⋮	⋮

$\neg O \Rightarrow \neg e$

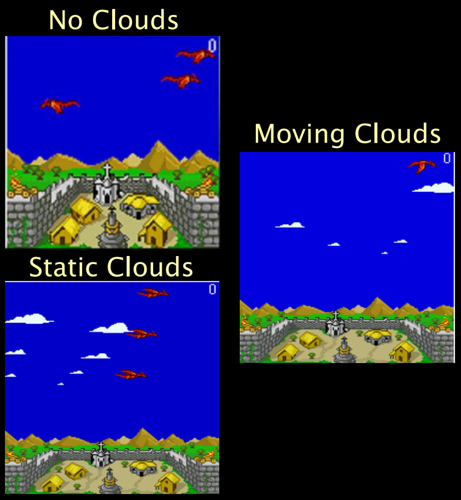
Automatic PL refinement checking

FM and CK equivalence checking



Send Photo ⇒ Photo

Mobile Media	MM.java, ...
Photo	Photo.java, ...
Music	Music.java, ...
Photo ∨ Music	Common.aj, ...
Photo ∧ Music	AppMenu.aj, ...
⋮	⋮



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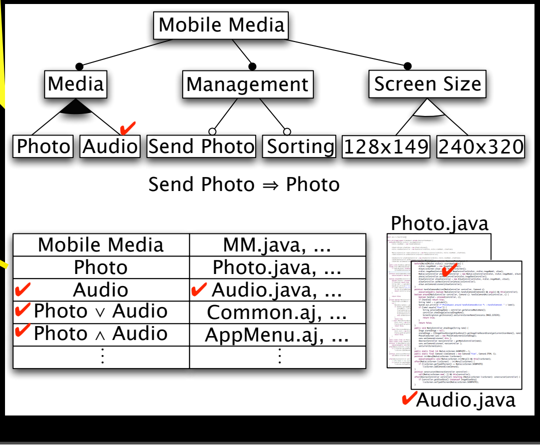

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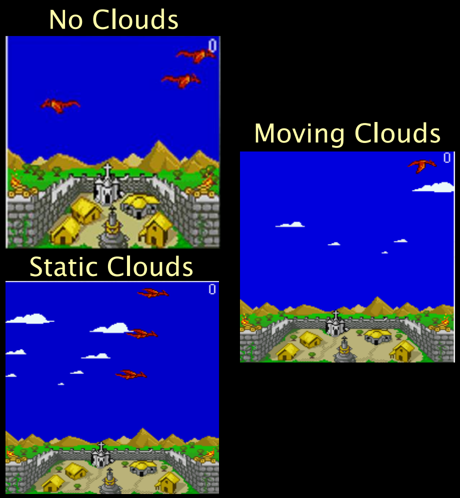
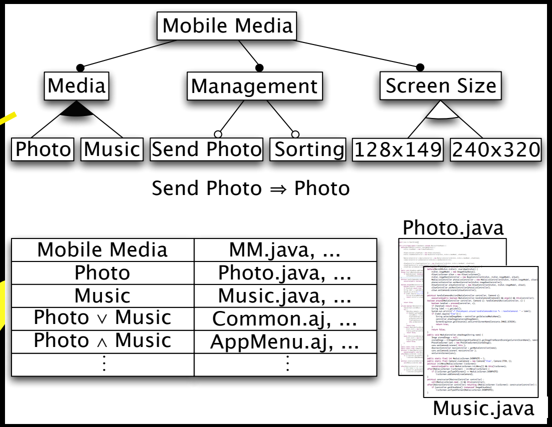


PL refinement approximation

testing individual assets



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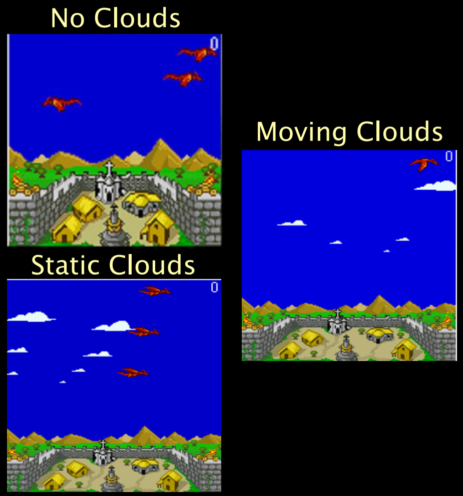
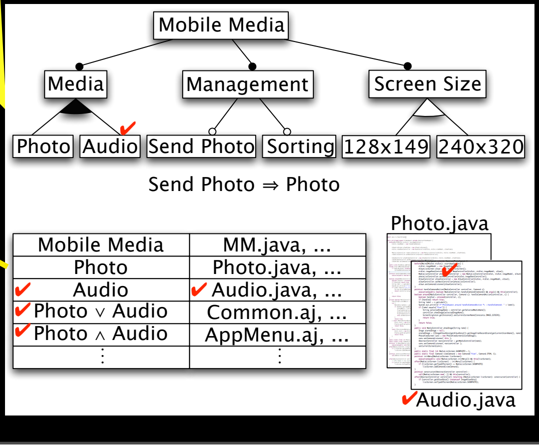


$\sqsubseteq$ $\sqsubseteq$



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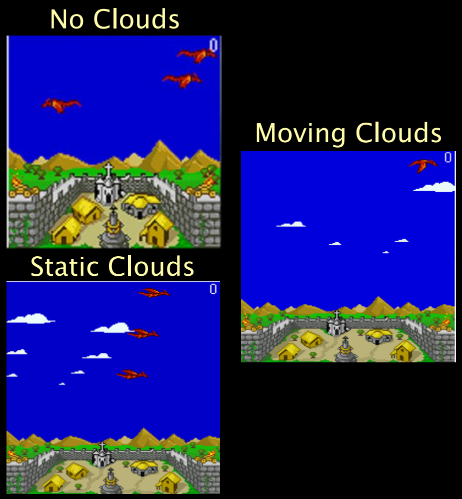

Ongoing Work

- Analysis of refactorings performed on TaRGeT SPL
    - 23 SPL refactorings identified
    - 8 of them analyzed until now
        - Average of 12 classes modified
        - 2 refactorings performed incorrectly
- Derivation of some refactoring templates

Possibilities

- Exercise different languages for FM-CK-Source with the theory
  - GenArch, CrossMDA...
- Validate the proposed templates by analyzing modifications in other SPLs
- Automate the proposed refactorings in the context of a development tool

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