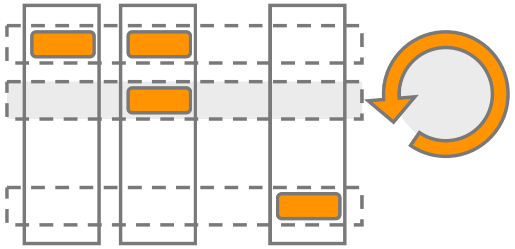
Foundations of Aspect-Oriented Languages (FOAL)
Modularity 2015



Recent Developments in Context-oriented Programming
(at HPI)

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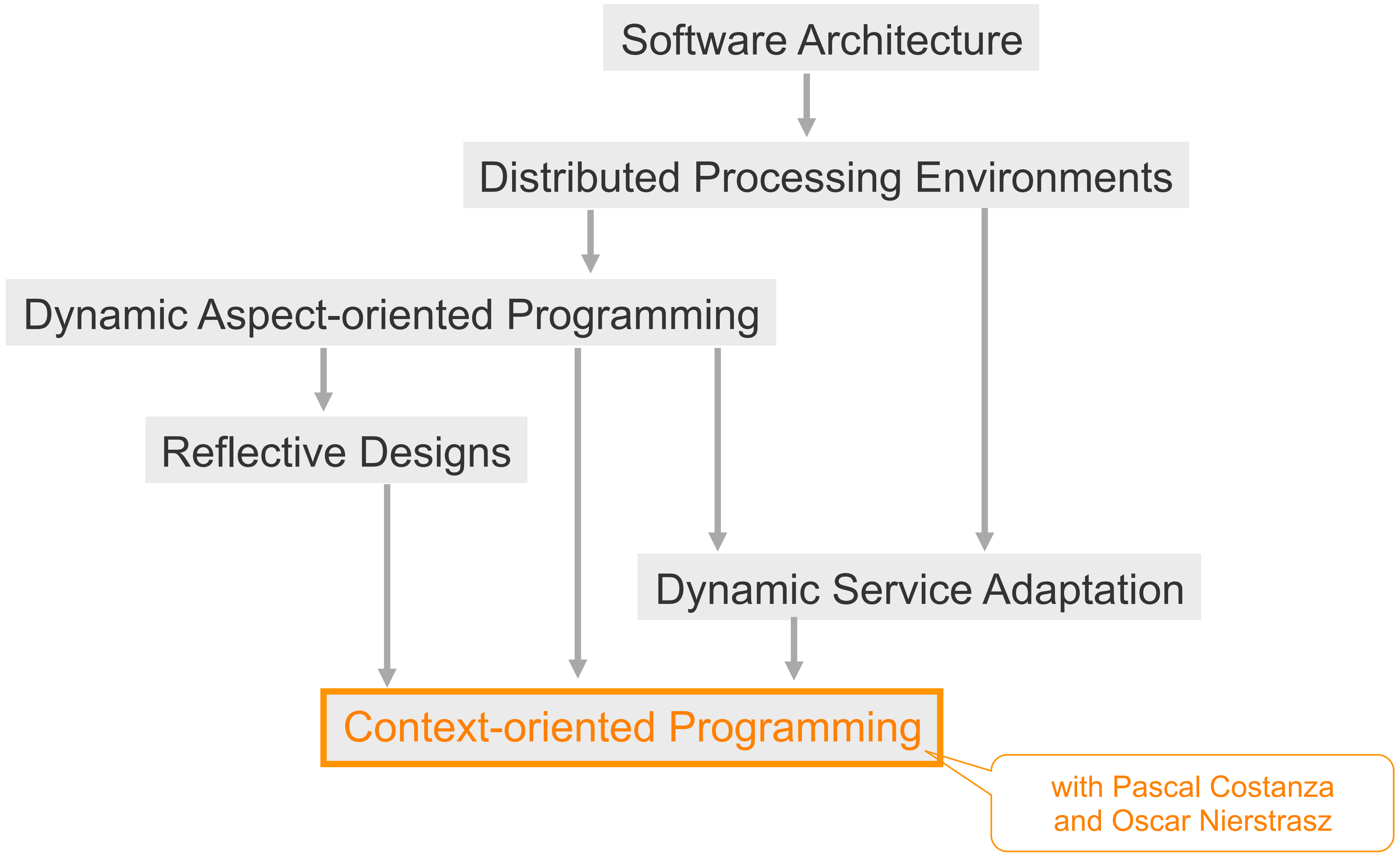
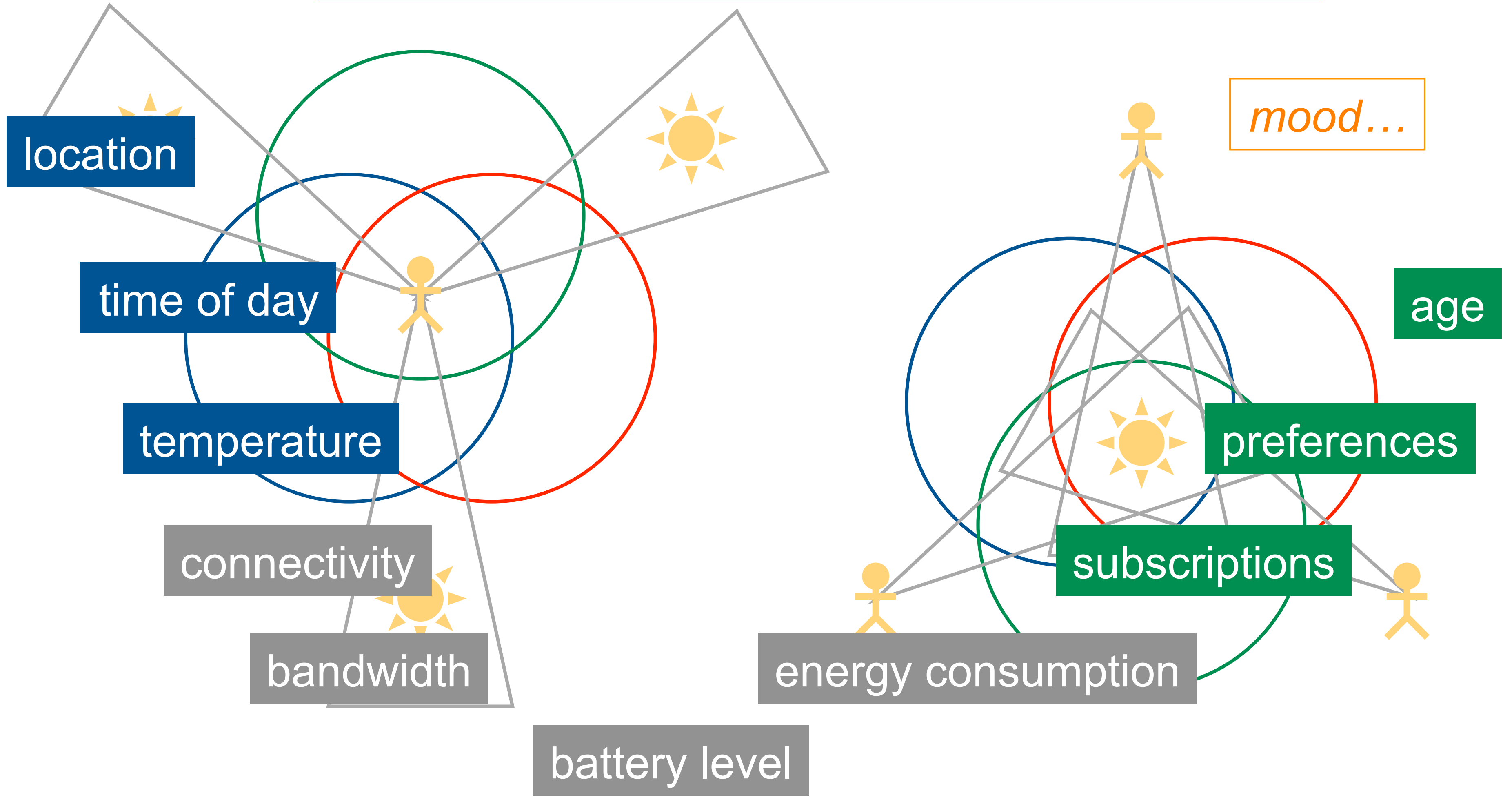
2015-03-16

Some History…

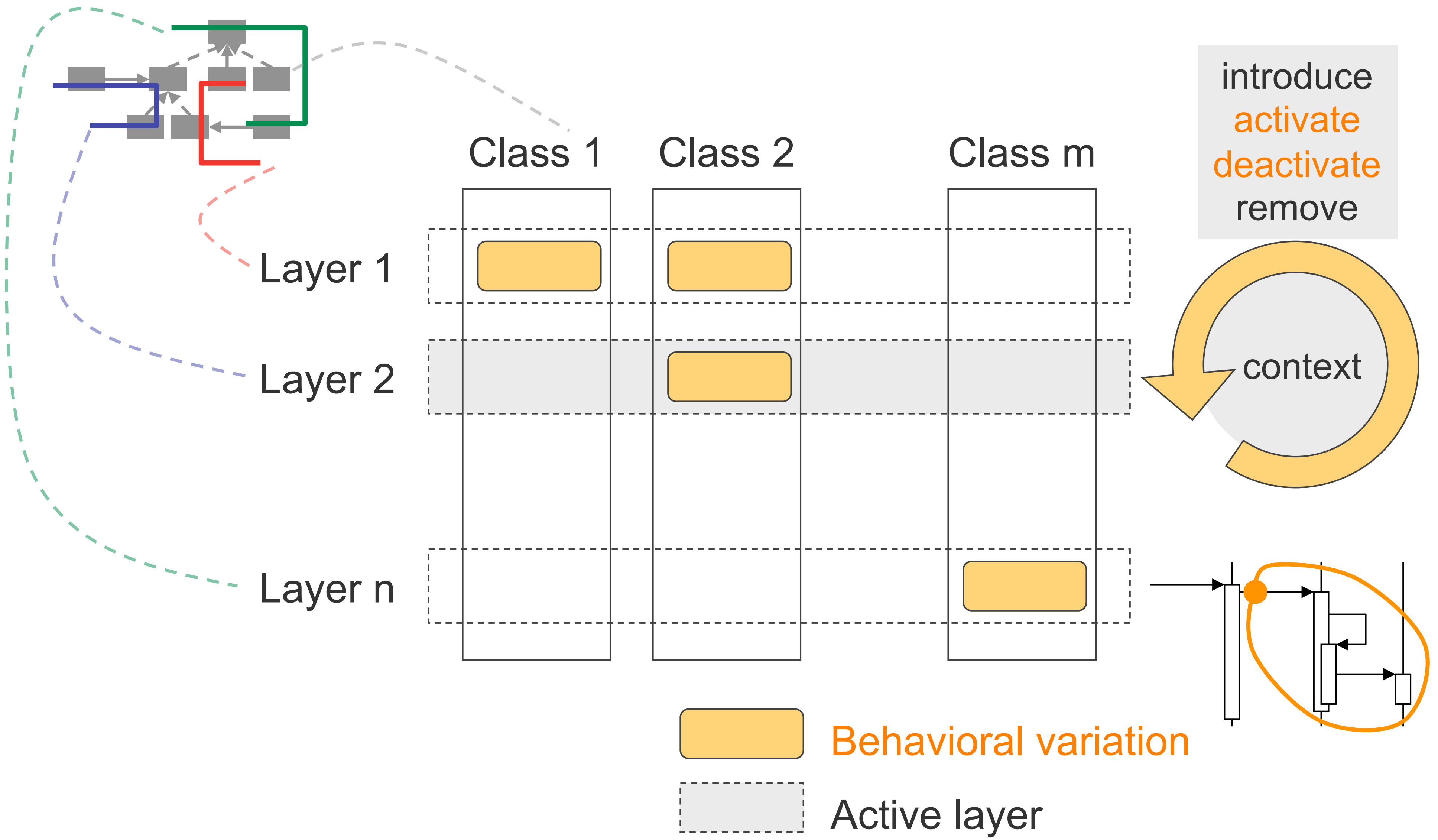

Software Architecture
Distributed Processing Environments
Dynamic Aspect-oriented Programming
Reflective Designs
Dynamic Service Adaptation
Context-oriented Programming
with Pascal Costanza and Oscar Nierstrasz

Context

context = everything computationally accessible



COP Basics Overview

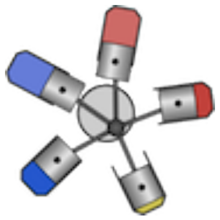
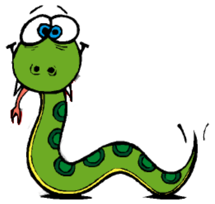


AOP, FOP, and COP

	AOP	FOP	COP
Inverse dependencies	●		
1:n relationships	●		
Layers		●	●
Dynamic activation			●
Scoping	●		●

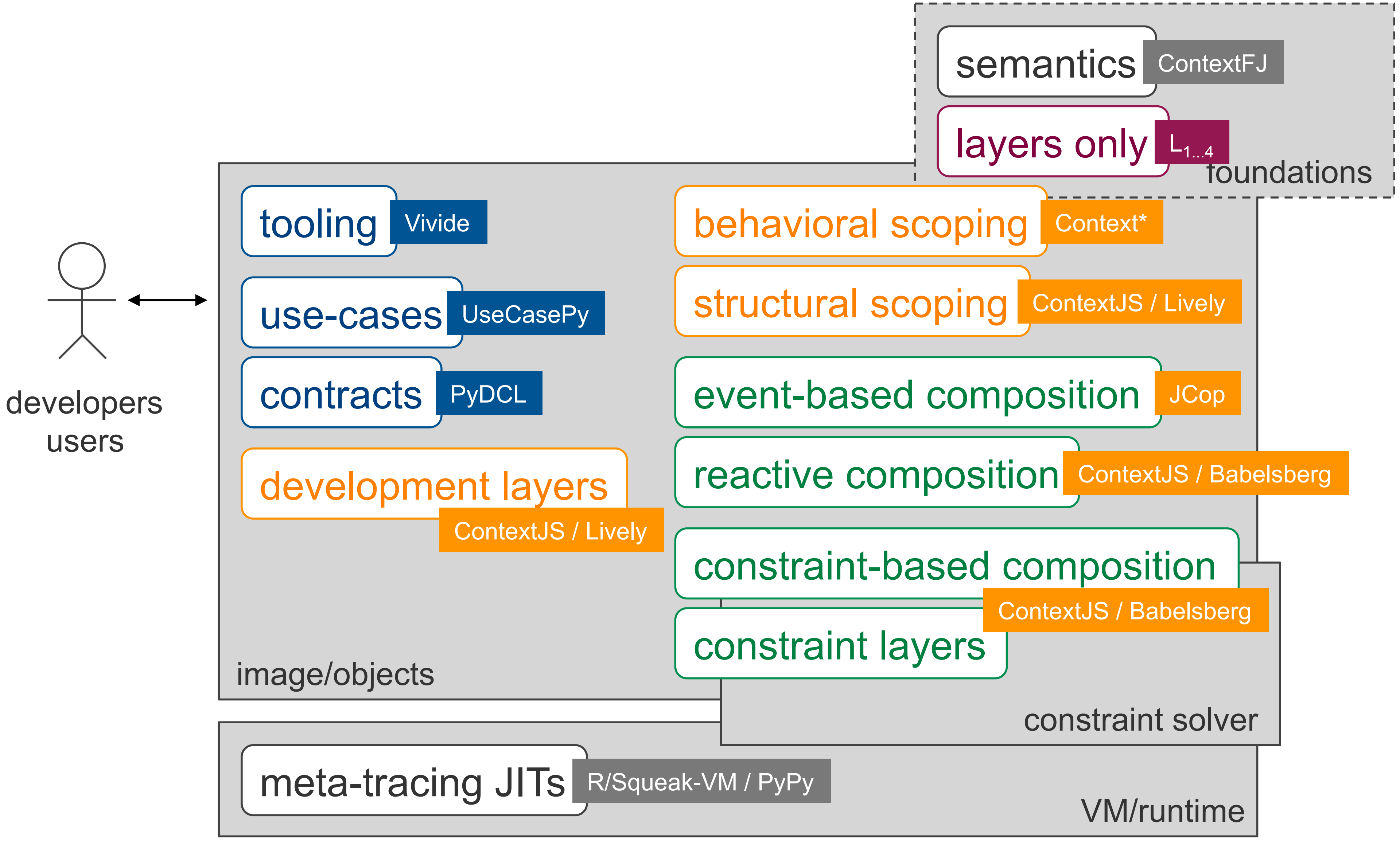
COP Extensions (Some…)

- ContextS
- ContextS2
- ContextJS
- JCop (ContextJ)
- ContextPy
- PyDCL
- UseCasePy
- PyContext
- ContextR
- ContextG
- ContextAmber
- $L_{1\ldots4}$

- ContextL
- ContextScheme
- ContextJ*
- ContextErlang
- EventCJ
- Lambic
- Ambience
- COP.JS
- delMDSCO/cj
- Phenomenal Gem
- Subjective-C
- Context Petri Nets

Recent COP Developments at HPI



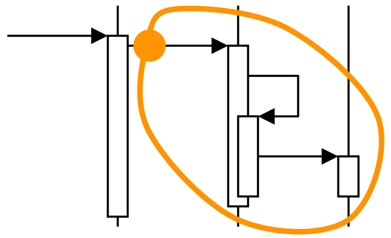
Behavioral Variations

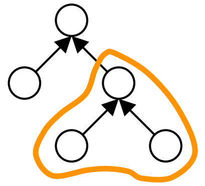
- Behavioral (dynamic) scoping
  - Dynamic extent of execution
  - Almost all COP extensions
- Structural (topological) scoping
  - ContextJS
  - Development layers
- Open implementation for scoping strategies
  - Allows for domain-specific scoping
  - Mainly applied to UI framework structures
    - Lively: Morphic
    - Webwerkstatt : Parts

behavioral scoping Context*

structural scoping ContextJS / Lively

development layers ContextJS / Lively





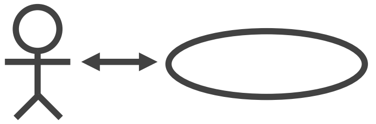
Development Support

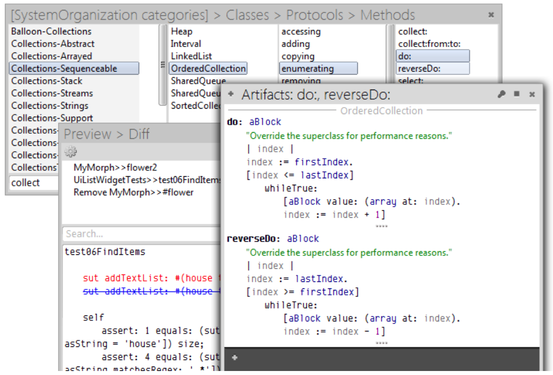
- More applied → more useful
- In PL work tool support often neglected
  - Usually too expensive, especially early…
    → Need for explorative tool building support
    - Vivide
- Crosscutting nature of layers lends itself nicely to crosscutting software engineering concerns
  - Explicit use-cases representation
    - UseCasePy
  - Dynamic contract layers
    - PyDCL

tooling Vivide

use-cases UseCasePy

contracts PyDCL





MyMorph>>flower2
UiListWidgetTests>>test06FindItem
Remove MyMorph>>#flower

```
test06FindItems

   sut addTextList: #(house
   ~~sut addTextList: #(house~~

   self
      assert: 1 equals: (sut
asString = 'house']) size;
      assert: 4 equals: (sut
```

```
do: aBlock
   "Override the superclass for performance reasons."
   | index |
   index := firstIndex.
   [index <= lastIndex]
      whileTrue:
         [aBlock value: (array at: index).
         index := index + 1]

reverseDo: aBlock
   "Override the superclass for performance reasons."
   | index |
   index := lastIndex.
   [index >= firstIndex]
      whileTrue:
         [aBlock value: (array at: index).
         index := index - 1]
```

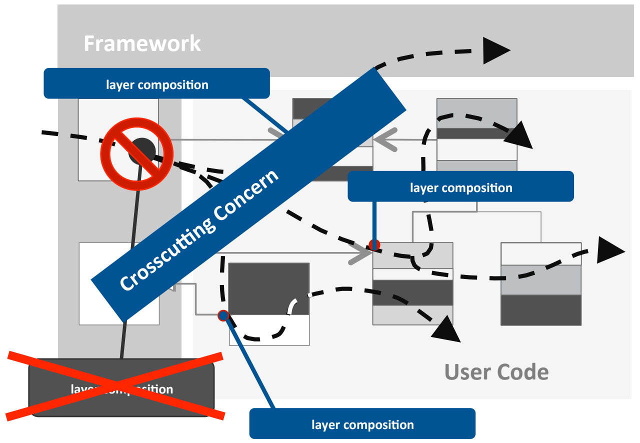
Reactive Approaches

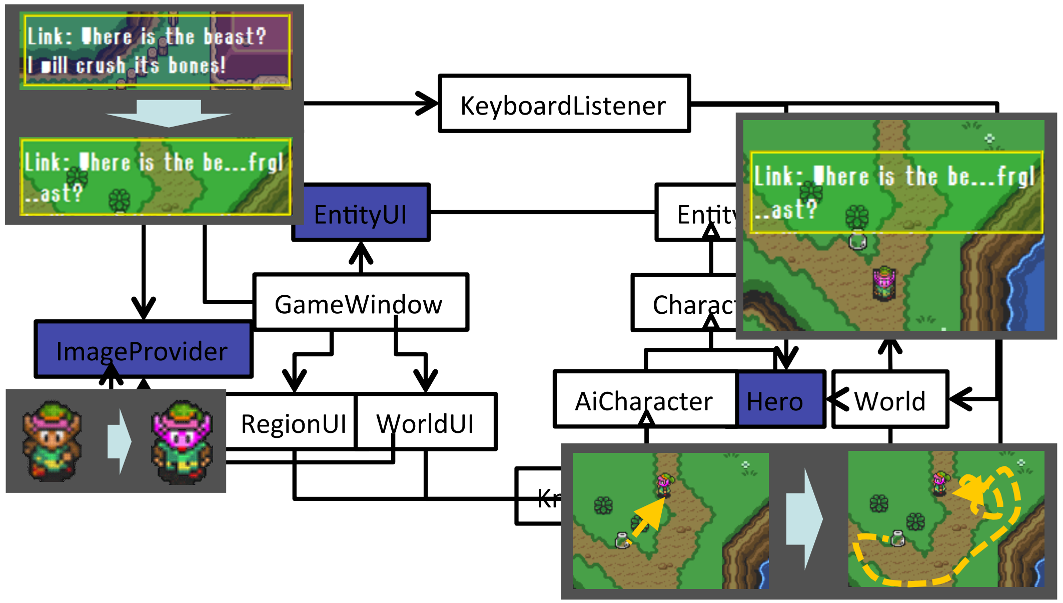
event-based composition — JCop

reactive composition — ContextJS / Babelsberg

constraint-based composition — ContextJS / Babelsberg

constraint layers




Link: Where is the beast? I will crush its bones!
Link: Where is the be...frgl ..ast?
KeyboardListener
EntityUI
Entity
GameWindow
Charac
ImageProvider
RegionUI
WorldUI
AiCharacter
Hero
World
Link: Where is the be...frgl ..ast?

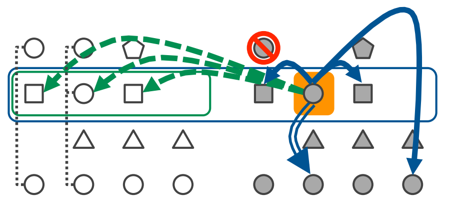
Foundations

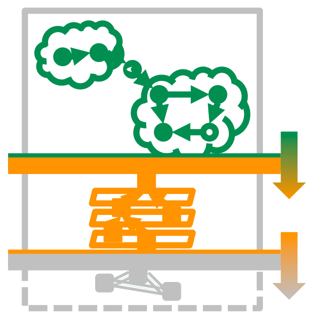
semantics ContextFJ

layers only $L_{1...4}$

meta-tracing JITs R/Squeak-VM / PyPy

- Semantics and types
  - ContextFJ
- Symmetry
  - No classes, only layers
  - No base system
    - $L_{1..4}$
- Sideways composition very expensive
  - Runtime support for optimizations
  - Meta-tracing JITs
    - R/Squeak-VM
  - Higher performance → more (meta-level) flexibility





$$\frac{PT(\mathtt{m},\mathtt{C},\mathtt{L}_0)\text{ undefined} \qquad mbody(\mathtt{m},\mathtt{C},\overline{\mathtt{L}}',\overline{\mathtt{L}}) = \overline{\mathtt{x}}.\mathtt{e}\ \mathtt{in}\ \mathtt{D},\overline{\mathtt{L}}''}{mbody(\mathtt{m},\mathtt{C},(\overline{\mathtt{L}}';\mathtt{L}_0),\overline{\mathtt{L}}) = \overline{\mathtt{x}}.\mathtt{e}\ \mathtt{in}\ \mathtt{D},\overline{\mathtt{L}}''}$$

Acknowledgements

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