

Leveraging Software Product Lines Engineering in the construction of Families of Domain-Specific Languages

David Méndez-Acuña

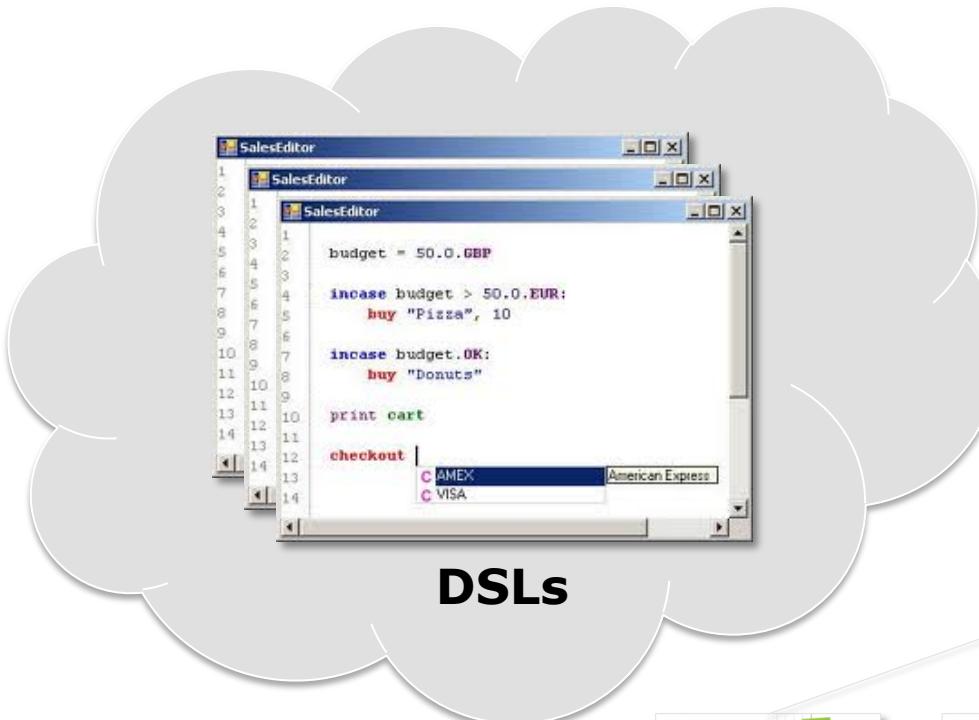
Benoît Combemale (Co-Advisor)
Benoît Baudry (Co-Advisor)



Research context

Research Context

Domain-Specific Languages and Multi-Companies



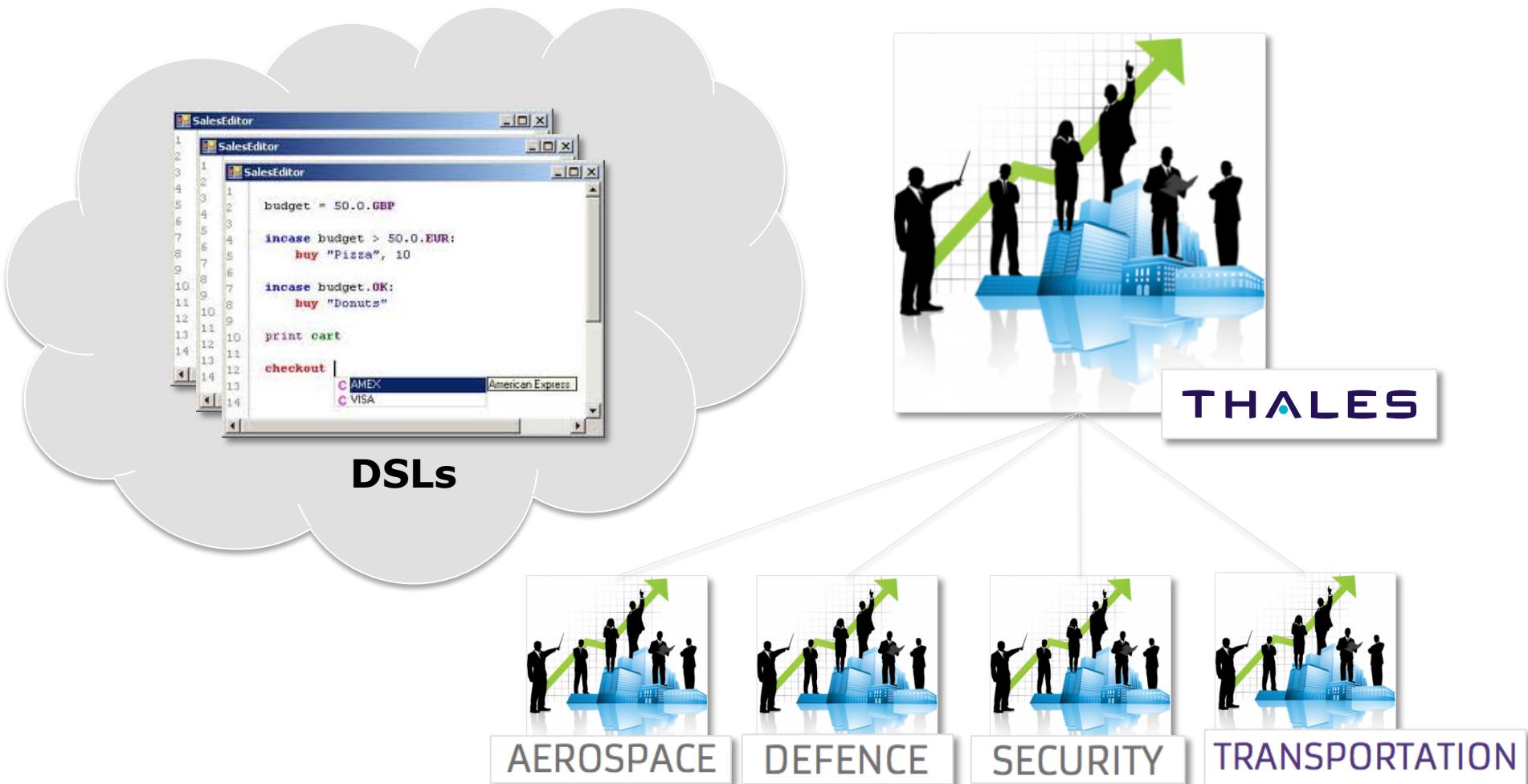
```
1 budget = 50.0.GBP
2
3 incase budget > 50.0.EUR;
4   buy "Pizza", 10
5
6 incase budget.OK:
7   buy "Donuts"
8
9 print cart
10
11 checkout |
12   C AMEX American Express
13   C VISA
```

DSLs



Research Context

Domain-Specific Languages and Multi-Companies

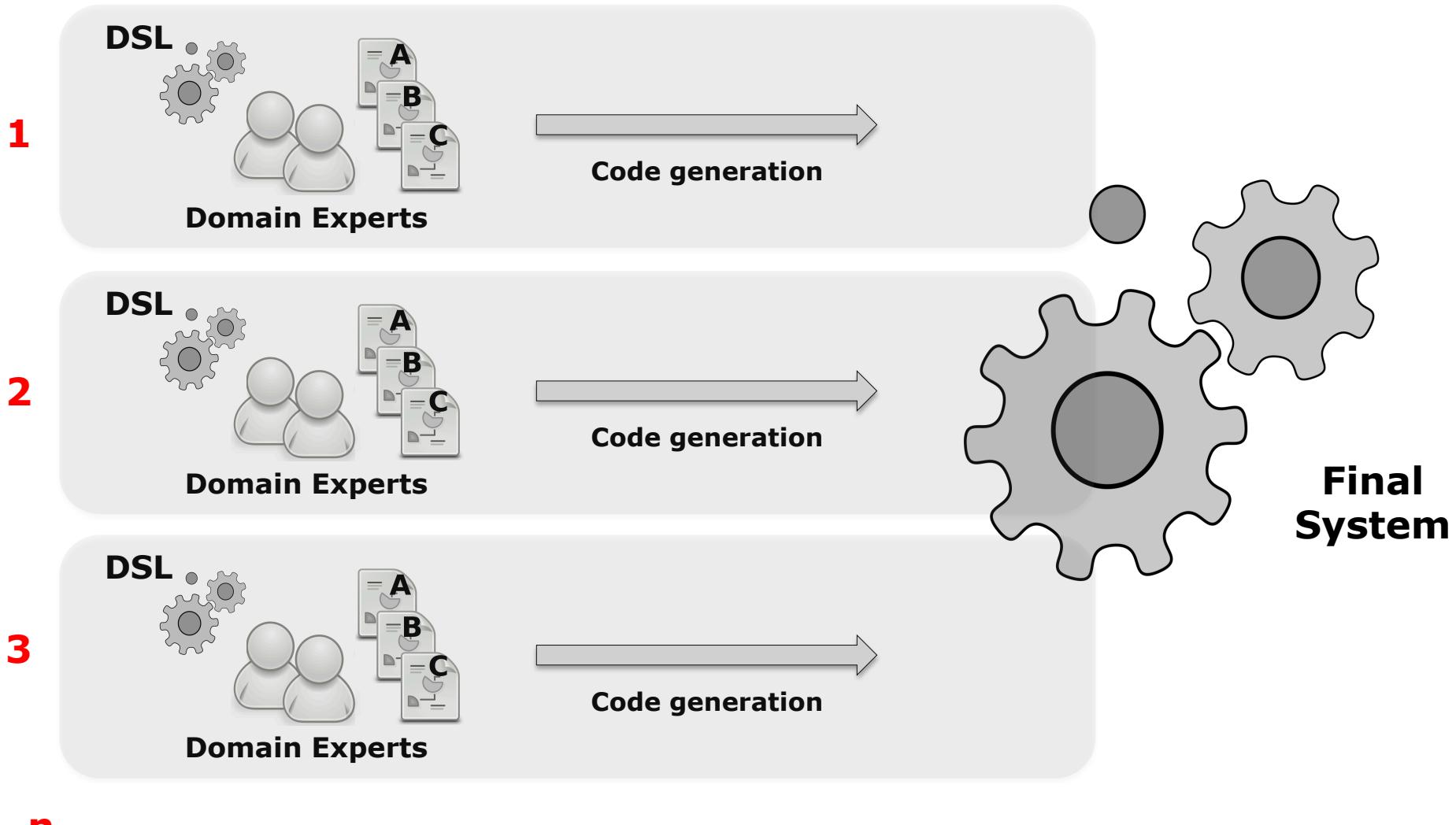


"From aerospace, space and defense to security and transportation, Thales helps its customers to create a safer world by giving them the tools they need to perform critical tasks."

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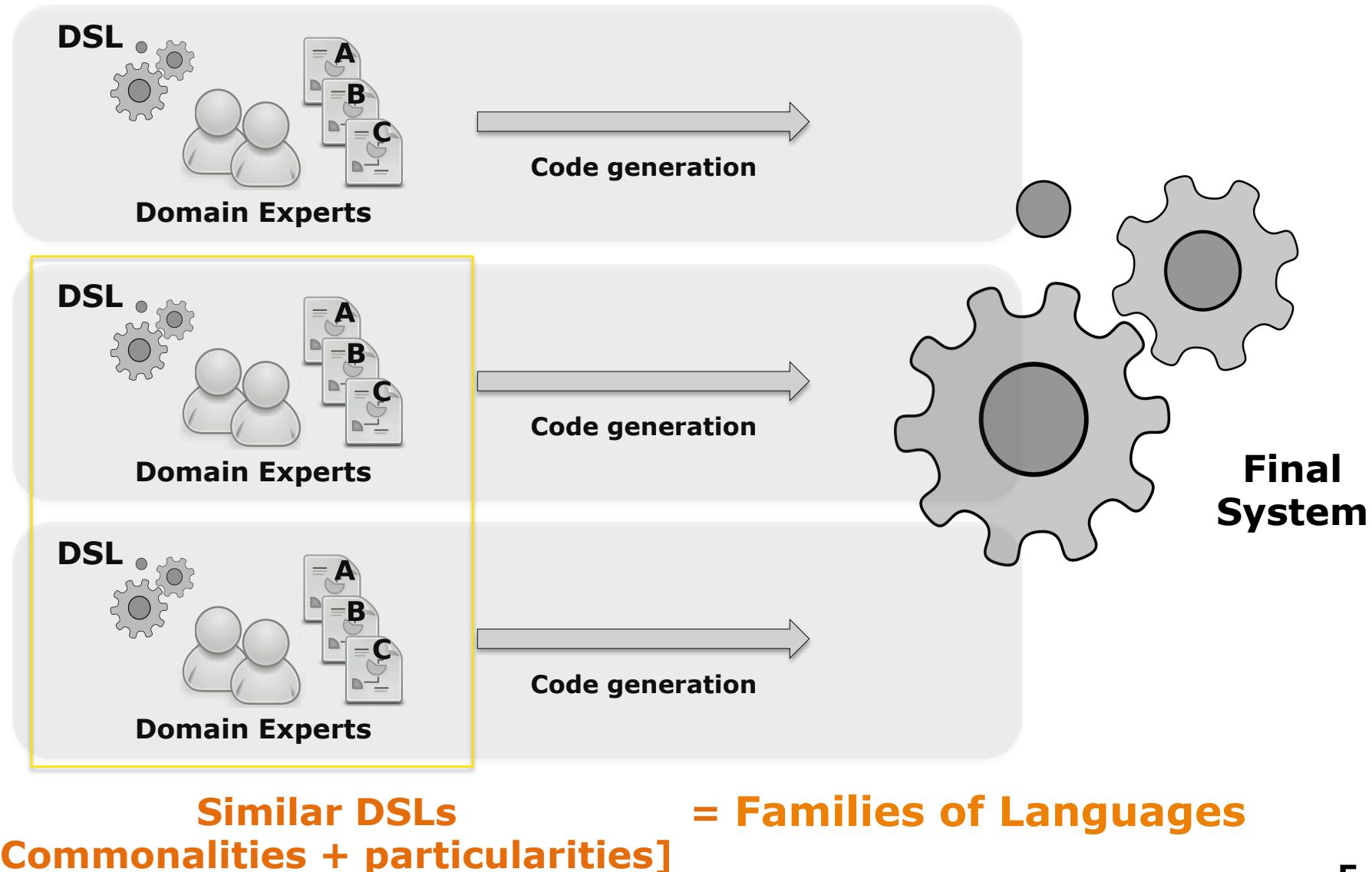
Research Context

Observations [1]



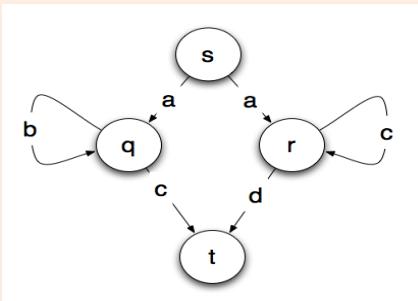
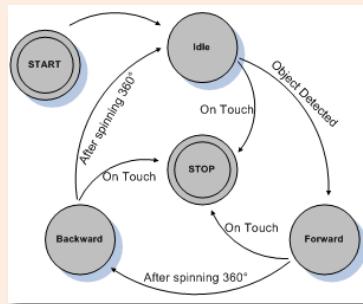
Research Context

Observations [2]



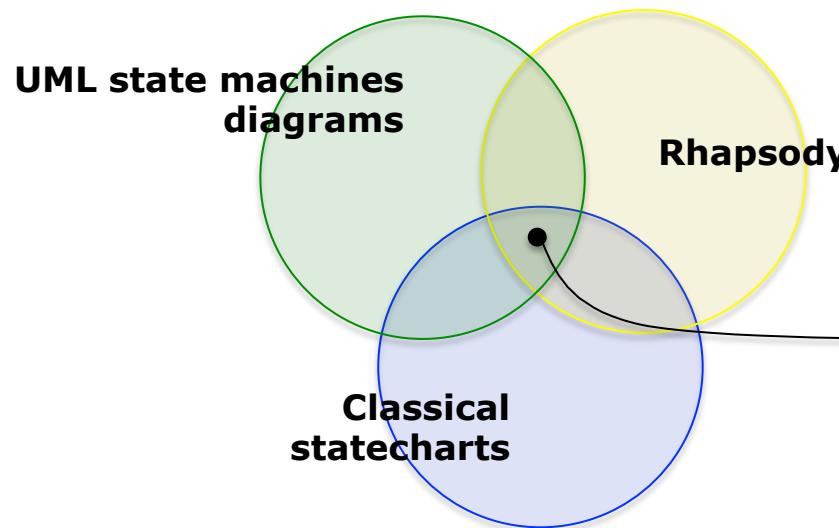
Research Context

Observations [3]



Research Context

Family of Languages for Finite State Machines

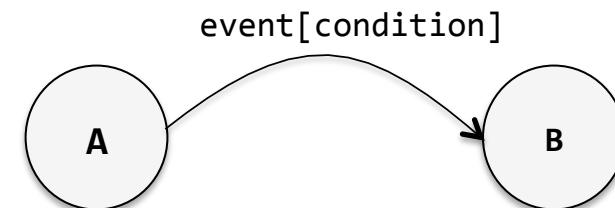


Academic example:

Crane, M., Dingel, J., ***UML vs. classical vs. Rhapsody statecharts: not all models are created equal.***
 Software & Systems Modeling. Vol. 6 No. 4. Springer-Verlag 2007.

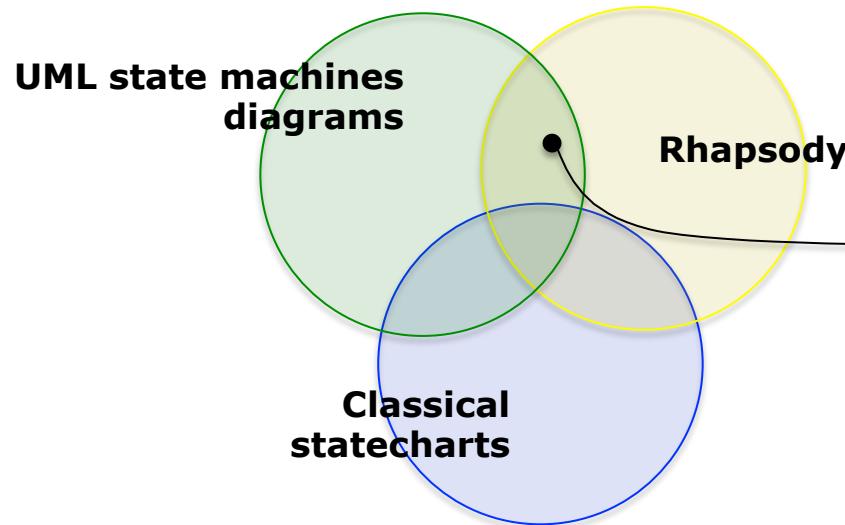
THALES

States and simple transitions (triggers, conditions, etc.)



Research Context

Family of Languages for Finite State Machines

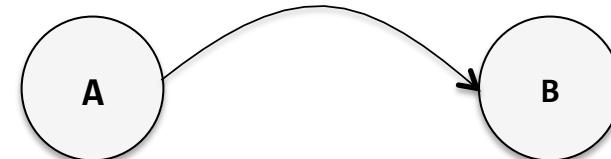


THALES

Academic example:

Crane, M., Dingel, J., **UML vs. classical vs. Rhapsody statecharts: not all models are created equal.**
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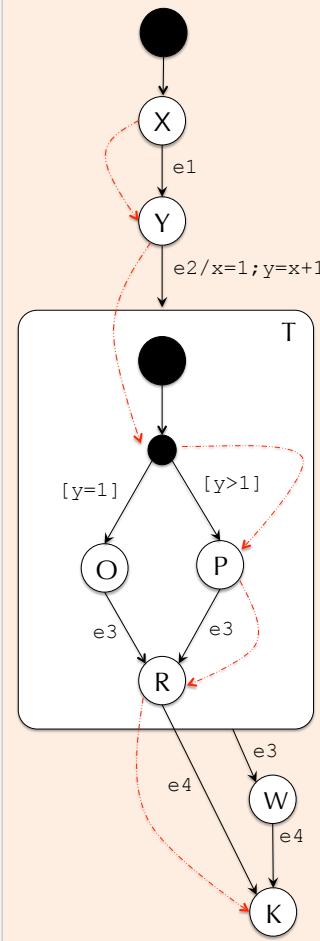
`event[condition] : time(ms)`



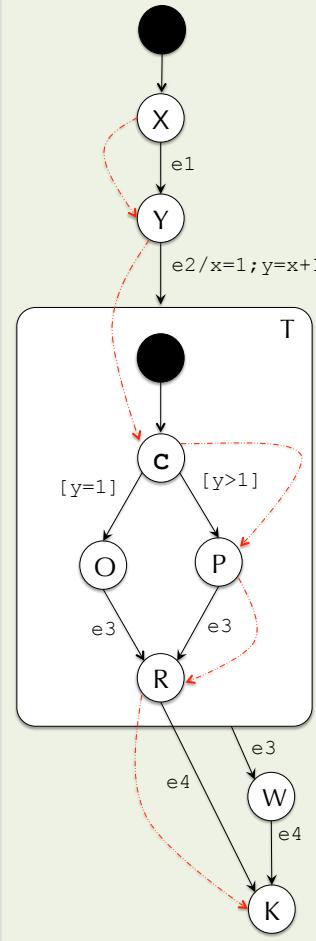
Research Context

Family of Languages for Finite State Machines

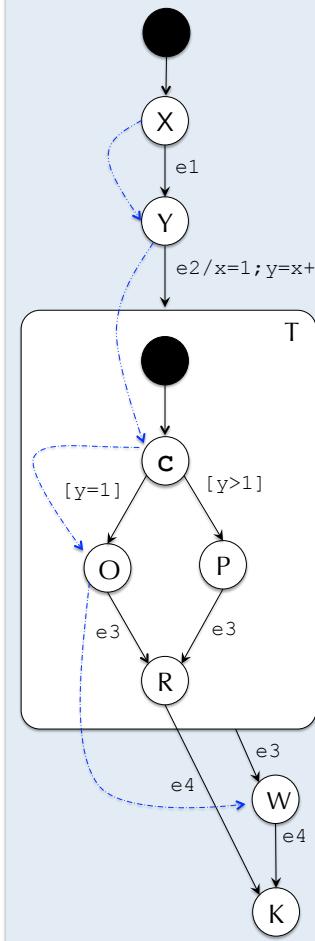
UML: State Machines



Rhapsody



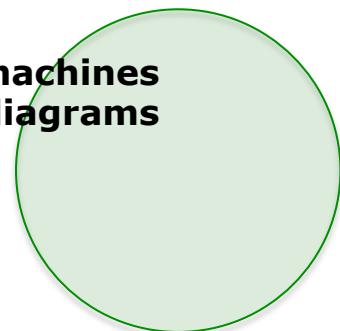
Classical



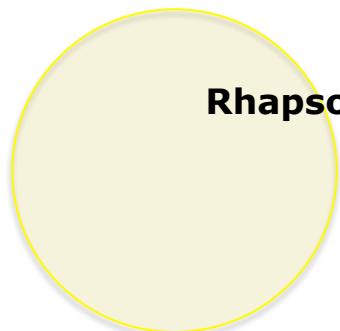
Problem Statement

Isolated Software Development Processes

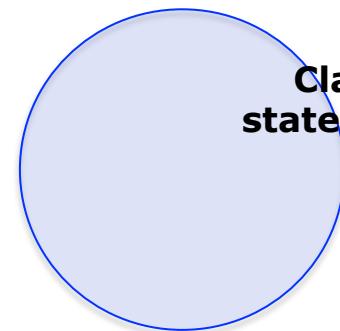
UML state machines
diagrams



Rhapsody



Classical
statecharts



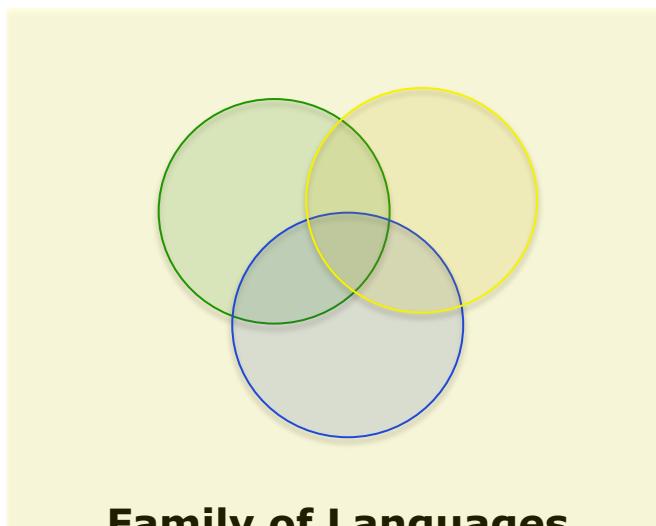
Proposed Approach

From Families of Languages to Language Product Lines

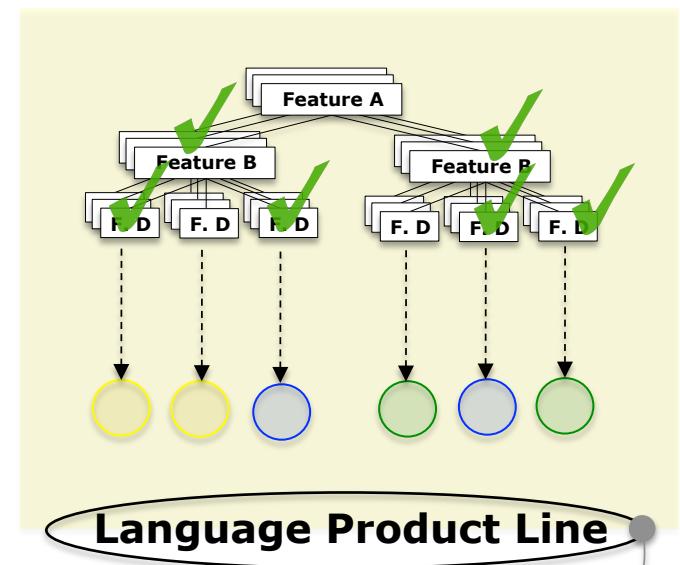
Software Languages are Software too!

Jean-Marie Favre, Dragan Gasevic, Ralf Lmmel, and Ekaterina Pek. **Empirical Language Analysis in Software Linguistics**. In Software Language Engineering. Springer. 2011

Software Engineering Techniques ... Software Product Lines Engineering



Méndez-Acuña's
PhD

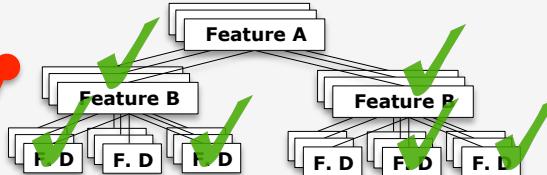


Language Product Line

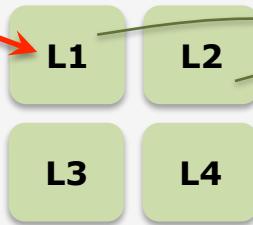
Steffen Zschaler, Pablo Sánchez, Joo Santos, Mauricio Alférez, Awais Rashid, Lidia Fuentes, Ana Moreira, Joo Arajo, and Uir Kulesza. **VML* A Family of Languages for Variability Management in Software Product Lines**. In Software Language Engineering. Springer. 2010.

FROM SCRATCH

Variability models as configuration artifacts



Language derivation



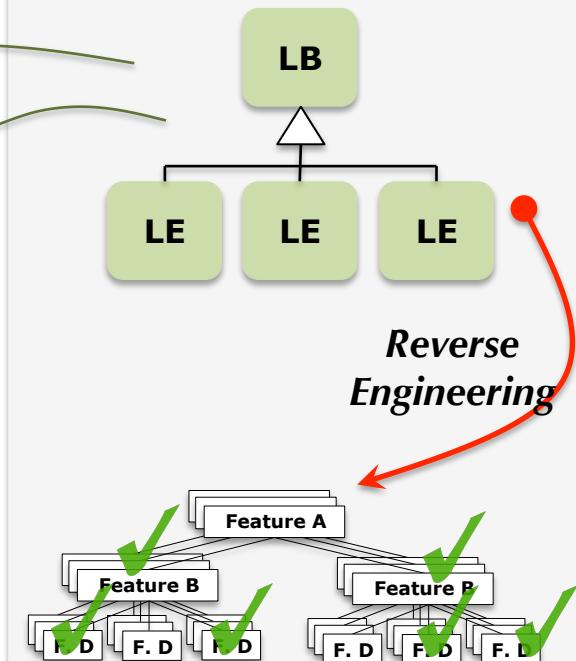
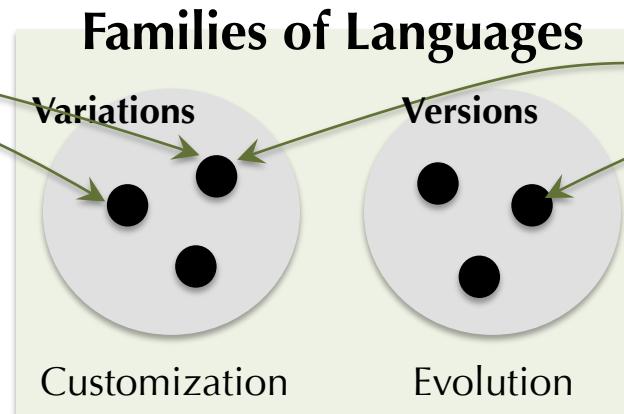
Variability-based development model for DSLs

- Variability modeling
- Components-based languages development

FROM LEGACY

Next generation languages' ecosystems

- Languages extension
- Languages interfaces
- Interoperability

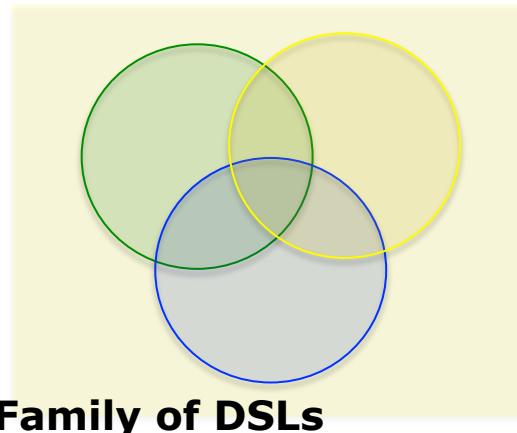


Variability models as documentation artifacts

Research Challenges

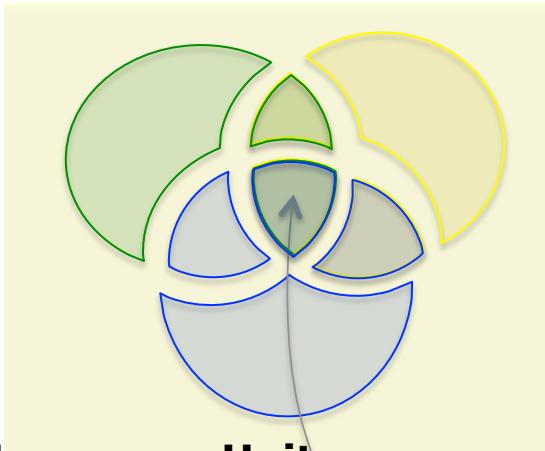
From Families of Languages to Language Product Lines

Objective: REUSE



Research Challenges

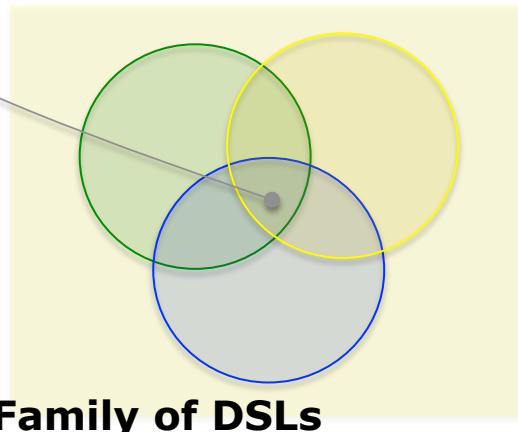
From Families of Languages to Language Product Lines



Language Units

**Modular Languages
Design**
(1)

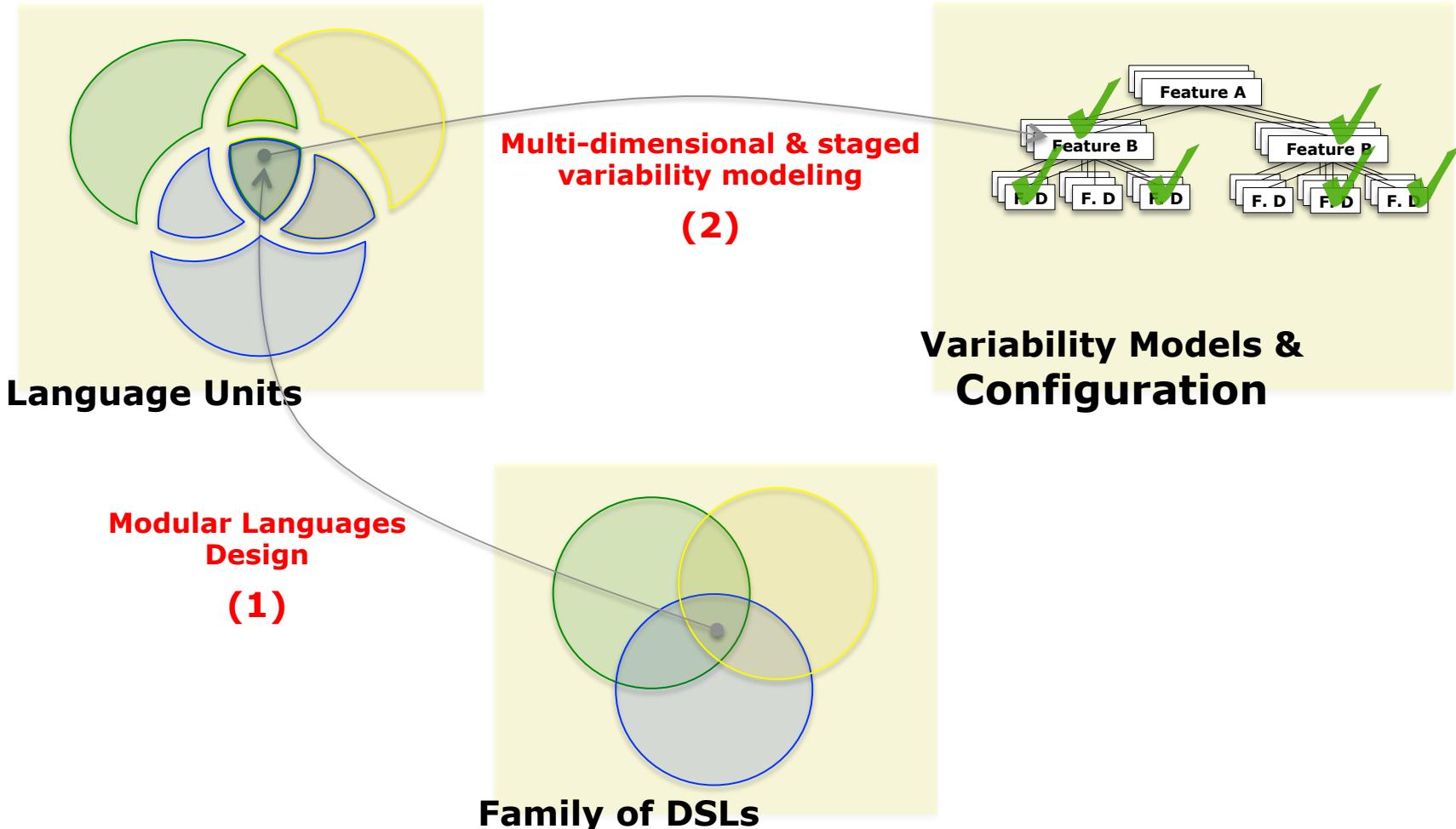
- **TOOL SUPPORT (COMPONENTS MODEL FOR LANGUAGES)**
- **DESIGN PROCESS**



Family of DSLs

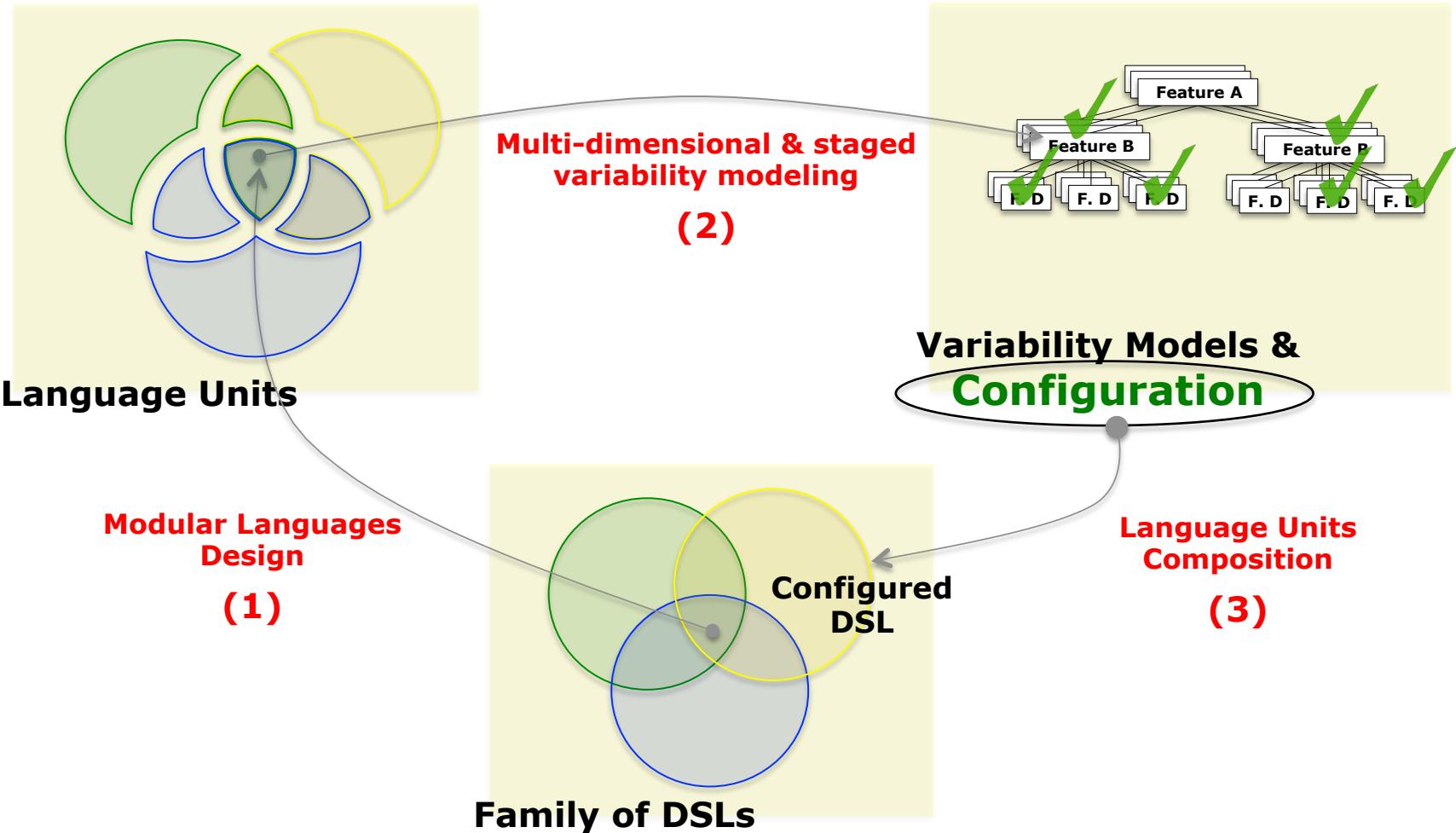
Research Challenges

From Families of Languages to Language Product Lines



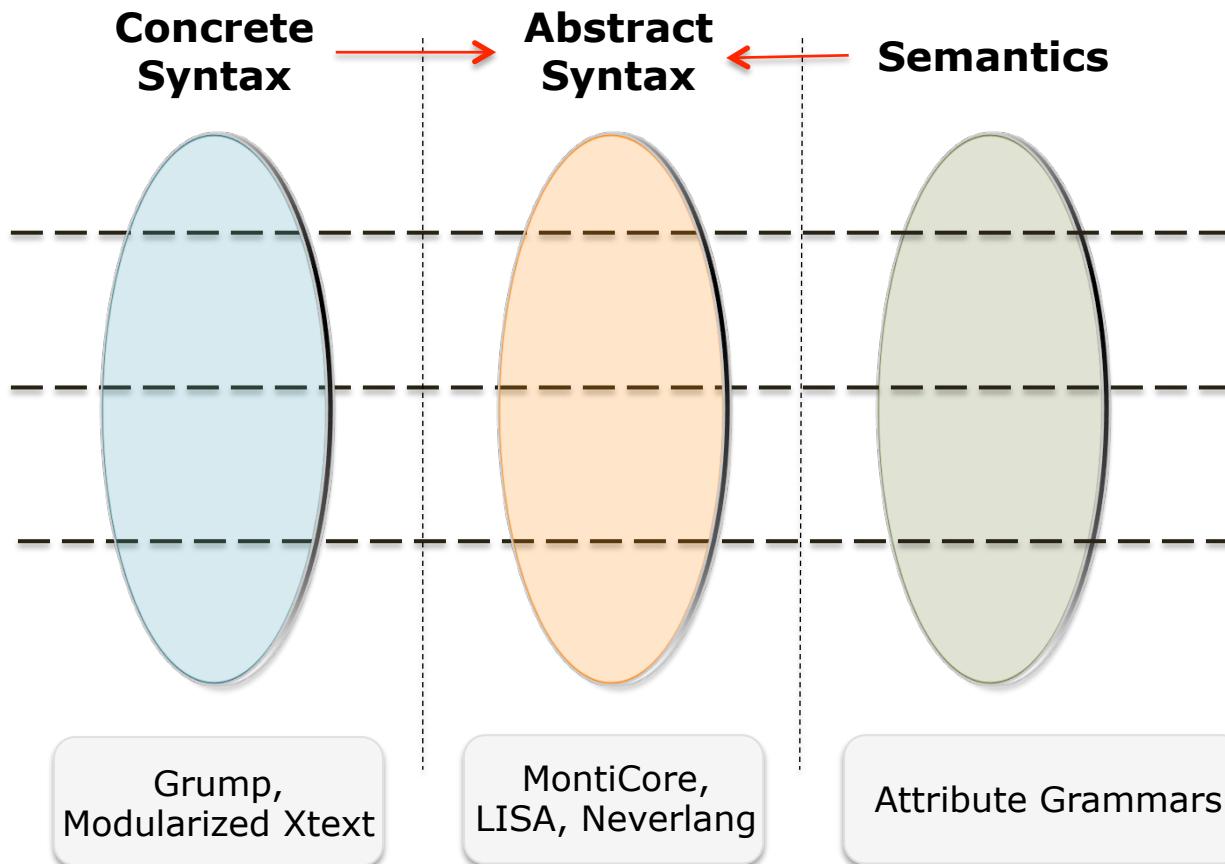
Research Challenges

From Families of Languages to Language Product Lines



Related Work

(1) Modular Languages Design & (3) Composition



Related Work

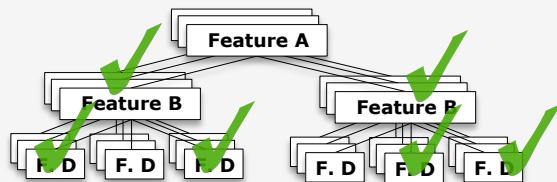
(2) Multi-dimensional & staged variability modeling

General variability modeling



Marko Rosenmüller, Norbert Siegmund, Thomas Thüm, and Gunter Saake. 2011. **Multi-dimensional variability modeling**. In *Proceedings of the 5th Workshop on Variability Modeling of Software-Intensive Systems* (VaMoS '11)

Languages-specific variability modeling



María Victoria Cengarle, Hans Grönniger, Bernhard Rumpe. 2009. **Variability within Modeling Language Definitions**. In Proc of International Conference in Model Driven Engineering Languages and Systems. Models.

Related Work

Identified Coopetitors

MontiCore + Variability Modeling. Cengarle, et al.

Maria Victoria Cengarle, Hans Grönniger, Bernhard Rumpe. 2009. **Variability within Modeling Language Definitions**. In Proc of International Conference in Model Driven Engineering Languages and Systems. Models.

NeverLang + Variability Modeling: Vaccchi et. Al.

Edoardo Vacchi, Walter Cazzola, Suresh Pillay, Benoît Combemale. 2013. Variability Support in Domain-Specific Language Development. In Proc of Software Language Engineering. Springer.

Families of Domain-Specific Languages: Liebig et. al.

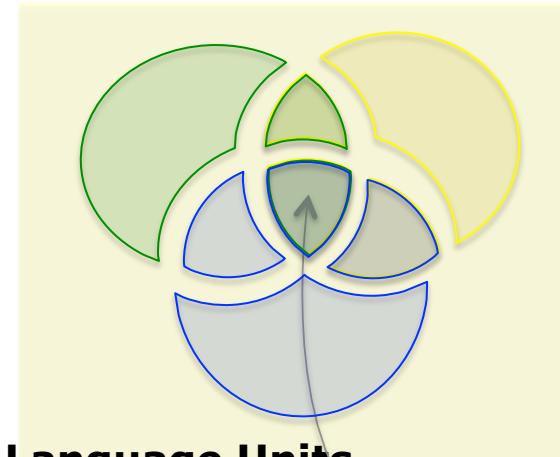
Jörg Liebig, Rolf Daniel, and Sven Apel. 2013. Feature-oriented language families: a case study. In *Proceedings of the Seventh International Workshop on Variability Modelling of Software-intensive Systems* (VaMoS '13)

Families of Domain-Specific Languages + Roles: Wende et. al.

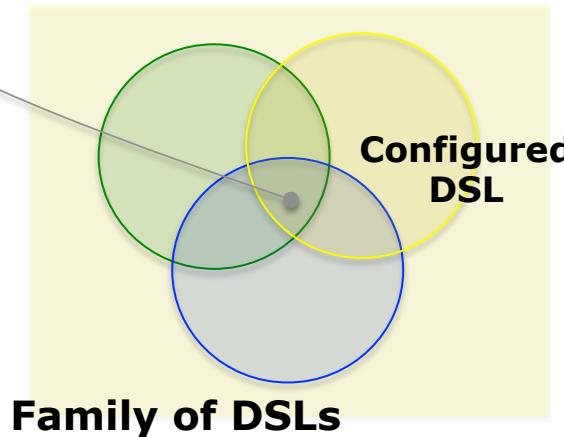
Christian Wende, Nils Thieme, Steffen Zschaler. **A Role-Based Approach towards Modular Language Engineering**. In Proc. Of Software Language Engineering. 2010

Limitations & Contributions

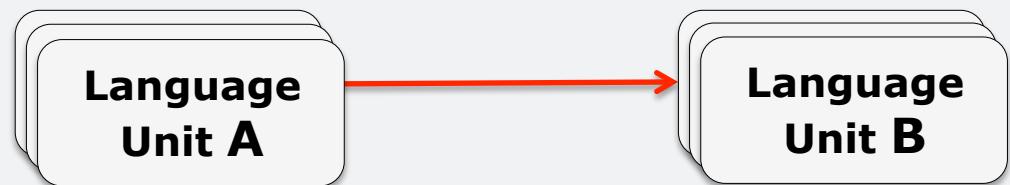
From Families of DSLs to Language Product Lines



Modular Languages Design
(1)

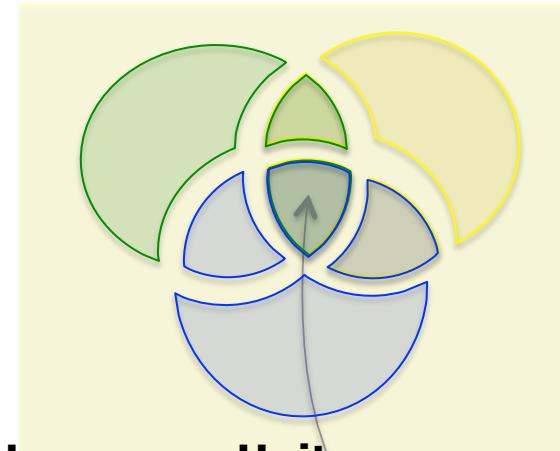


Direct dependencies between artifacts

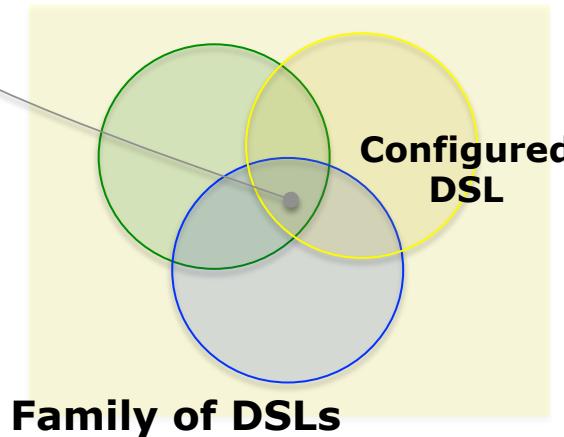


Limitations & Contributions

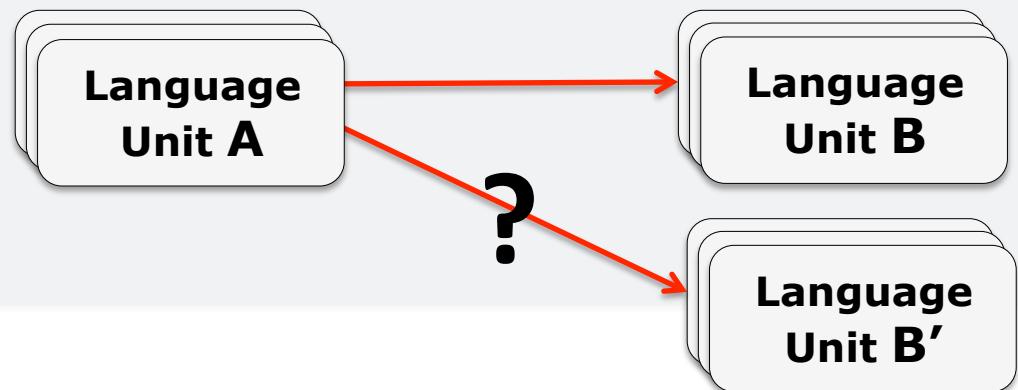
From Families of DSLs to Language Product Lines



Modular Languages Design
(1)

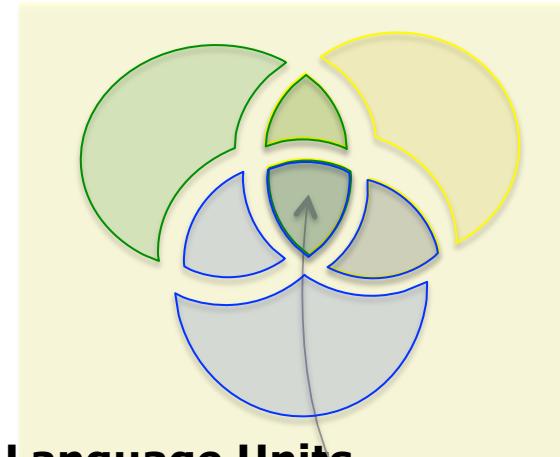


Direct dependencies between artifacts

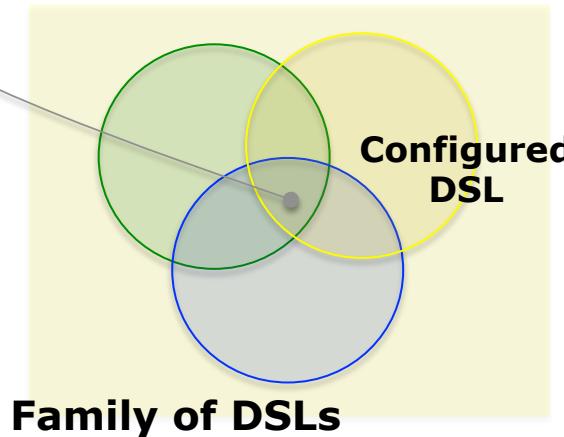


Limitations & Contributions

From Families of DSLs to Language Product Lines



Modular Languages Design
(1)

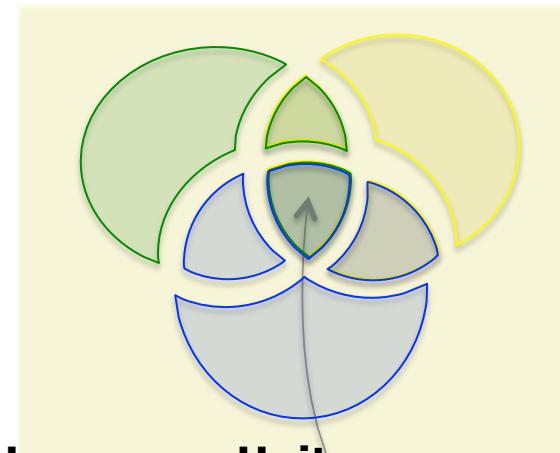


Direct dependencies between artifacts

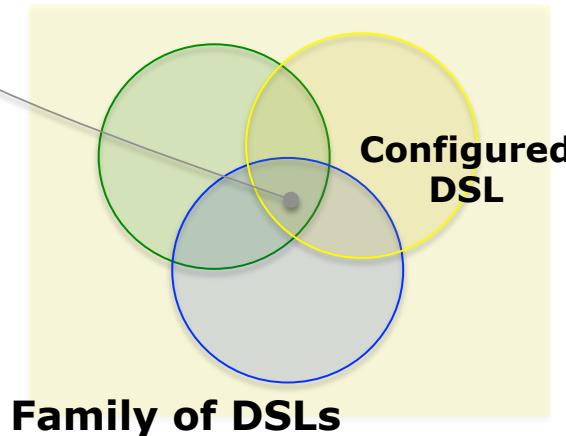


Limitations & Contributions

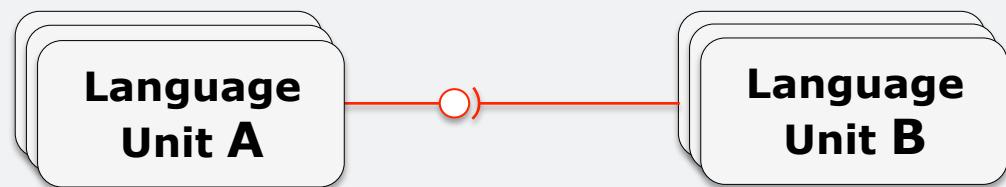
From Families of DSLs to Language Product Lines



Modular Languages Design
(1)



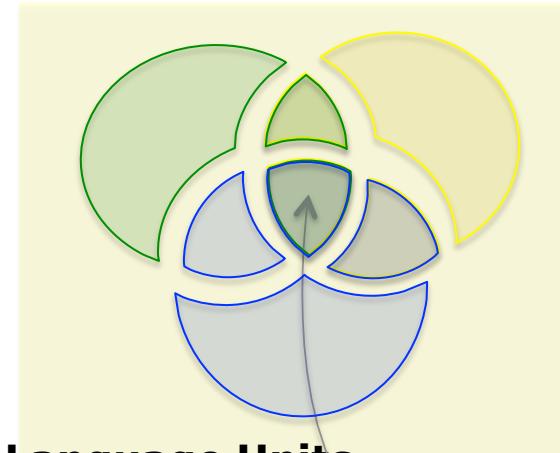
Direct dependencies between artifacts



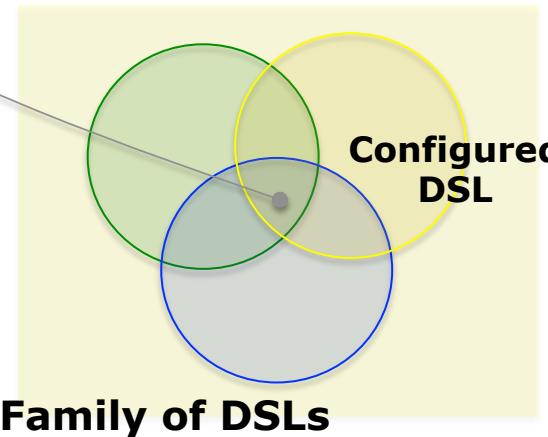
Christian Wende, Nils Thieme,
Steffen Zschaler. **A Role-Based Approach towards Modular Language Engineering**. In Proc. Of Software Language Engineering. 2010

Limitations & Contributions

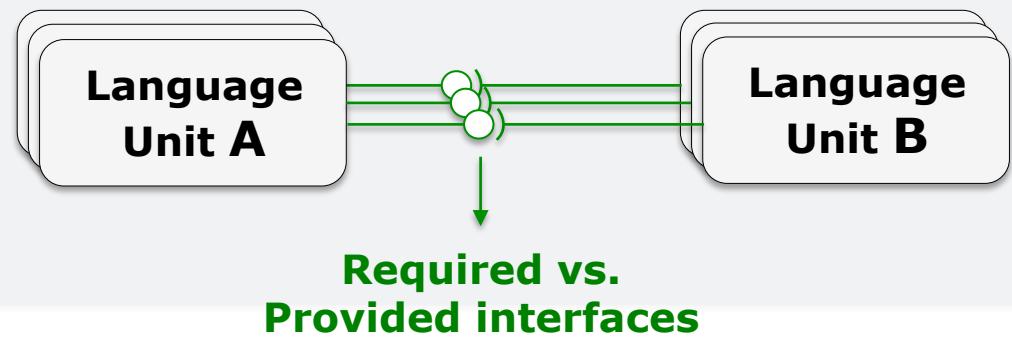
From Families of DSLs to Language Product Lines



Modular Languages Design
(1)

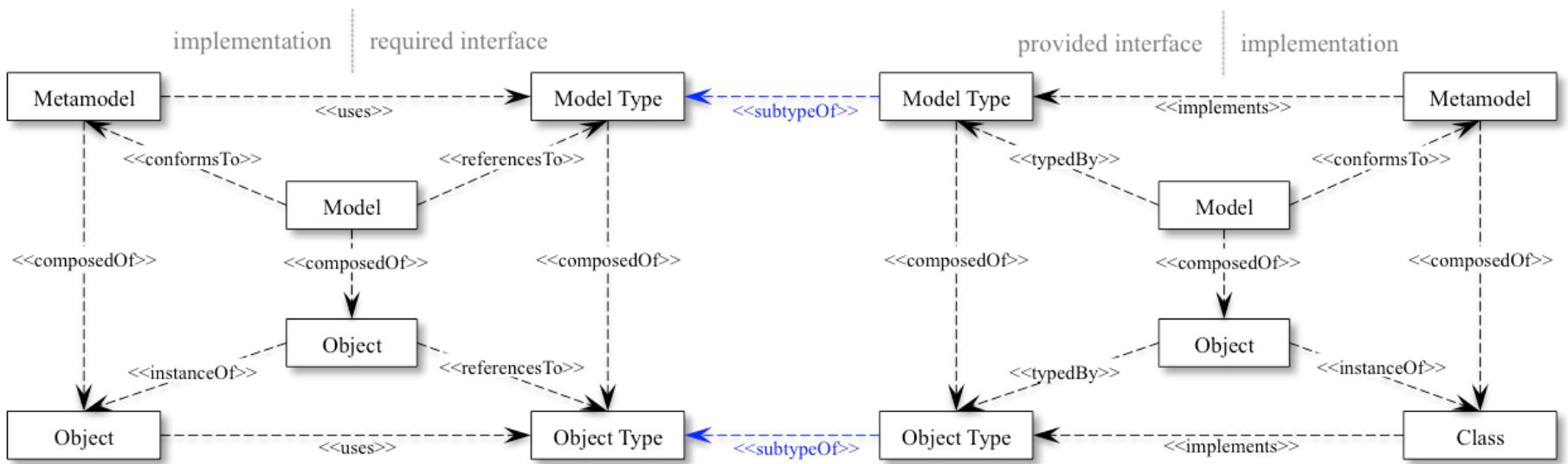


Language Interfaces



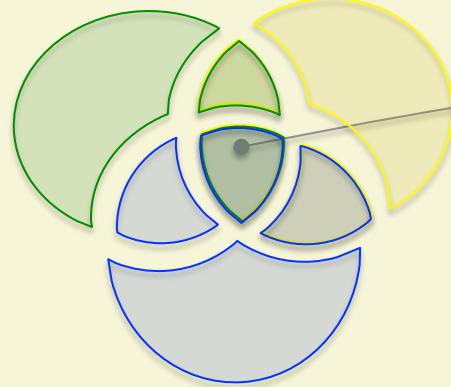
Limitations & Contributions

From Families of DSLs to Language Product Lines



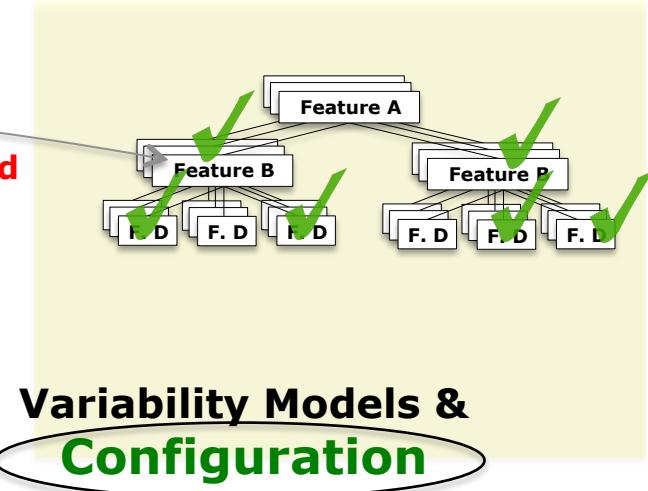
Limitations & Contributions

From Families of DSLs to Language Product Lines

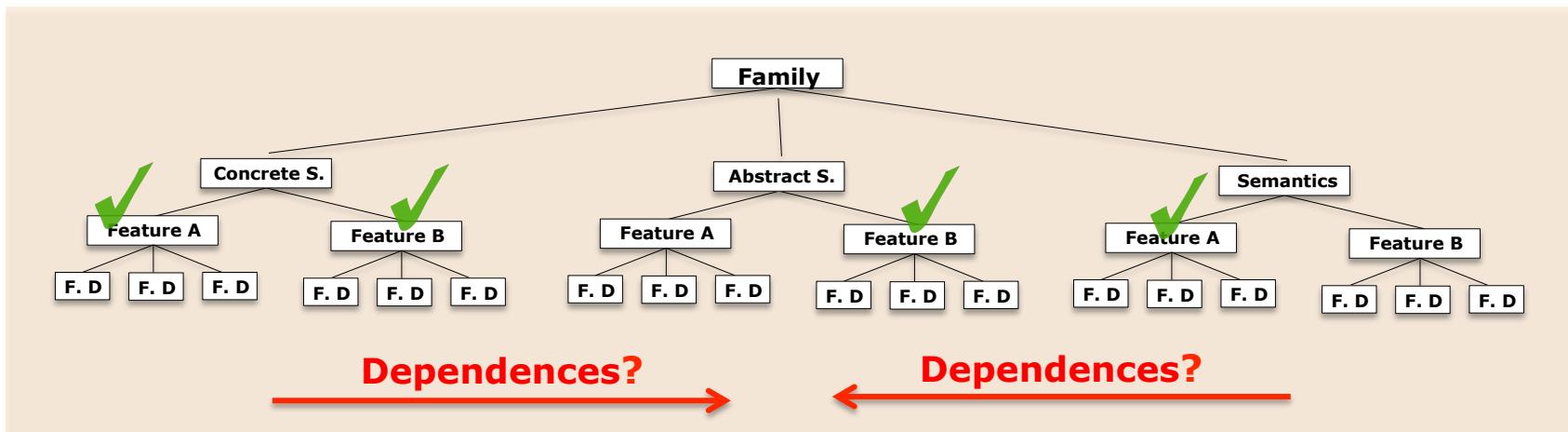


Language Units

Multi-dimensional & staged
variability modeling
(2)

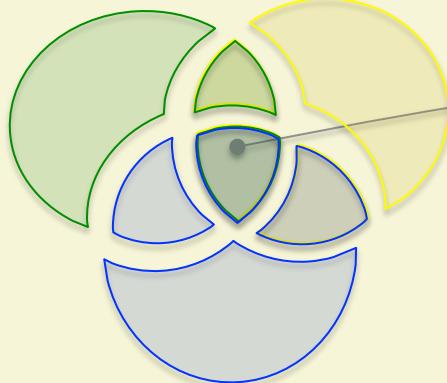


Variability Models &
Configuration



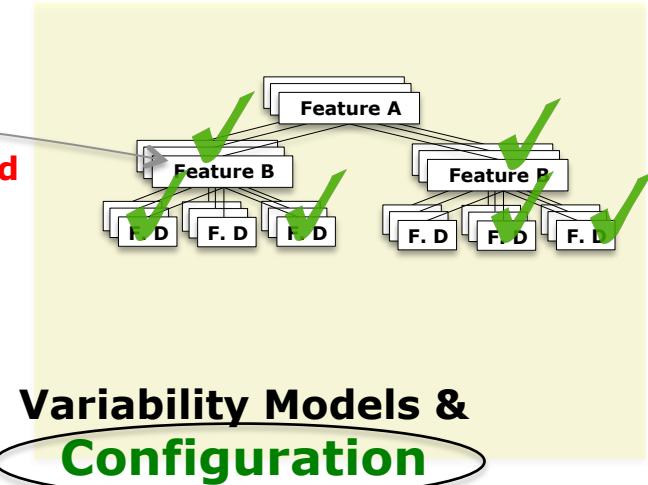
Limitations & Contributions

From Families of DSLs to Language Product Lines



Multi-dimensional & staged
variability modeling
(2)

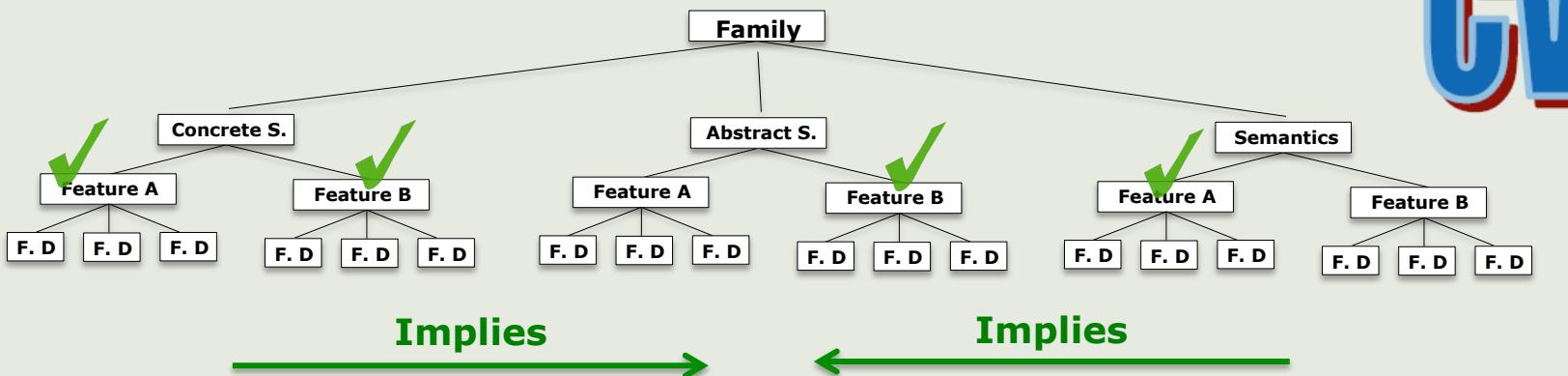
Language Units



Variability Models &
Configuration

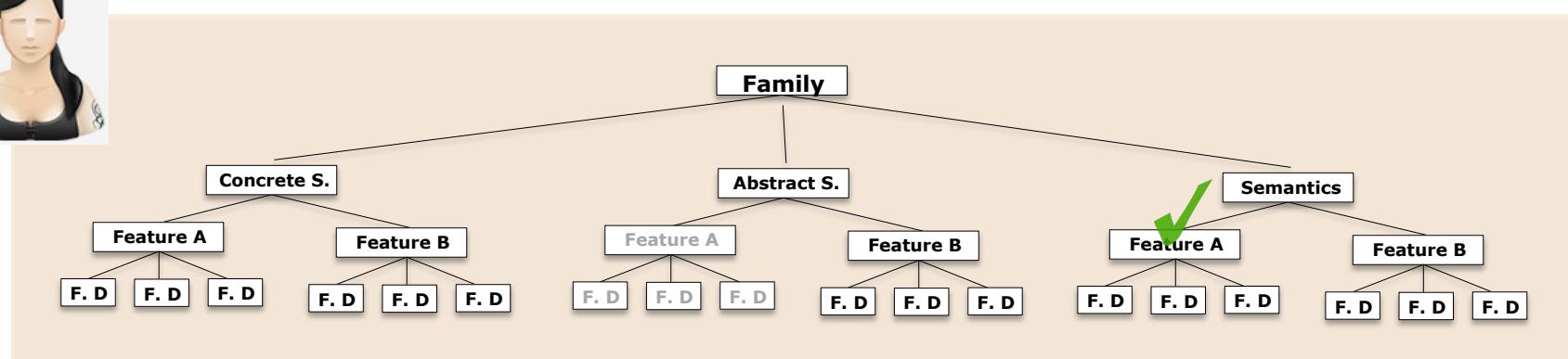
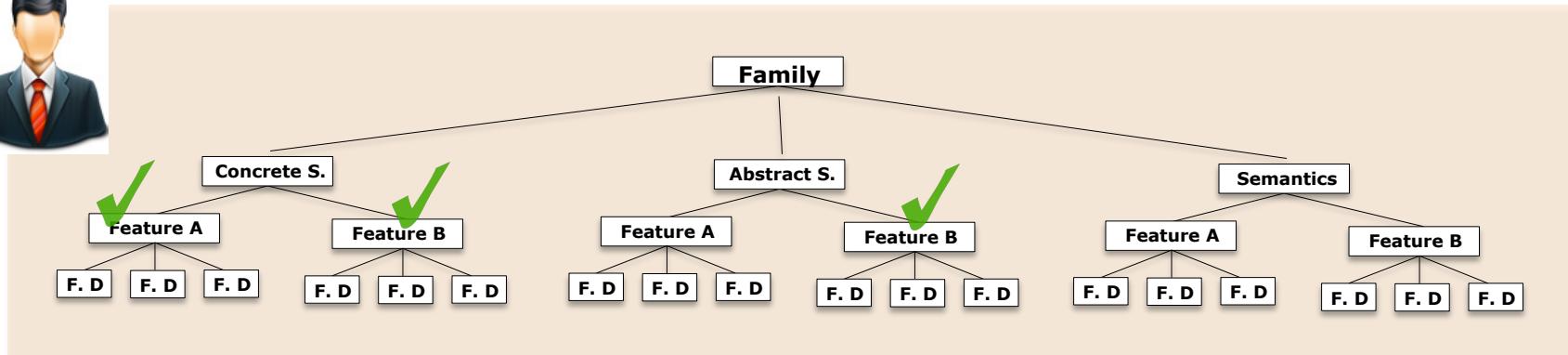
Formalization!

CVL



Limitations & Contributions

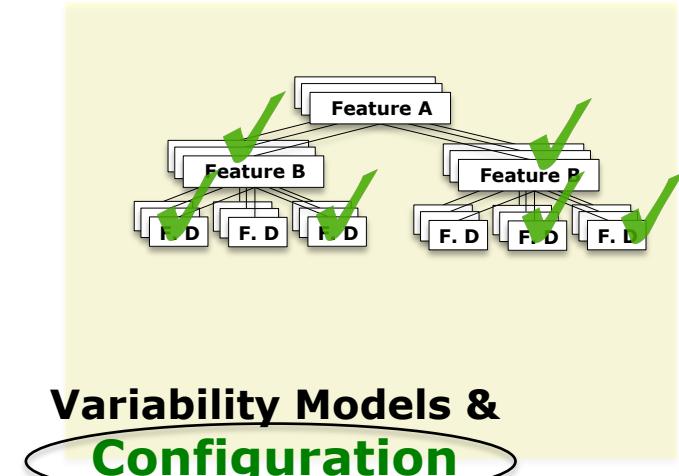
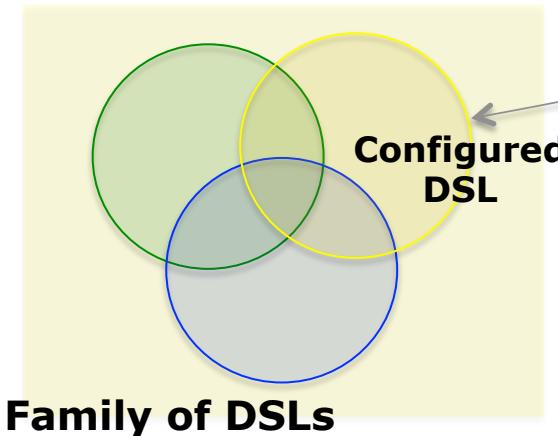
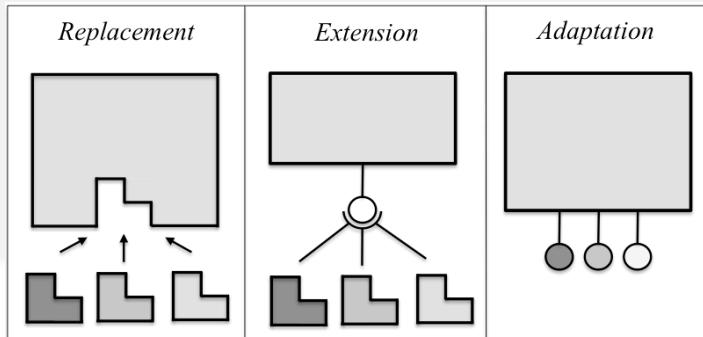
From Families of DSLs to Language Product Lines



Limitations & Contributions

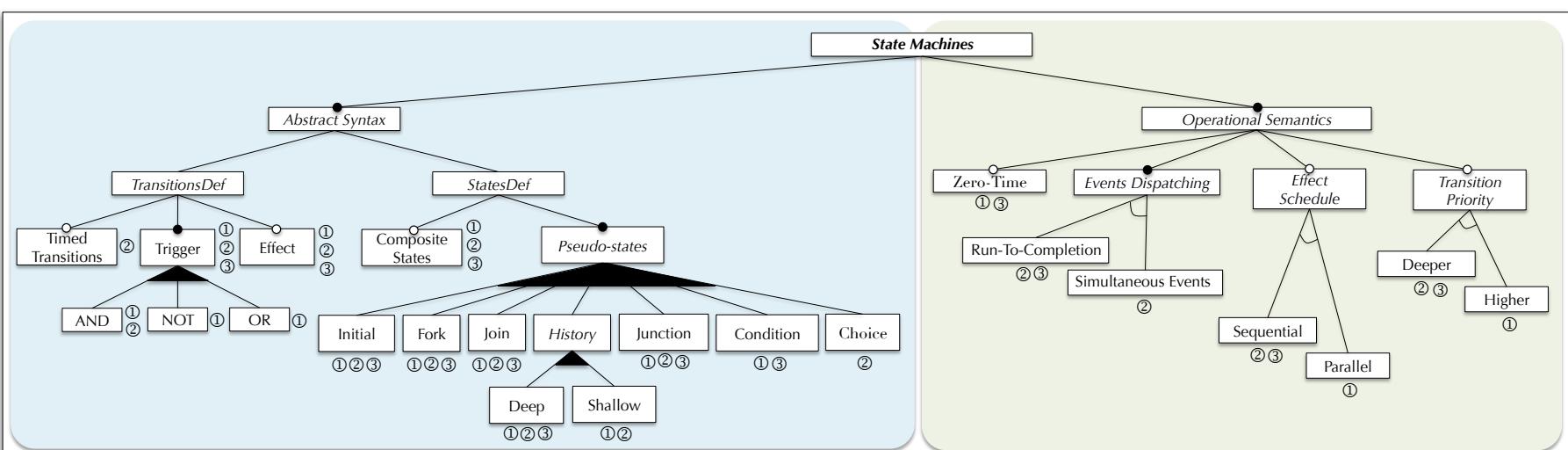
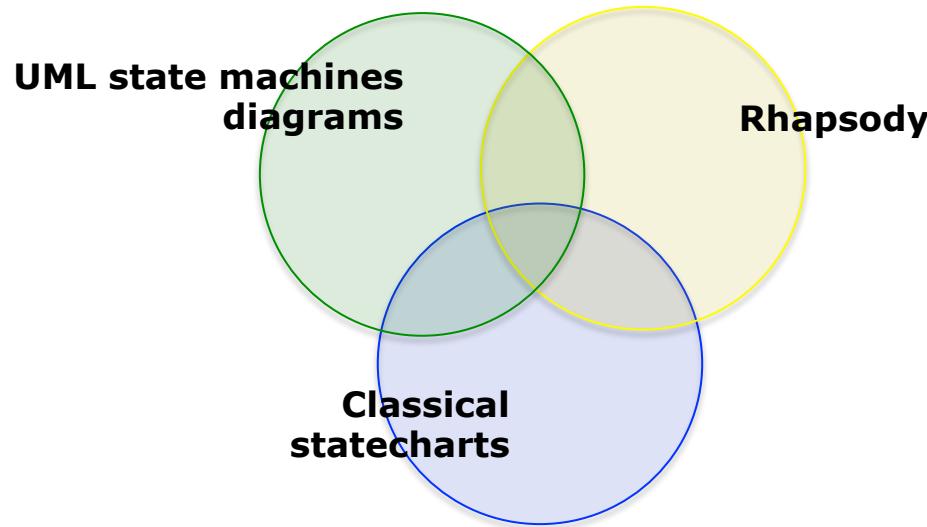
From Families of DSLs to Language Product Lines

Language Composition Strategies & Operators

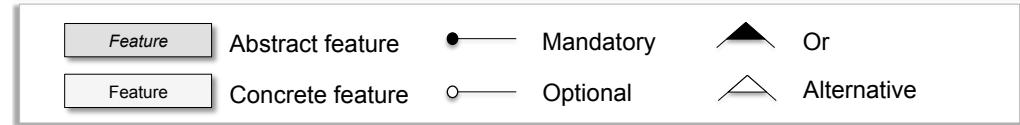
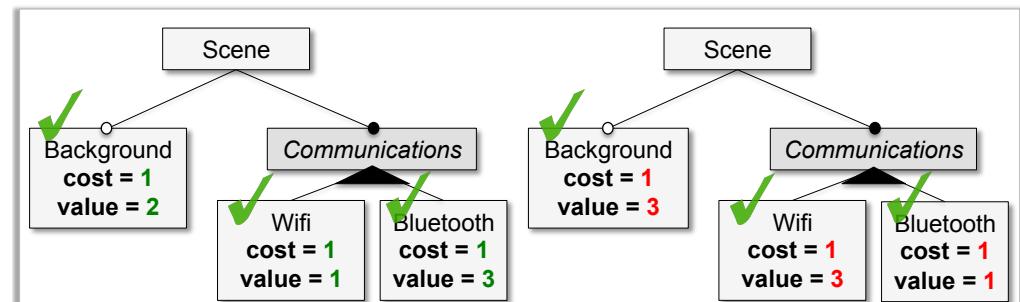
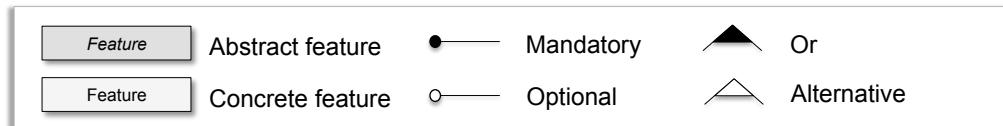
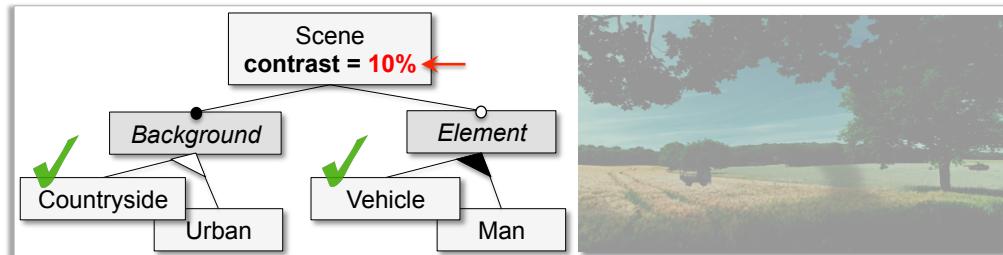
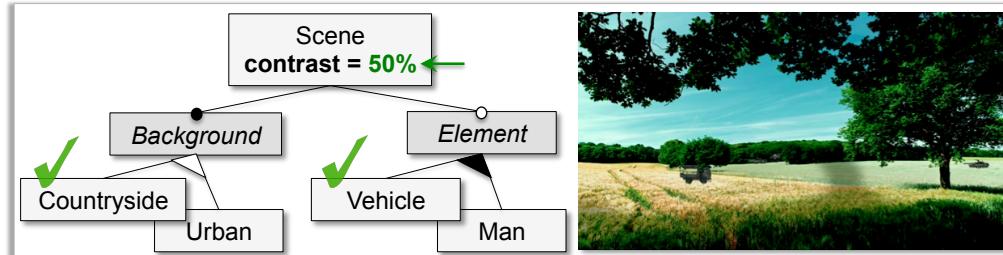


Language Units
Composition
(3)

Case study 1



Case study 2



Case study 2

Extended feature modeling languages: Do they all mean the same?

David Méndez-Acuña
DiverSE Team
INRIA/Université de Rennes 1
Rennes, France
david.mendez-acuna@inria.fr

José A. Galindo
DiverSE Team
INRIA/Université de Rennes 1
Rennes, France
jagalindo@us.es

Mauricio Alférez
CEA Saclay Nano-INNOV
Institut CARNOT CEA LIST
Gif-sur-Yvette CEDEX, France
mauricio.alferez@cea.fr

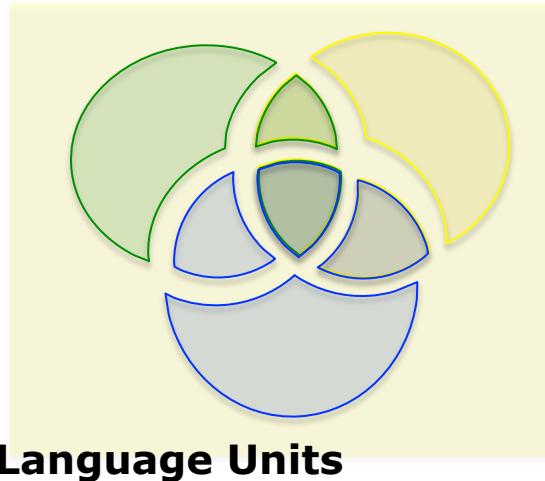
Benoit Combemale
DiverSE Team
INRIA/Université de Rennes 1
Rennes, France
benoit.combemale@inria.fr

Mathieu Acher
DiverSE Team
INRIA/Université de Rennes 1
Rennes, France
mathieu.acher@inria.fr

Ambiguity	A.1		A.2		A.3		A.4		
Interpretation	①	②	①	②	①	②	①	②	③
FAMA	-	✓	-	✓	-	-	-	-	-
VELVET	-	✓	-	✓	-	-	-	-	-
FAMILIAR	✓	-	-	✓	✓	-	✓	-	-
PURE::VARIANTS	-	✓	✓	✓	-	-	-	-	-
CLAFER	-	✓	✓	✓	✓	✓	✓	✓	✓
CVM	-	-	✓	✓	✓	✓	✓	-	✓
TVL	-	✓	-	✓	-	-	-	-	-

Open Questions

How to break down a language?



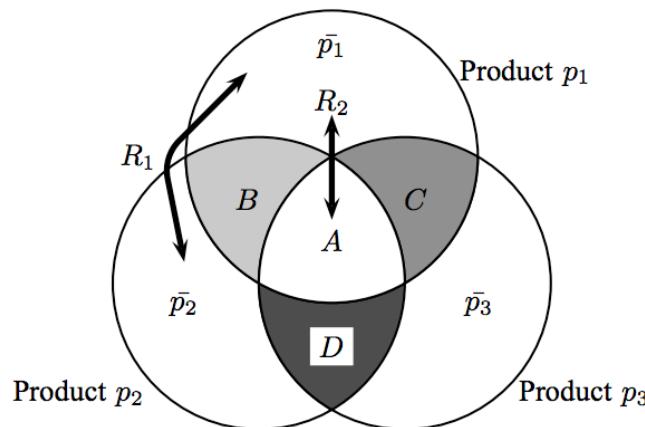
Open Questions

How to evaluate the approach? Metrics for Software Product Lines?

Product Line Metrics for Legacy Software in Practice

Christian Berger, Holger Rendel, Bernhard Rumpe
Software Engineering
RWTH Aachen University
Aachen, Germany
<http://www.se-rwth.de/>

Carsten Busse, Thorsten Jablonski, Fabian Wolf
Electronics Development
Volkswagen AG Business Unit Braunschweig
Braunschweig, Germany
<http://www.volkswagen.de/>



Open Questions

How to achieve interoperability between language units?

