Language, Models and Megamodels
Tutorial on Megamodelling

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SATToSE'14
2014-07-10

Learning Outcomes

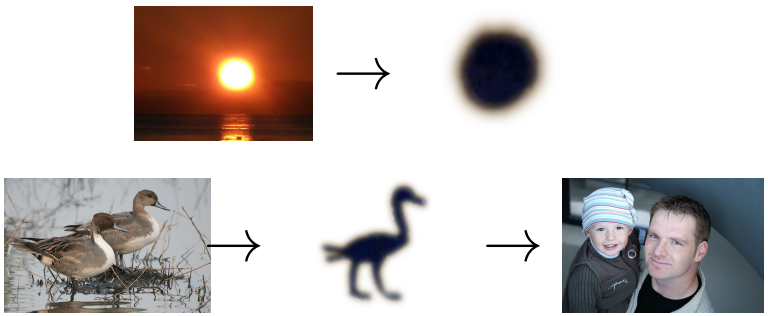
- What is a model? ...a metamodel? ...a megamodel?
- Why would would you need one?
- Relations between models
- Kinds of megamodels
- Mega patterns
- Practical megamodelling

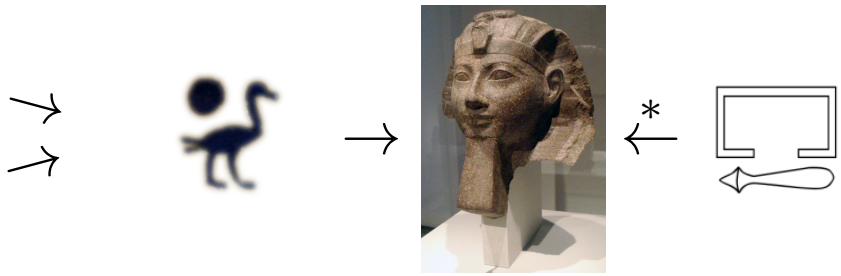
I'm a language engineer, so we'll start from a language perspective.

So... What's a Language?

A language

- is a form of communication
- has structure
- carries meaning
- is/creates abstraction





Languages

Kinds:

- Natural
- Artificial
  - Formal

Software language: *Artificial language used in software development*

- Programming, Modelling, Data representation, Ontologies, APIs, ...

Forms:

- Written
- Spoken
- Diagrams

Purpose:

- General-Purpose
  Can define arbitrary abstractions
- Domain-specific

What's a model?

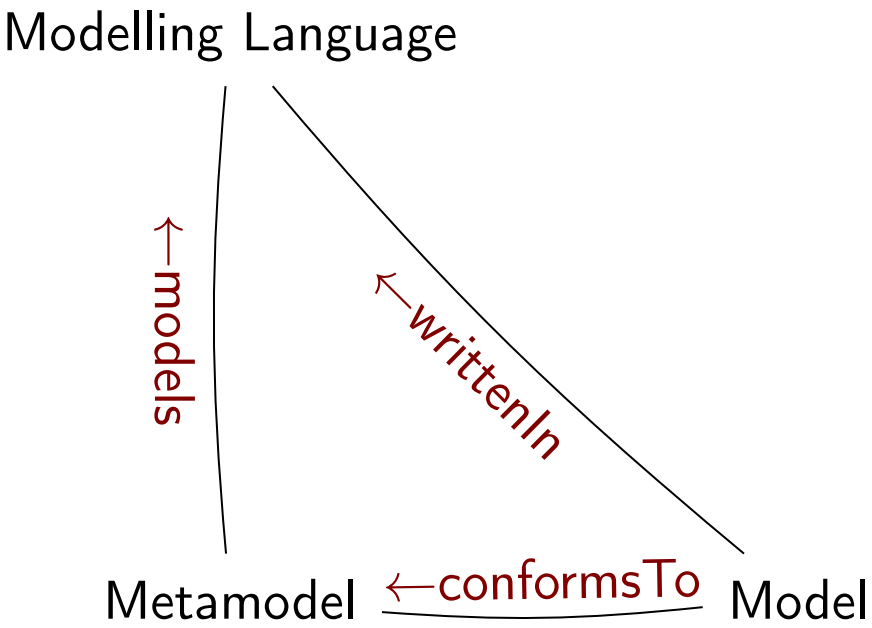
*A model is a simplification of a system build with an intended goal in mind. The model should be able to answer questions in place of the actual system**

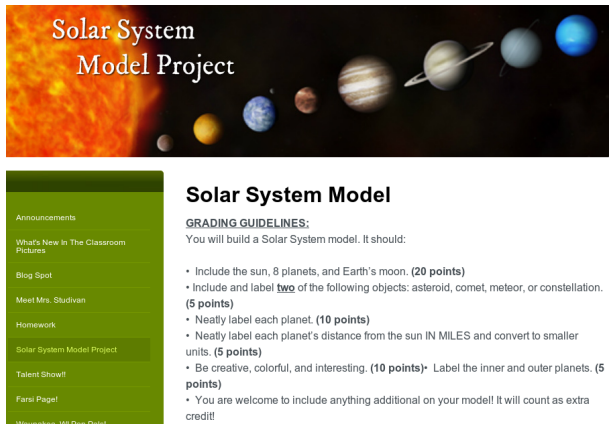
- Typically, a model represents a system
- System may be abstract or real
- May also be used in the sense of a type/class, example, instance, mold
- Descriptive or prescriptive

* [Bézivin, Gerbé, *Towards a Precise Definition of the OMG/MDA Framework*]

...aaand a metamodel?

A metamodel is model of a modelling language

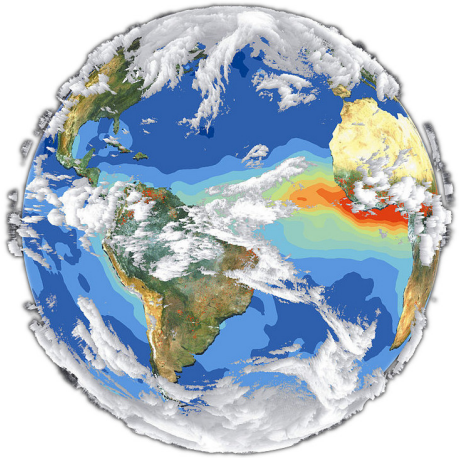




'Sup With Megamodels?

A megamodel is model of a system of models

A Totally Unrelated Example: Climate Modelling



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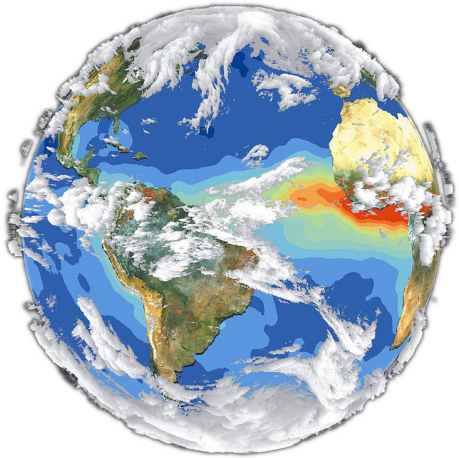

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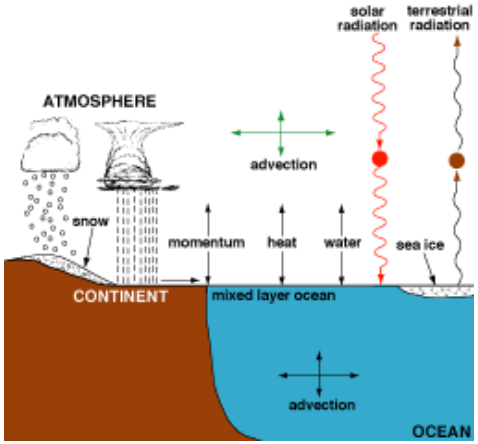

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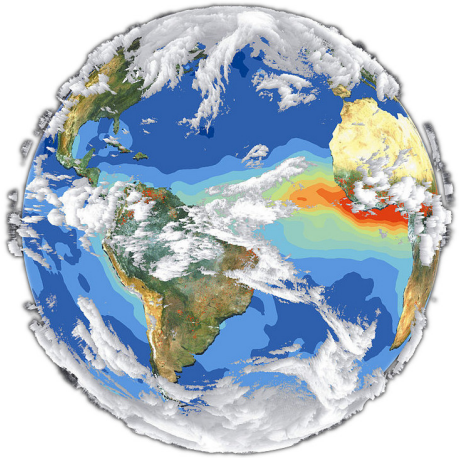

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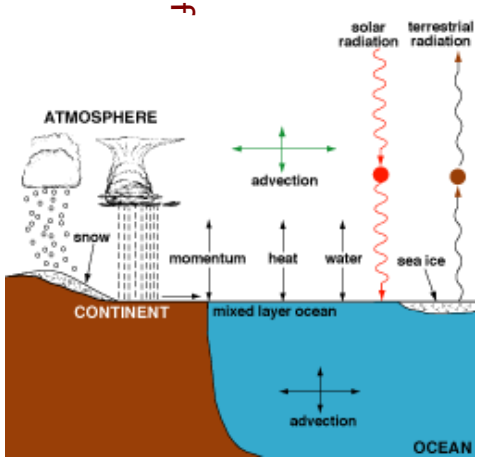

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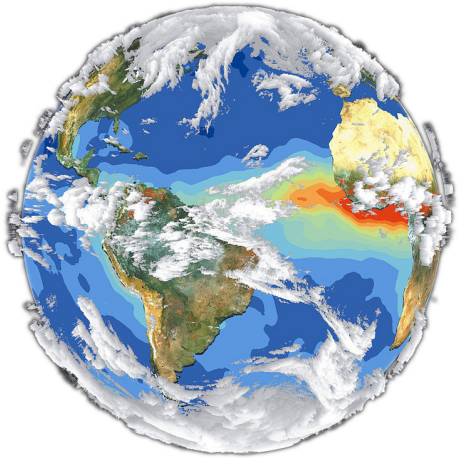

← impacts →

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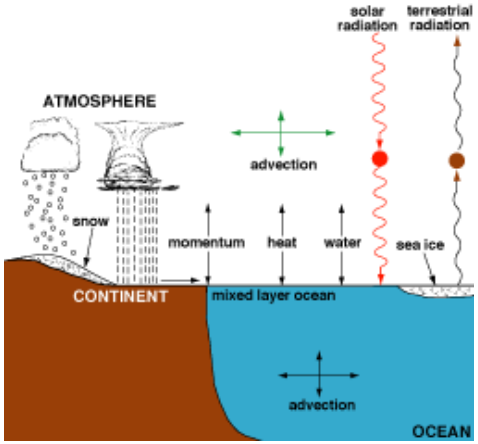

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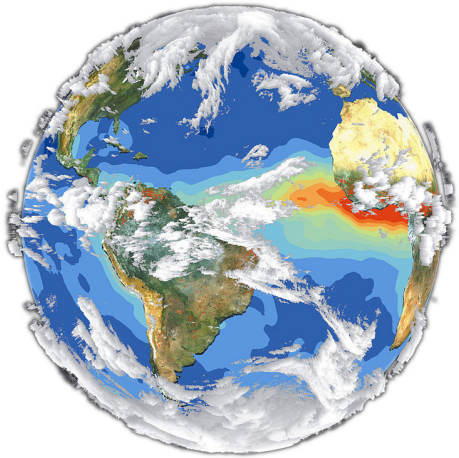

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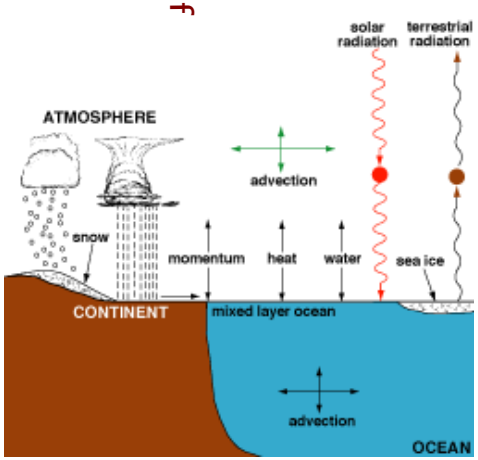

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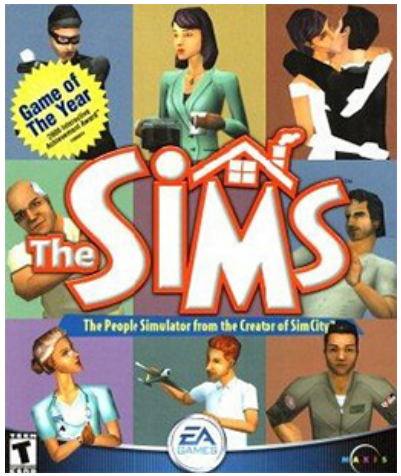

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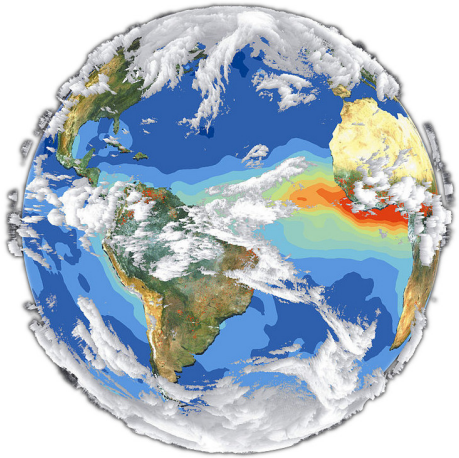

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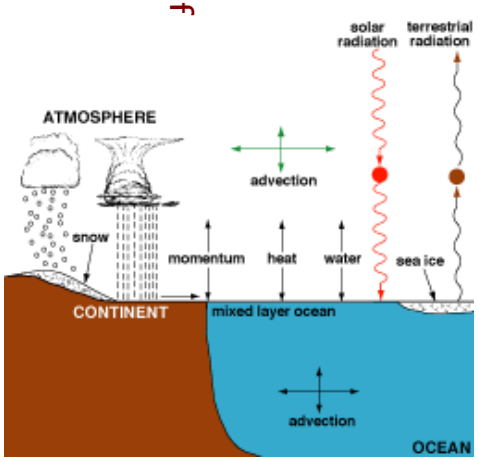
impacts? →



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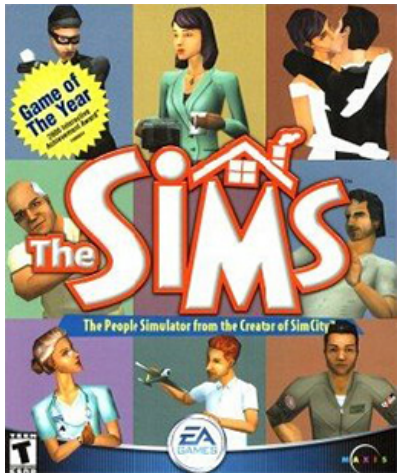


Why Would You Need a Megamodel?

To understand your system:

- Models have implicit relations and assumptions:
  - What technologies are in the environment?
  - How does this model relate to other models? (e.g. models may show different views of same system)
- Systems of models may very complex
  - Need a model to understand them!
- Supporting MDE with model management
- Define software architecture

Things to model:

- Languages
- Technologies
- Programs
- Transformations
- Relations
- ...

Relationships:

- Conformance
- Transformation
- Composition
- Representation
- ...

Megamodel Relations

Ad hoc megamodelling:

- Draw a diagram with models
- Add relations between them
- Relations are in natural language

Focus is on understanding and communicating.

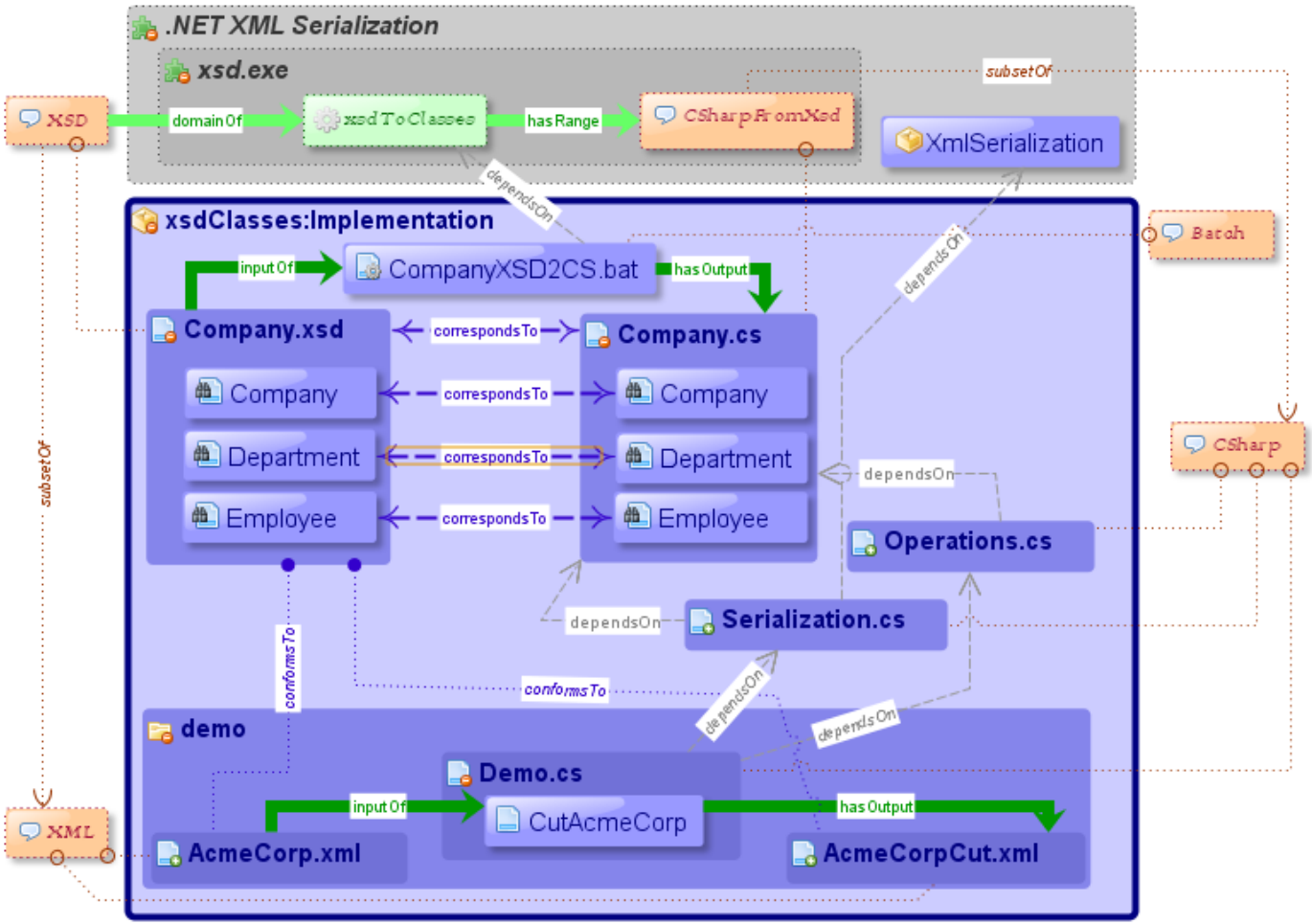
Jean-Marie's relations:

- μ: representationOf
- ϵ: elementOf
- δ: decomposedIn
- χ: conformsTo

E.g.: *Program is ElementOf Language*, *Grammar is RepresentationOf Language*, *Program ConformsTo Grammar*, *System is DecomposedIn Component*

Megamodel Relations

Relations in MegaL:



[Favre, Lämmel, and Varanovich, *Modeling the Linguistic Architecture of Software Products*]

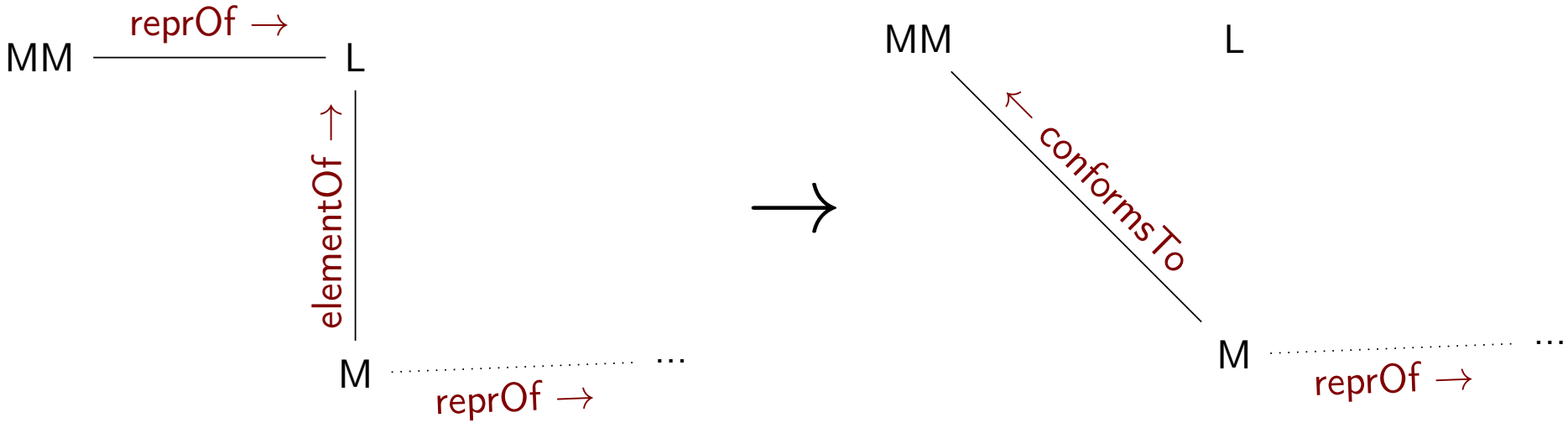
Megamodel Relations

Relations in MegaL:

- *:Language* subsetOf *:Language*
- *:Artifact* elementOf *:Language*
- *:Language* domainOf *:Function*
- *:Function* hasRange *:Language*
- *:FunctionApplication* elementOf *:Function*
- *:Artifact* inputOf *:FunctionApplication*
- *:FunctionApplication* hasOutput *:Artifact*
- *:Artifact* conformsTo *:Artifact*
- *:Artifact* partOf *:Artifact*
- *:Artifact* correspondsTo *:Artifact*
- *:Artifact* dependsOn *:Artifact*
- *:Artifact* dependsOn *:Language*
- *:Artifact* realizationOf *:Function*
- *:Artifact* definitionOf *:Language*
- *:Program* partOf *:Technology*
- *:Library* partOf *:Technology*

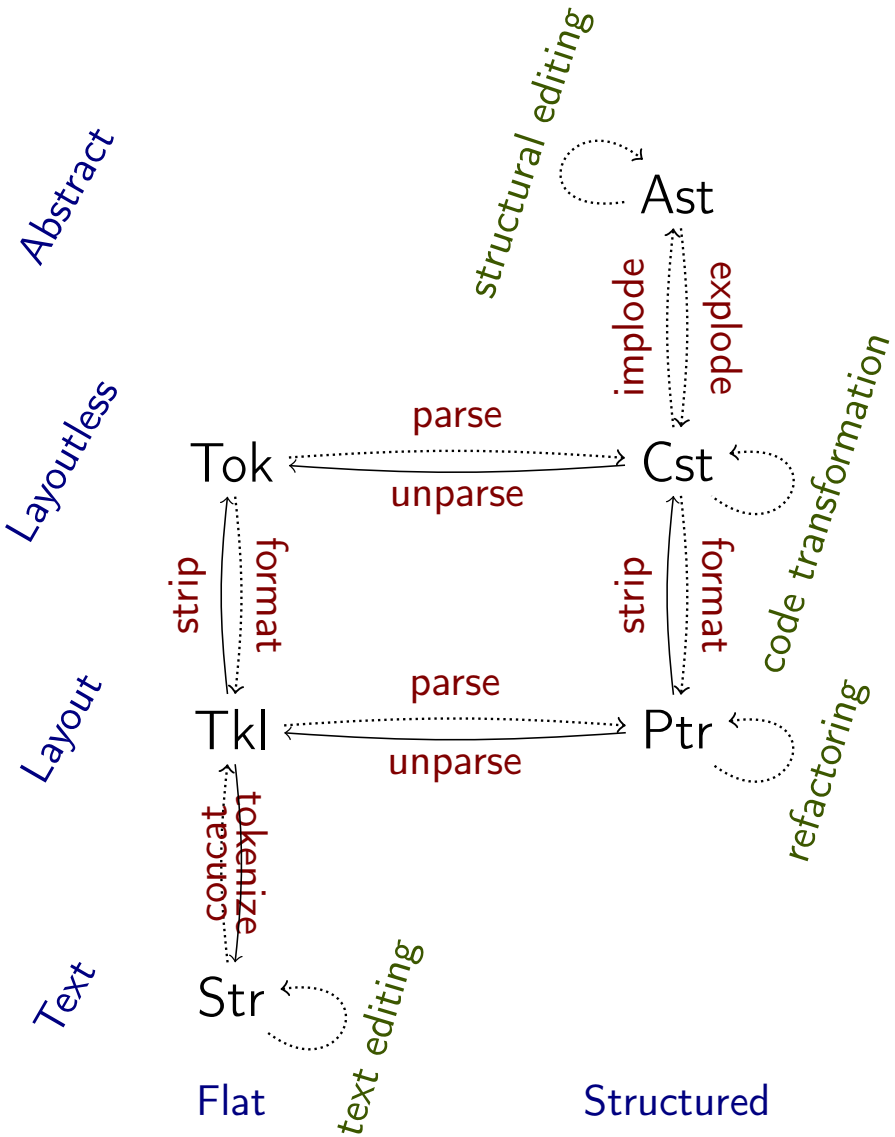
[Favre, Lämmel, and Varanovich, *Modeling the Linguistic Architecture of Software Products*]

Example:
Specification/Language/Program or Metamodel/Language/Model



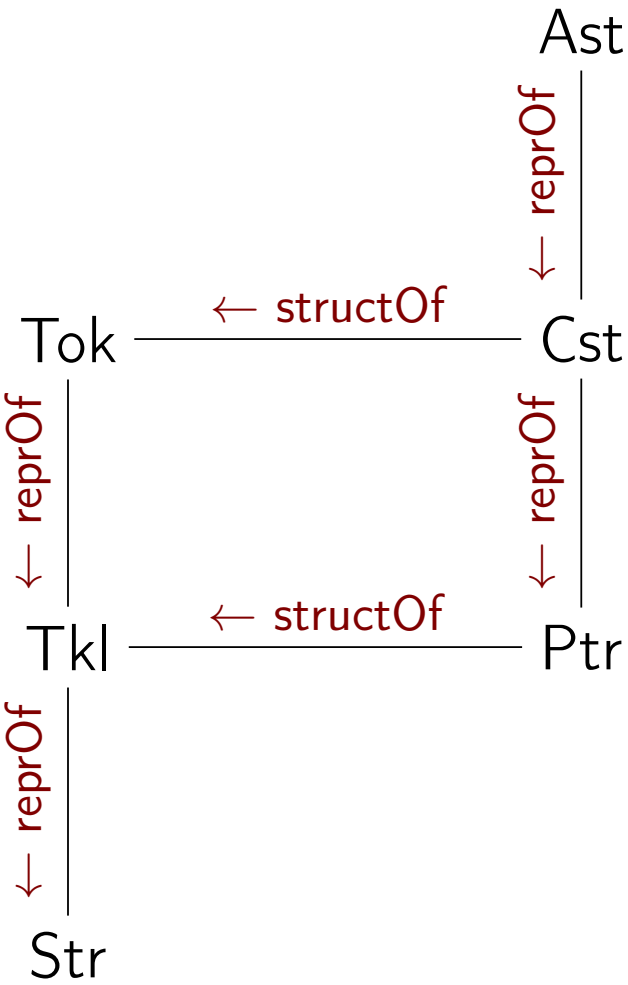
[Favre, *Megamodelling and etymology. A story of words: from MED to MDE via MODEL in five millenniums*]

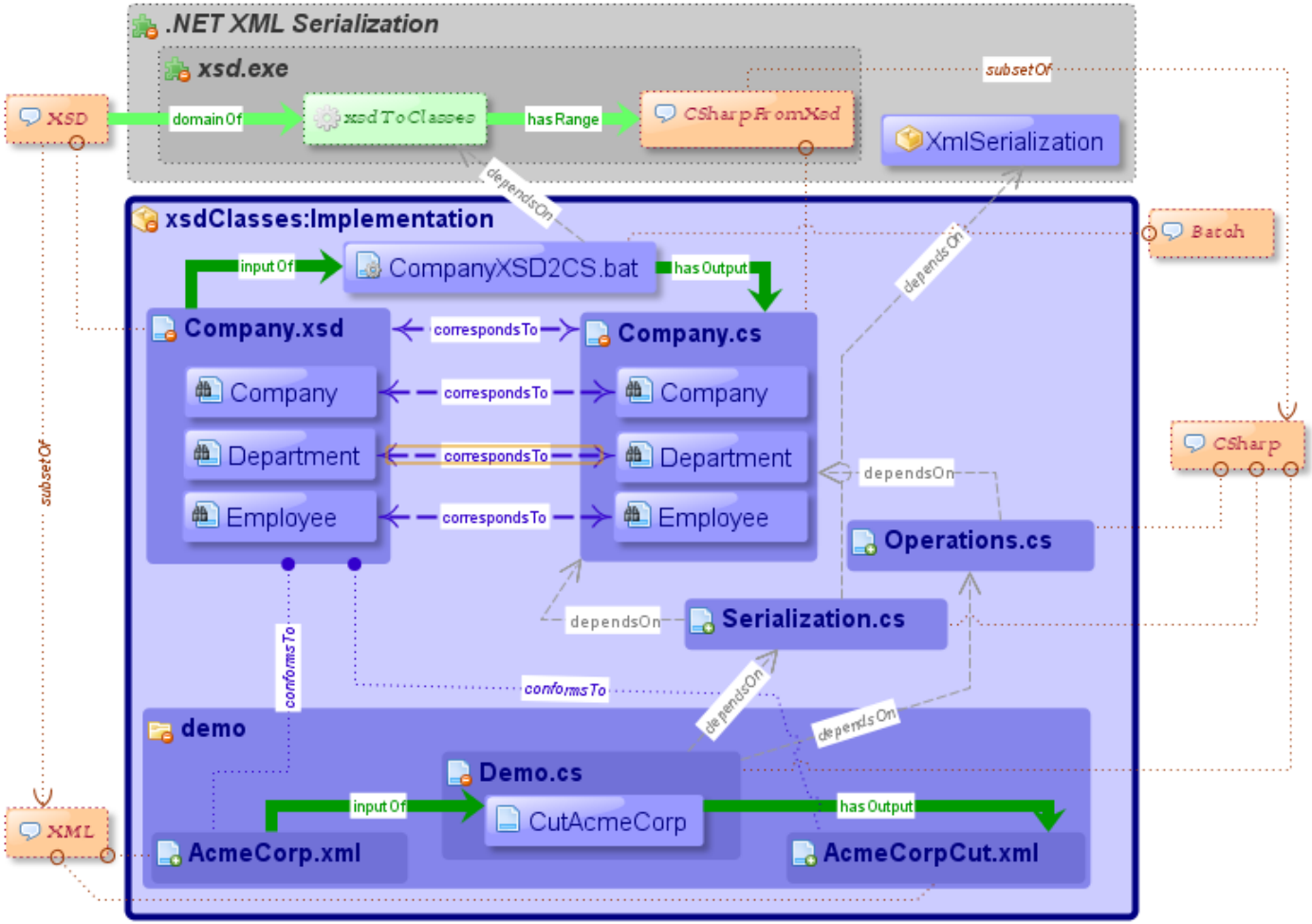
Practical Megamodelling: Modelling Language Artifacts



[Zaytsev & Bagge: Parsing in a Broad Sense]

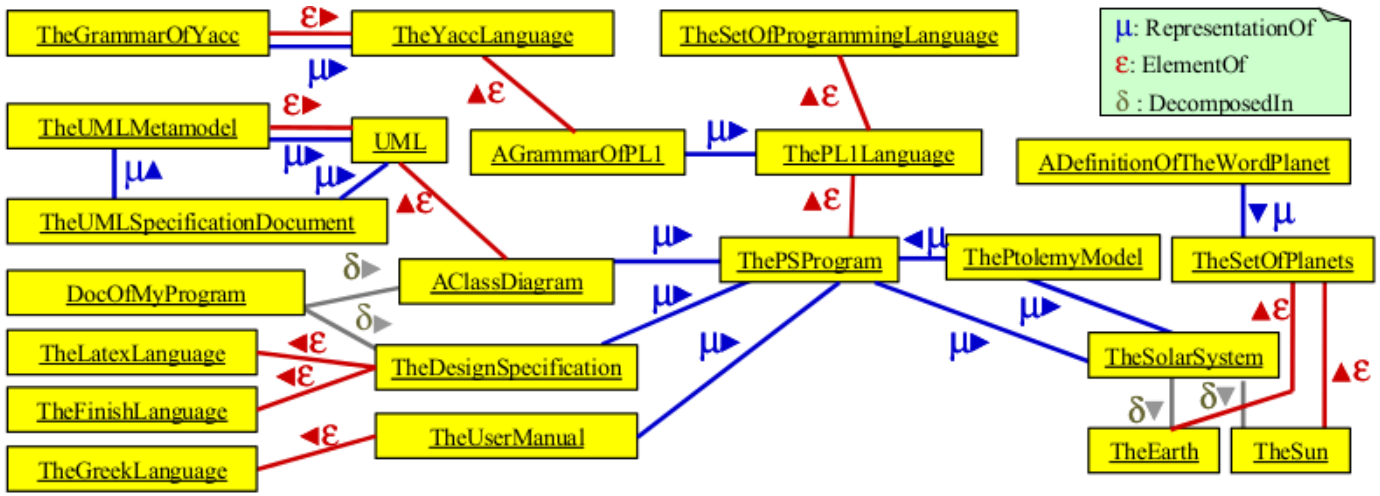
Practical Megamodelling: Modelling Language Artifacts





[Favre, Lämmel, and Varanovich, *Modeling the Linguistic Architecture of Software Products*]

Another Example: Astronomical Simulation Software



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Summary

- Language is structured and meaningful communication
- Models abstract over and represent systems
- Metamodels are models of (modelling) languages
- Megamodels are models of systems of models
  - Aimed at understanding (for humans)
  - Makes relationships explicit
  - Identifies roles – and missing models

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