universitätbonn ROOTS

Model based Software Development

A famous painting by René Magritte

Systems versus Modells

A system

isModelOf

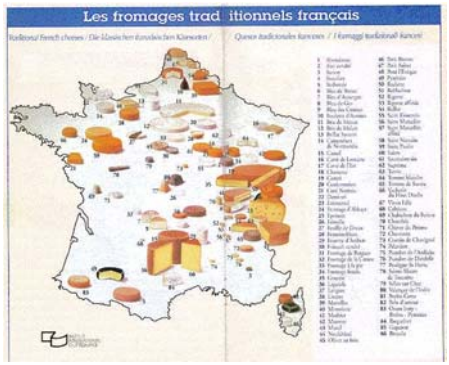
conformsTo

A model

- With an image (= a model) we cannot smoke.
- But the image (model) captures important properties and lets us reason about
  - appeareance
  - functions
  - usability
  - etc

Modells Represent Views of a System

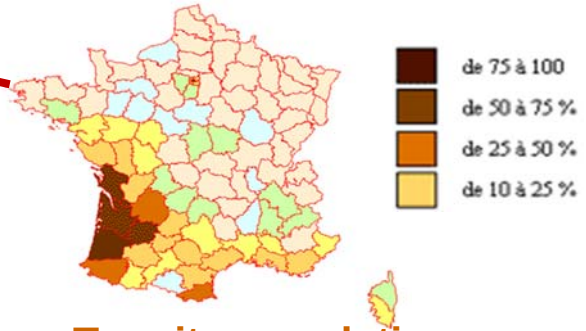
France 1453



French cheese map

Models

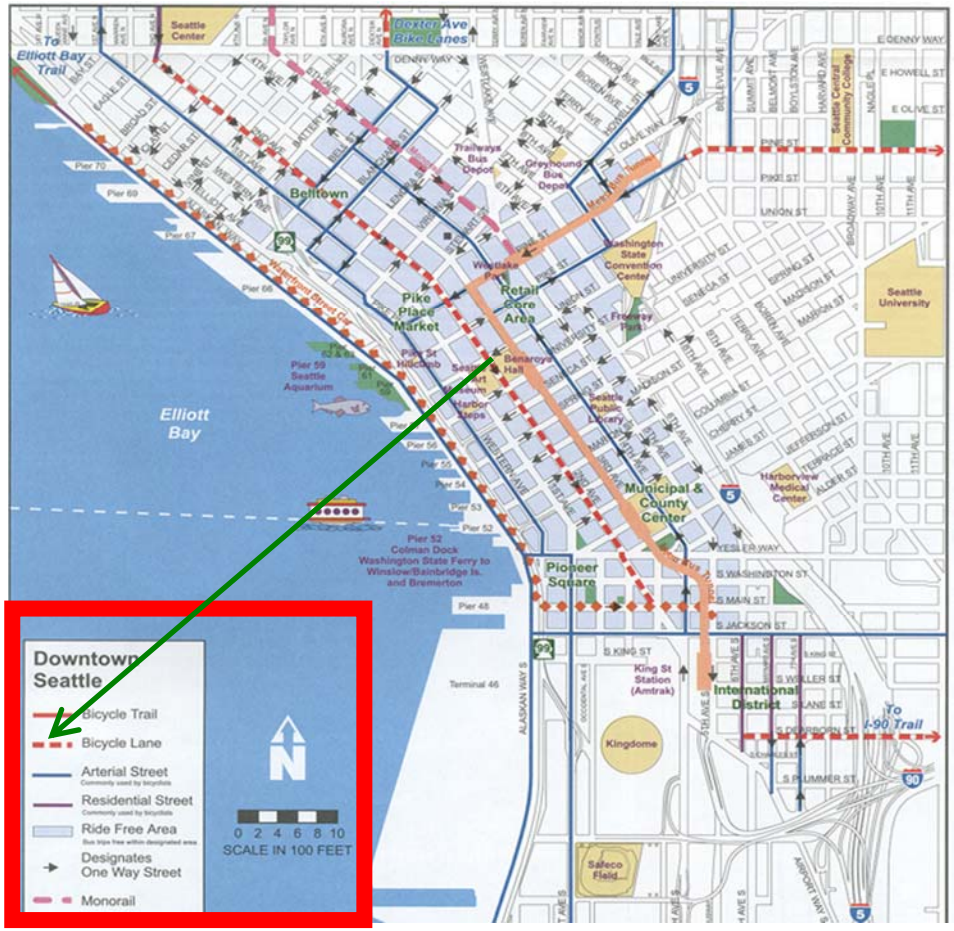
Railroads in France



Termite population in France

Metamodels explain Models

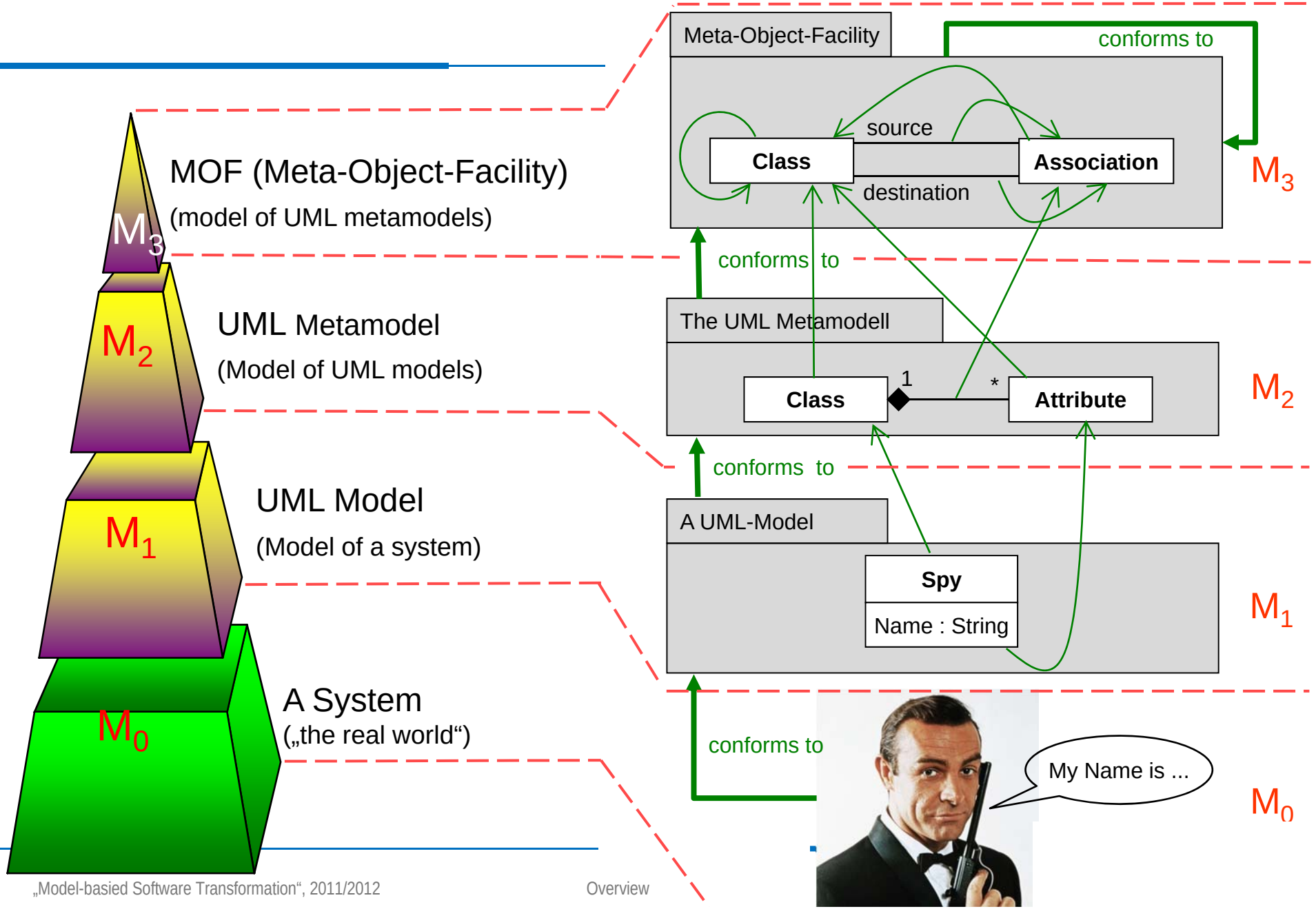
- How do we know what a map tells us?
- The „Legend“ explains the used symbols
  - „Bicycle Lane“
  - …
- It is the „metamodel“ of the map
- Metamodels model the language of models
  - Elements & their legal use → syntax
  - Meaning of elements → semantics



Meta-Modelle

- The „Image of an image of an image“ is a metametamodel
  - One could go on like this forever…
- The „image of an image of a pipe“ is a modell of a model – a metamodell
  - It captures aspects of images
    - ⇨ Frame, contents, label, …
- The „image of a pipe“ is a model of the system
  - It captures aspects of pipes
    - ⇨ Shape, colour, ...
- The pipe is real – a system.

The (Meta-)Modell-Pyramid

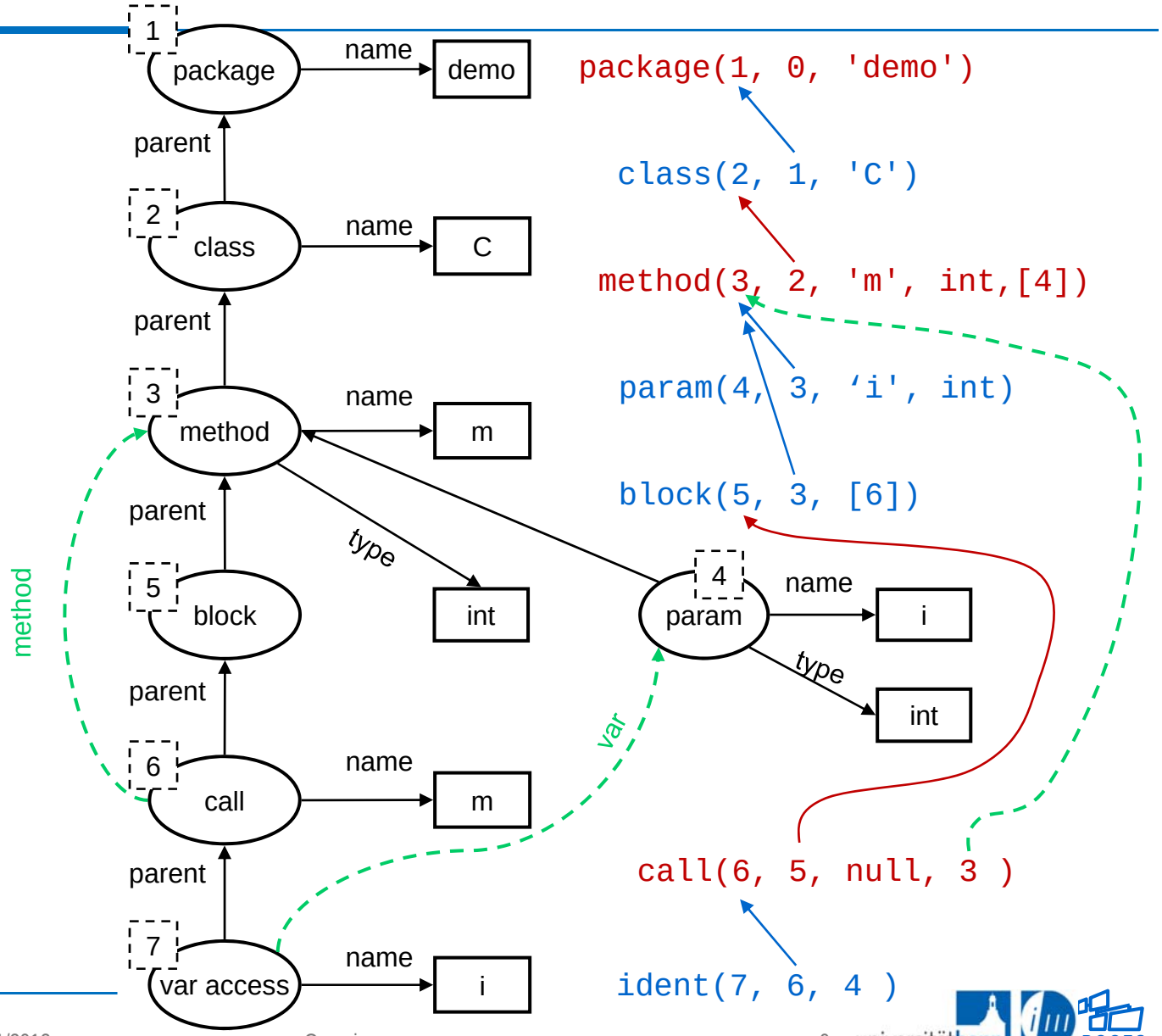


Domain Specific Language (DSL)

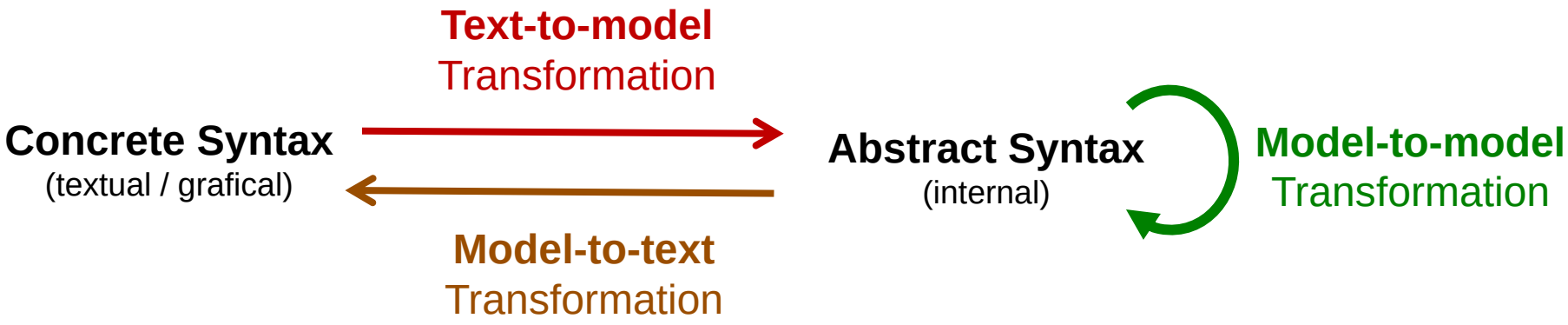
- Domain
  - An are of knowldege with tightly interrelated concepts
  - Examples: Genetics, flight control, data base management, …
- DSL – Domain Specific Language
  - Approach: The Concepts of a domain are defined by a metamodel
  - Advantages compared to general purpose language
    - ⇨ Higher abstraction level
    - ⇨ Easier understanding by domain experts
    - ⇨ Automated mapping to lower abstraction levels
  - Examples
    - ⇨ Representation of database schema by ER diagramm (grafical DSL)
    - ⇨ Representation of database schema by DDL script (textual DSL)
- MOF – Meta Object Facility
  - Model based language for defining meta models
  - Master form (unique metametamodell MMM)

Concrete versus Abstract Syntax

```
package demo;

class C {

   int m(int i) {

      m(i);
   }
}
```



Model Transformation



Choose a topic from the abovr three families of model transformation systems.

Another important topic is the introduction of the general idea of MDSE.

→ https://sewiki.iai.uni-bonn.de/teaching/projectgroups/most/2011/en/seminar

Let me know your choice by Wednesday, March 30.

Literature

In addition to the links on the course website, you can explore:

- Jean Bézivin: „Introduction to Model Engineering“
- Apache Velocity: „http://velocity.apache.org“
- EMF: „http://www.eclipse.org/modeling/emf“
- mediniQVT: „http://projects.ikv.de/qvt“

Meta-Metamodelle

M_3 = Meta-Metamodell

Ein UML-Modell
von Sprachen
zur Beschr. von Sprachen

beschreibt

M_2 = Metamodell

UML-Modell
der UML-Sprache

beschreibt

M_1 = Modell

UML-Modell eines Programms

beschreibt

M_0 = System

Ein Programm

Meta-Metamodelle

M_3 = Meta-Metamodell

Ein Bild
eines Bildes
eines Bildes einer Pfeife

beschreibt

M_2 = Metamodell

Ein Bild
eines Bildes einer Pfeife

beschreibt

M_1 = Modell

Ein Bild einer Pfeife

beschreibt

M_0 = System

Eine Pfeife

Metamodelle in UML