

Lightweight Model-Driven Engineering

Jordi Cabot



About

An aerial night view of San Francisco, California, featuring the Transamerica Pyramid and other illuminated skyscrapers. The text 'SOM Research Lab' is overlaid in large white font. Below it, the slogan 'Software runs the world. Models run the software' is written in a smaller white font. The city lights create a vibrant blue and yellow glow against the dark sky.

SOM Research Lab

Software runs the world. Models run the software



Nuestra misión

Interested in the broad area of systems and **software engineering**, especially promoting the rigorous use of software **models and engineering principles** in all software engineering tasks.



SOM

Disclaimer



“As a writer, my job is to change your perspective and make you think outside the box.” - Mary Sage Nguyen



2013

OFFENDED YOU ARE?

A FUCK I DON'T GIVE.

MDE Preliminaries

A man with a grey beard and long hair, wearing a pink shirt, covering his eyes with his hands in a dramatic gesture. The background is a grey, vertically-slatted wall.

The entire history of software engineering is that of
the rise in levels of abstraction

- Grady Booch

Goal: Write less and less code

Everybody is doing it



django



YEOMAN

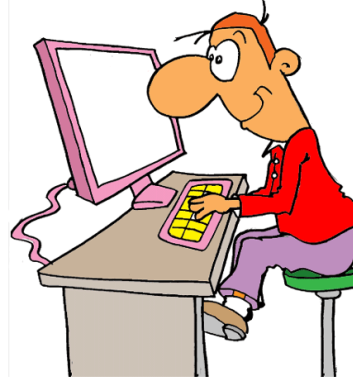
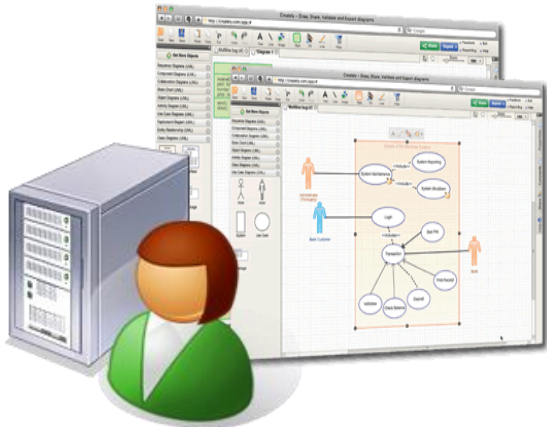


GRAILS

METEOR

THE FASTEST WAY TO BUILD APPS

MDE is just the logical next step



A great book to stick your nose in!

Software modeling FOR DUMMIES[®]

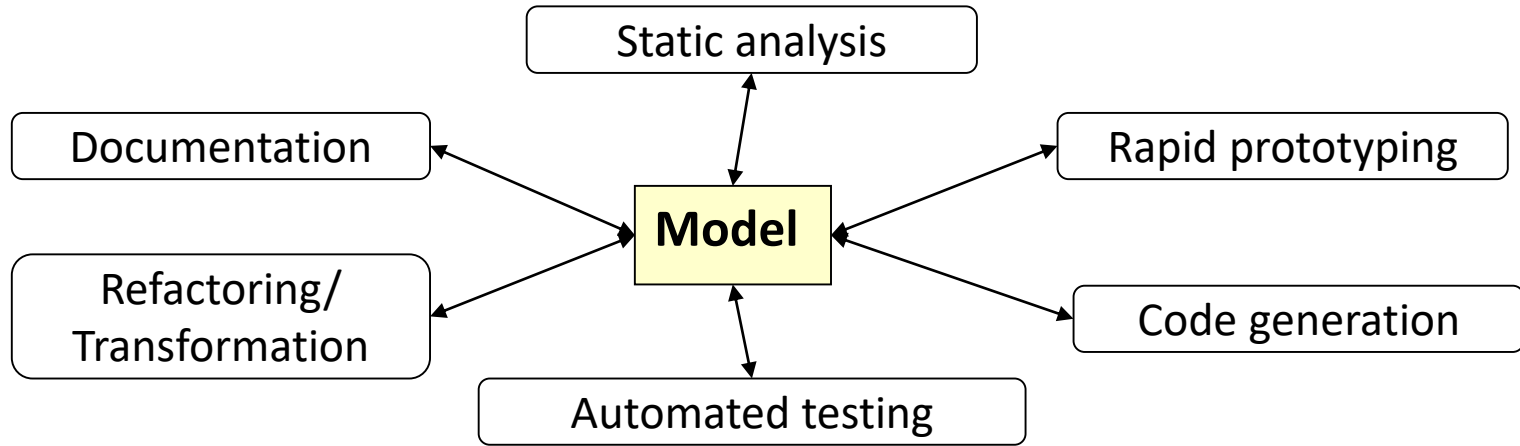
*A Reference
for the
Rest of Us!*

10 years of
research
crammed into 3
slides

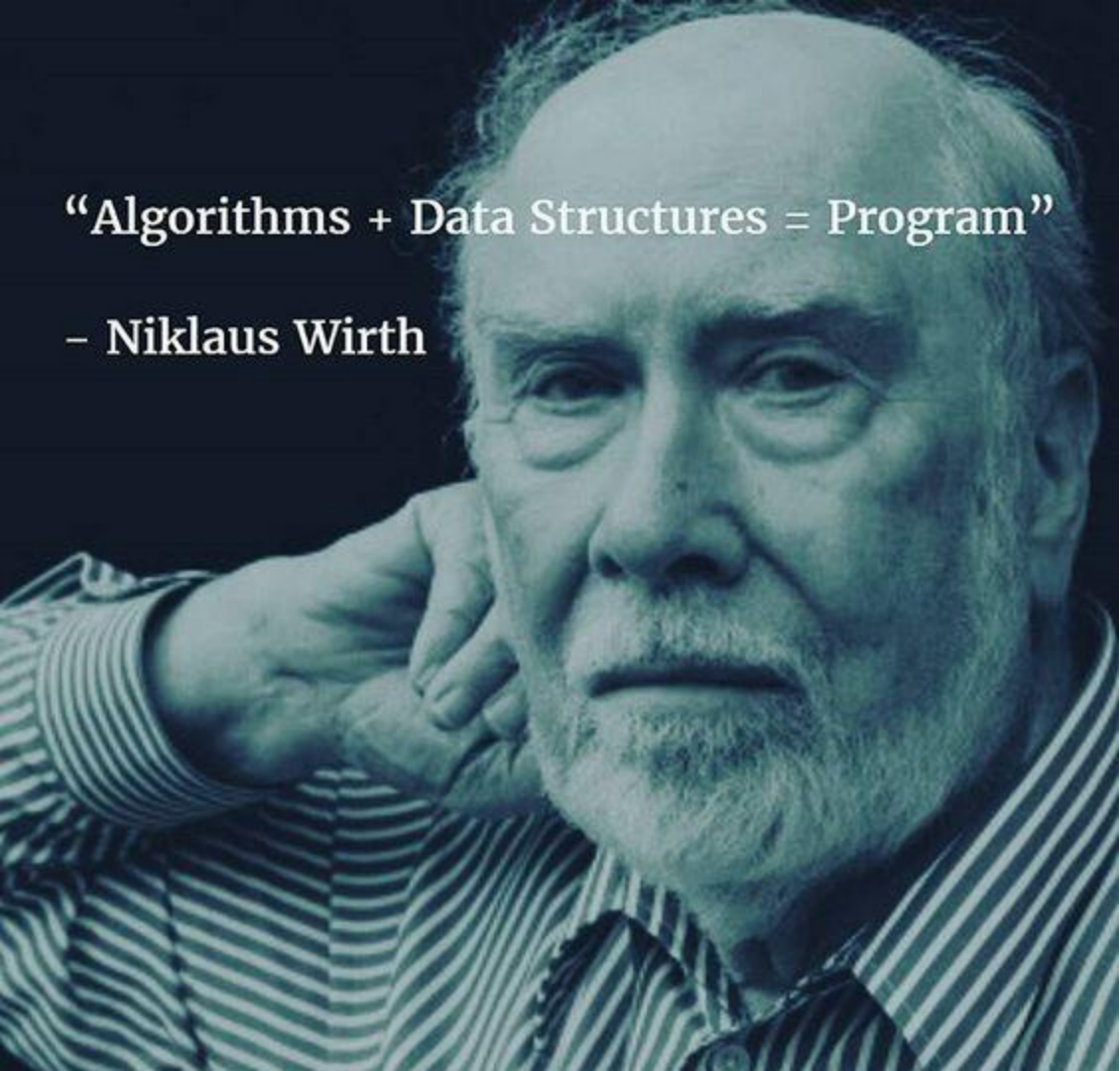
By SOM Research Lab



MDE = Models as key elements in all aspects of Software Engineering



[Illustration by Bernhard Rumpe]

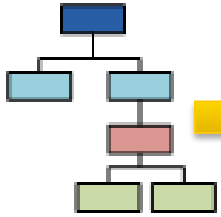
A portrait of Niklaus Wirth, an elderly man with a white beard and hair, wearing a striped shirt. He is resting his chin on his hand, looking thoughtfully towards the camera. The image has a blue tint.

“Algorithms + Data Structures = Program”

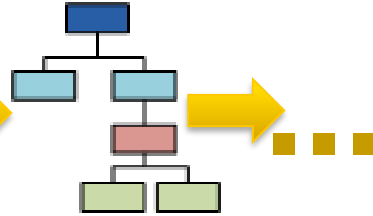
– Niklaus Wirth

The MDE equation
Models +
Transformations =
Software

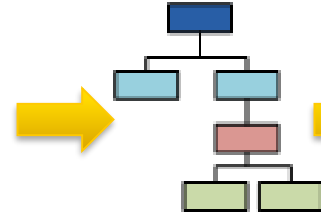
Original model



1st refinement

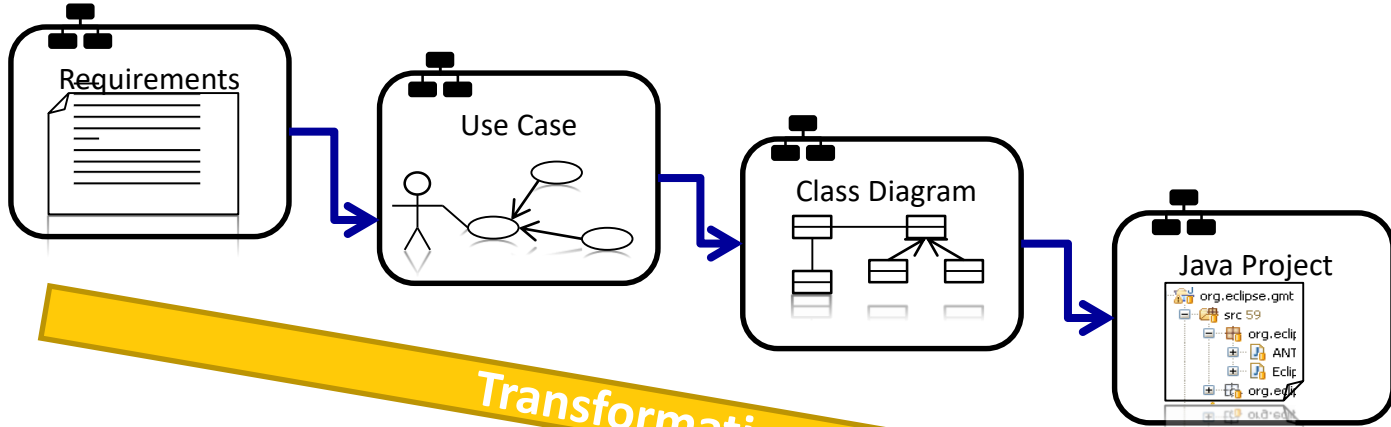


nth refinement



Model-to-model Transformation

Model-to-text Transformation



Transformations

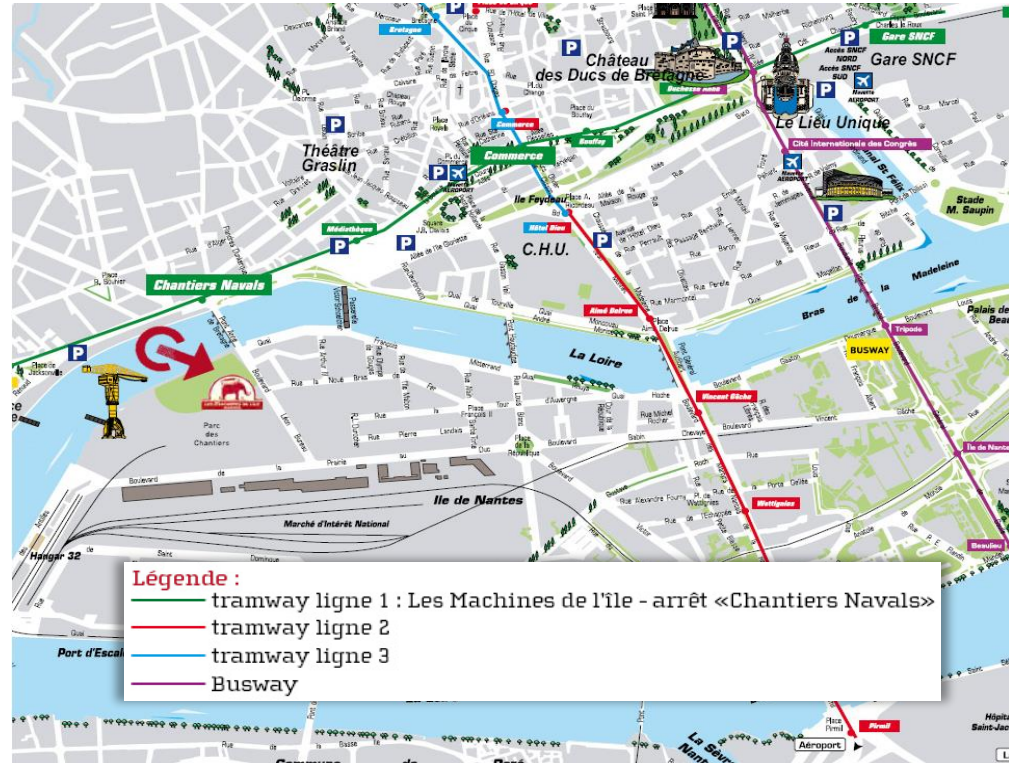
What is a model

City of Nantes = “system” to be modeled

A map is a model of this system

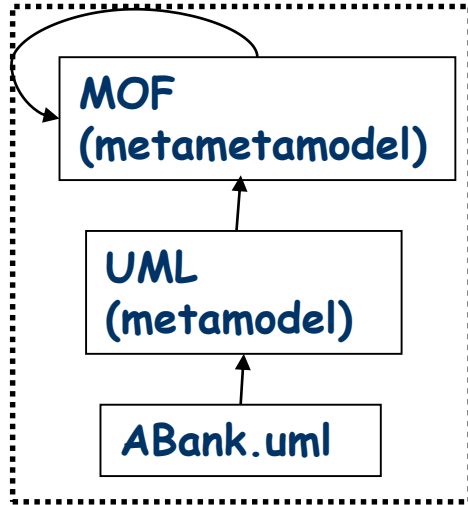
Its legend is the grammar/
metamodel

Different maps can focus on
different “views” of the city

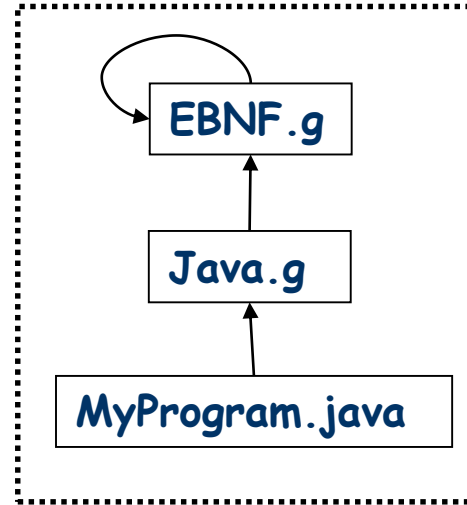


Not so different from languages

MDE



Grammarware



(common-sense) code generation

**Pareto principle for MDE:
20% of the modeling effort
suffices to generate 80% of
the application code**



Dorsal
Hombros
Triceps
Gemelos

Hold down "Control", or "Command" on a Mac, to select more than one.

MDE benefits

```
graph TD; A[MDE benefits] --- B[+productivity]; A --- C[+quality]; A --- D[+Maintenance]; A --- E[....]; B --- B_val[2X - 8X]; C --- C_val[1.2X - 4X]; D --- D_val[80%];
```

+productivity

2X - 8X

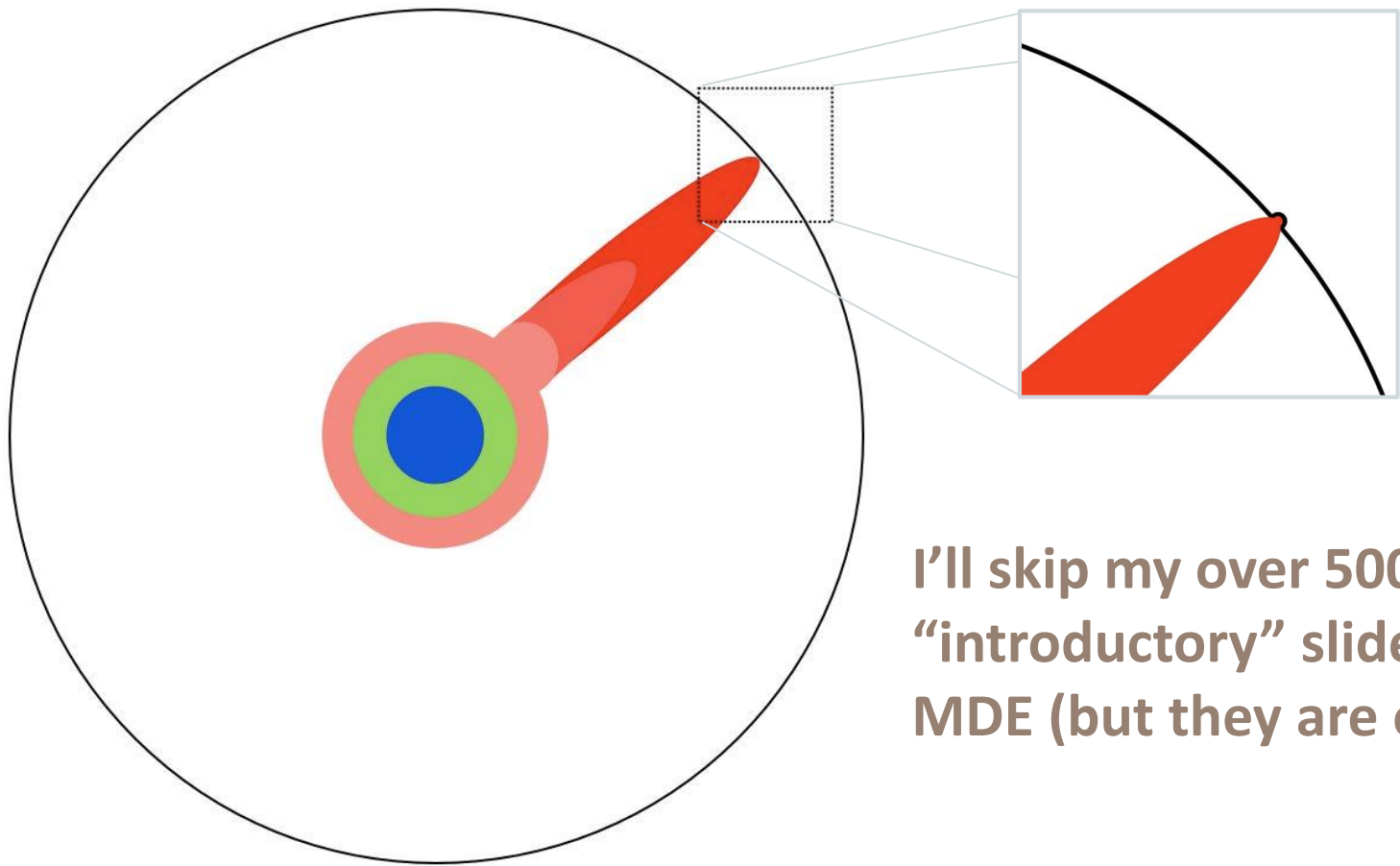
+quality

1.2X - 4X

+Maintenance

80%

....



**I'll skip my over 500
"introductory" slides to
MDE (but they are online)**

Lightweight adoption of MDE



“Modeling will be commonplace in three years time.”

– Stephen J. Mellor

**BUT he is saying
this since 1985**



There is still money to be made on this market

55M



outsystems




mendix

25M



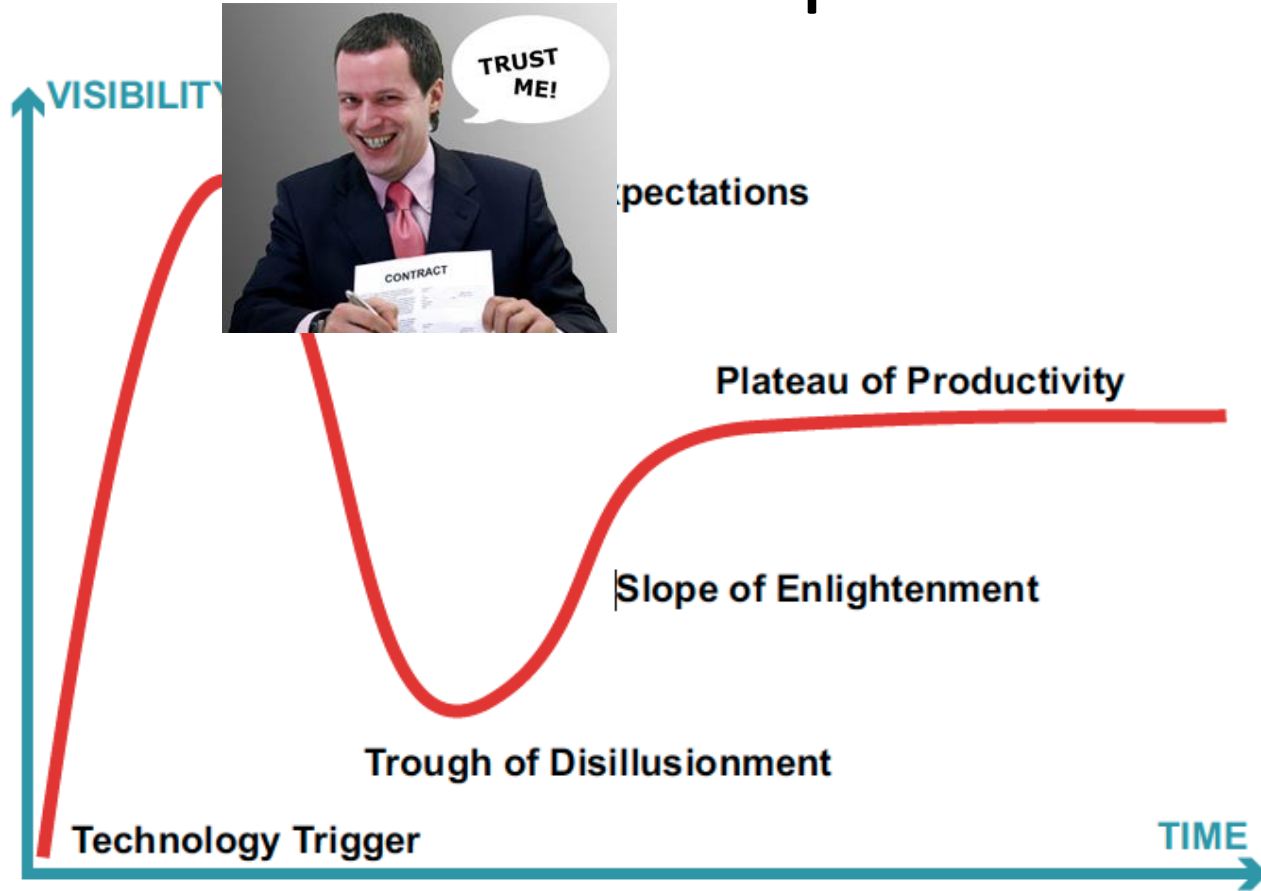
Lucidchart

36M



**Do you really think Agile has more
market penetration?**

MDE Adoption



GAULISH VILLAGE

COMPENDIUM

LAUDANUM

TOTORUM

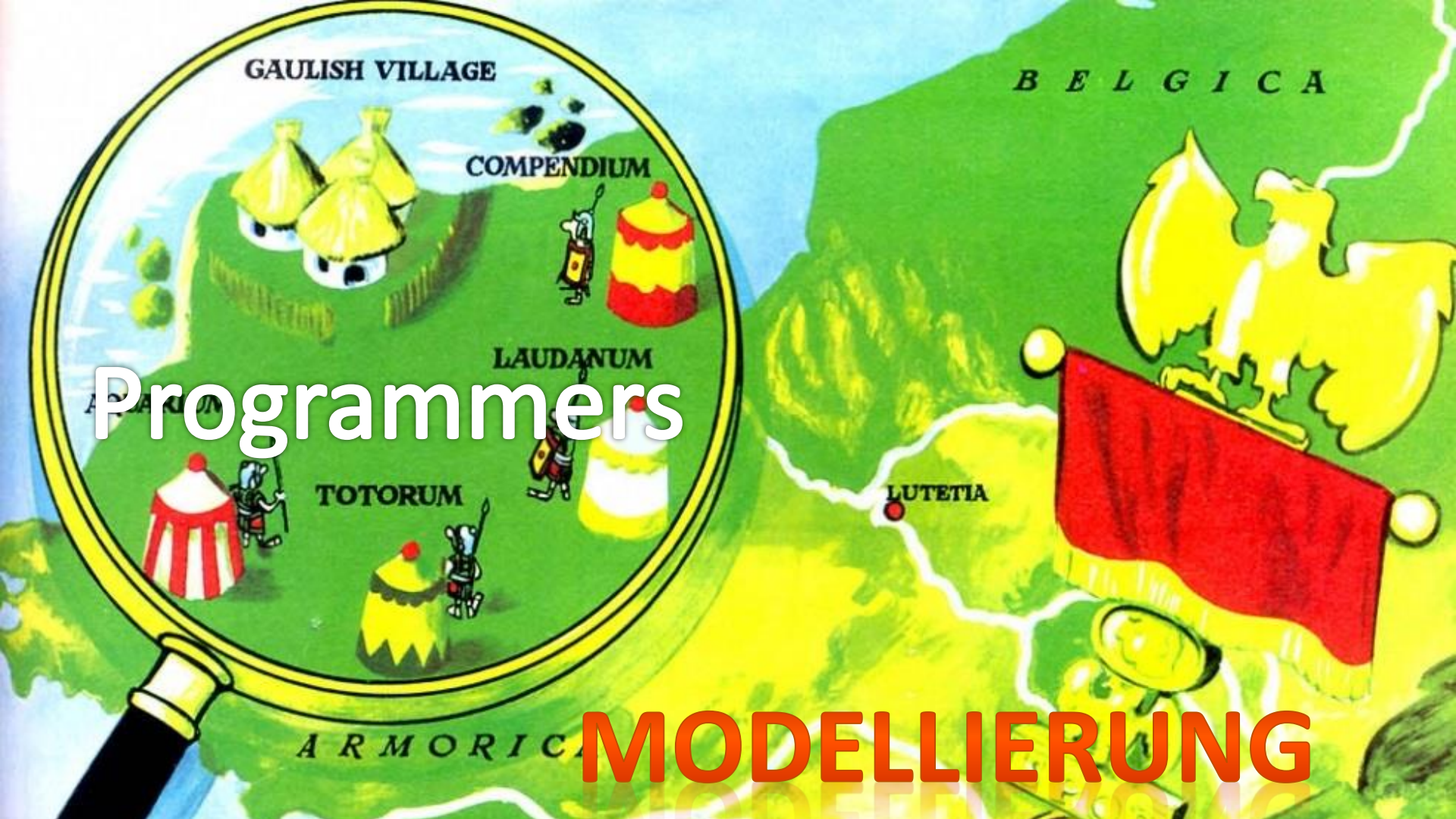
Programmers

BELGICA

LUTETIA

ARMORICA

MODELLIERUNG





You can use an eraser on the
drafting table or a sledge hammer
on the construction site.

— *Frank Lloyd Wright* —

AZ QUOTES

To model, or not to model, this is the WRONG
question

- Shakespeare



Real question

**What/when/how many
models ?**

**- Depends on: Size,
Team, Domain,
Complexity**

A black and white portrait of George Box, an elderly man with glasses, resting his chin on his hand. The image is semi-transparent and serves as a background for the quote.

“All models are wrong but
some are useful.”

- George Box

Why lightweight MDE

Even if MDE is not dead...



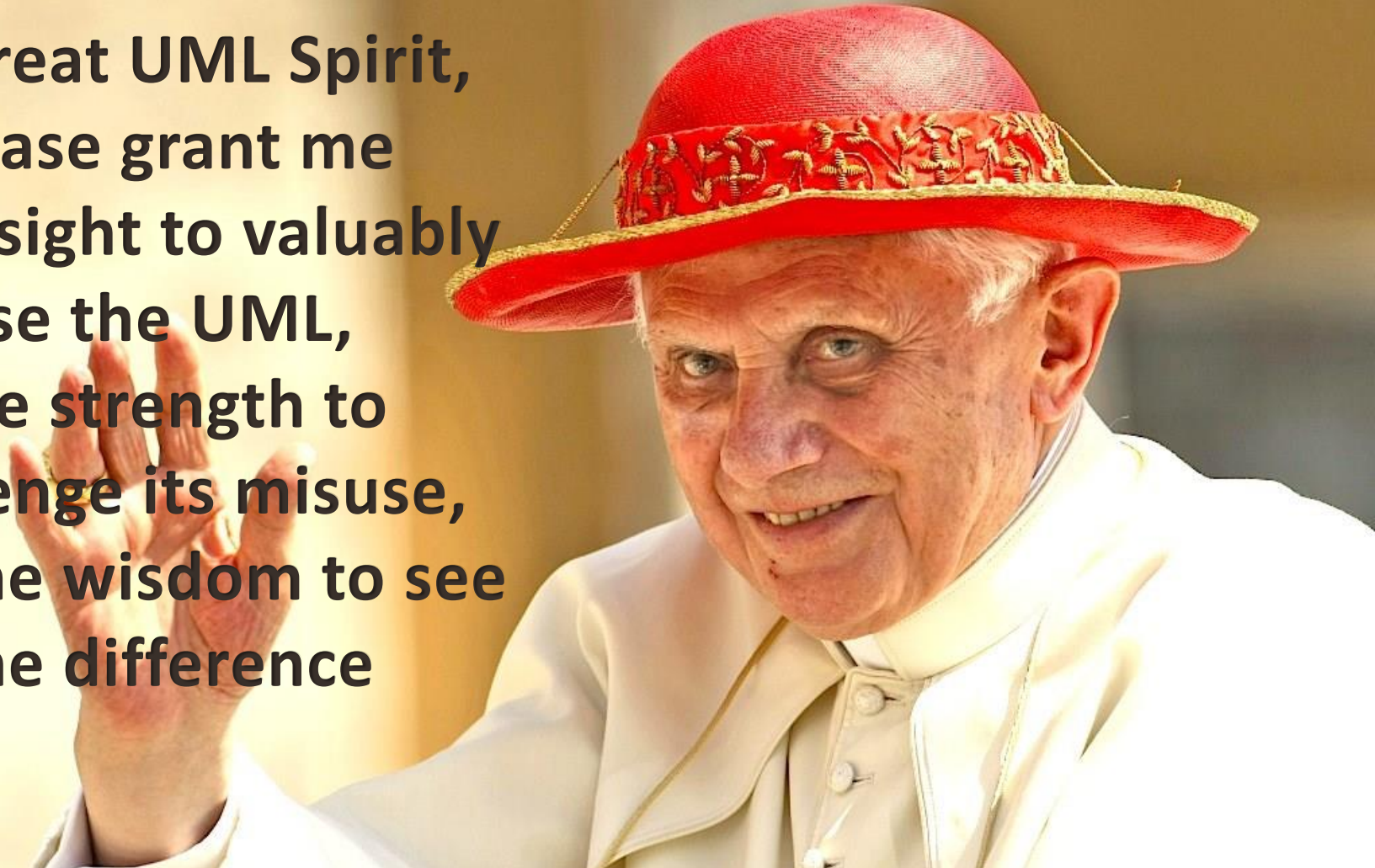


User experience

Design

MDE Research vs User
needs & interests

**Oh great UML Spirit,
please grant me
the insight to valuably
use the UML,
the strength to
challenge its misuse,
and the wisdom to see
the difference**



Metamodelers anonymous

MMA is a support network to help those unfortunate people who are **seriously addicted to meta-modelling**. You should [contact us](#) if you or someone you know suffers from any of the following **symptoms**. We are here to help.

- Withdrawal symptoms (repetitive constraint writing tendencies) when unable to meta-model.
- Hiding meta-models around the house or workplace.
- Pretending that the document you're reading is not a meta-model, e.g. disguising it as a model.
- Constantly philosophising about your life as an object, or reflecting on the 4-layer meta-model.
- Worrying about where your next meta-model is going to come from.
- Worrying about the spelling of 'modeller' versus 'modeler' and 'meta-model' versus 'metamodel'.
- Putting off important tasks just to meta-model.
- Writing [philosophical stories](#) about levels of reality and the meaning of the universe.
- Forgetting whether you're at level 0 or level 3. And what is level 0 anyway?

Remember that it is easier to deny, than to accept that you are a meta-modeller. [Reflect](#) on it.

The background features a dark red and black color scheme with a grid of small white plus signs. On the left side, there are several faint, overlapping line graphs and bar charts in shades of red and white, suggesting a financial or data analysis context. The main text is centered and rendered in a large, bold, sans-serif font.

Death by UML

ALEX E. BELL, THE BOEING COMPANY

Operación bikini



Revisiting MDE under a lightweight perspective

Lightweight application of MDE

CAN

Everything is a model

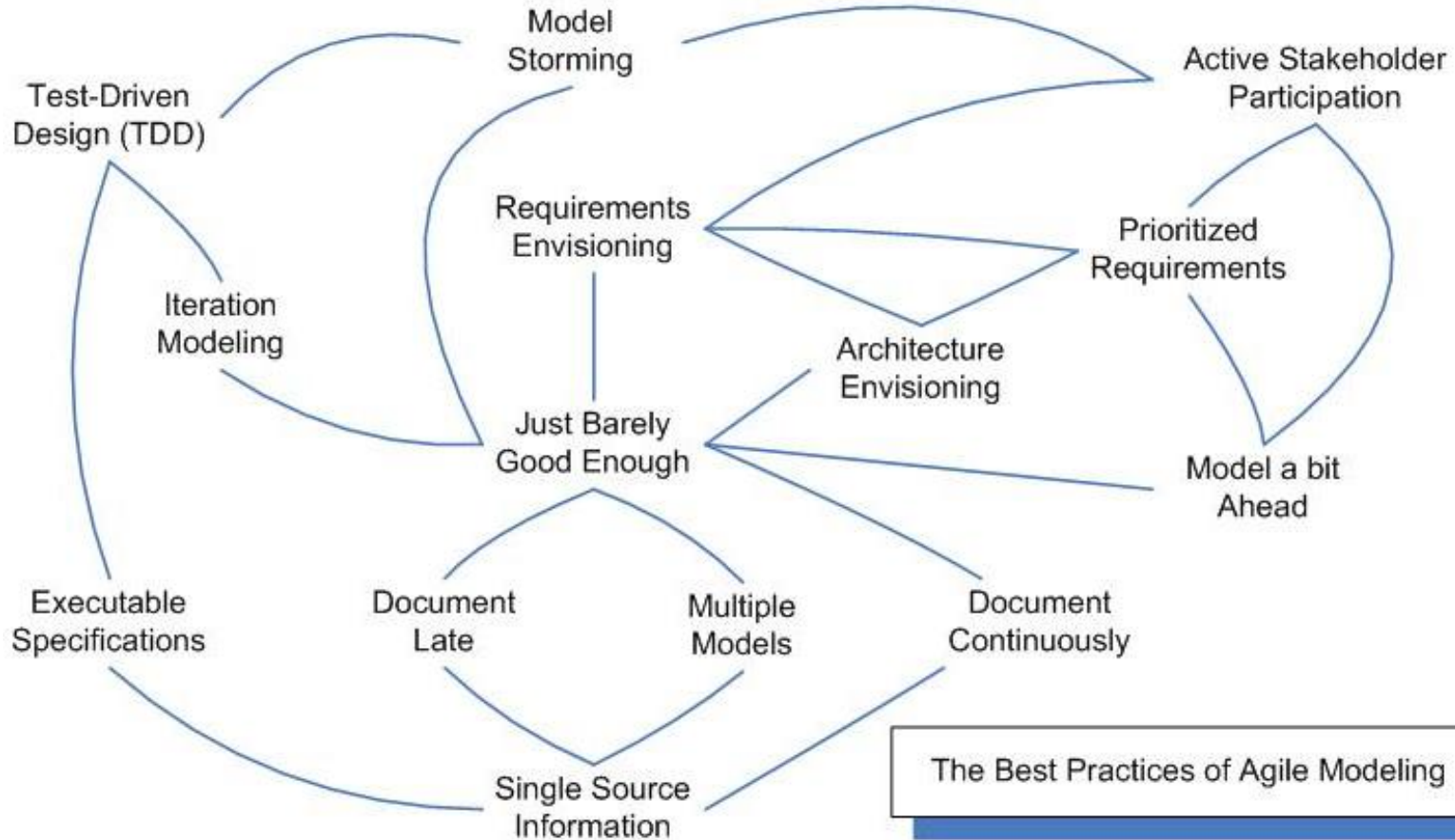
BE



Models in real development processes



Agile Modeling



The Best Practices of Agile Modeling

Collaboro: end-user driven DSL Development

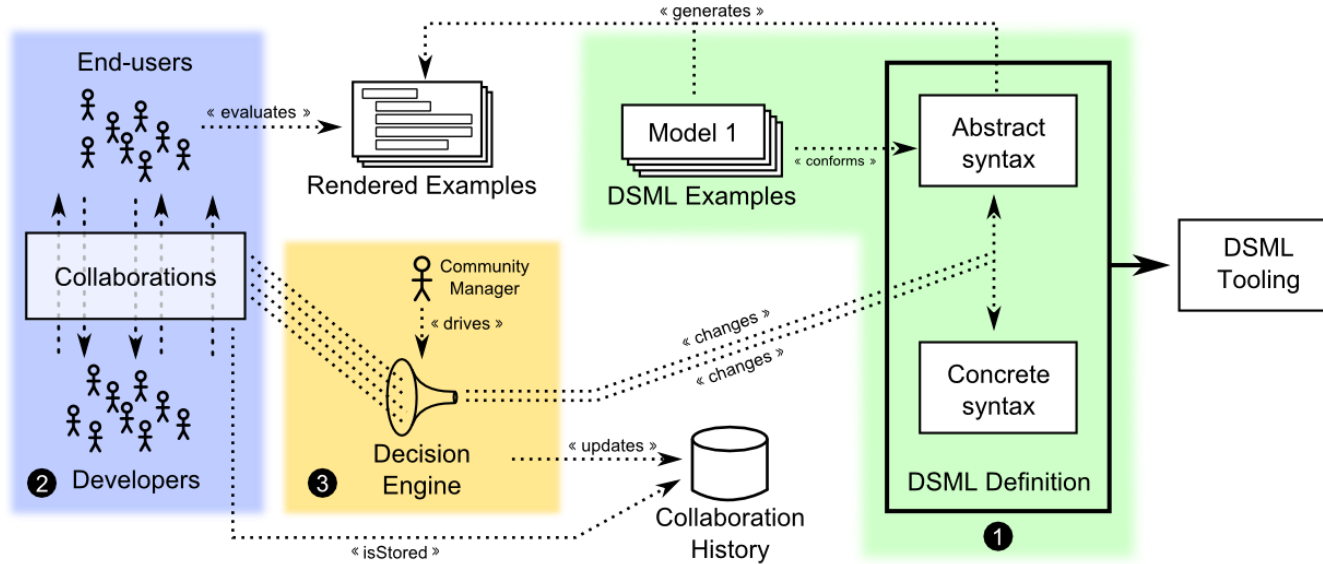
Participation

- Providing means to discuss about language elements
- Overcoming technical barriers

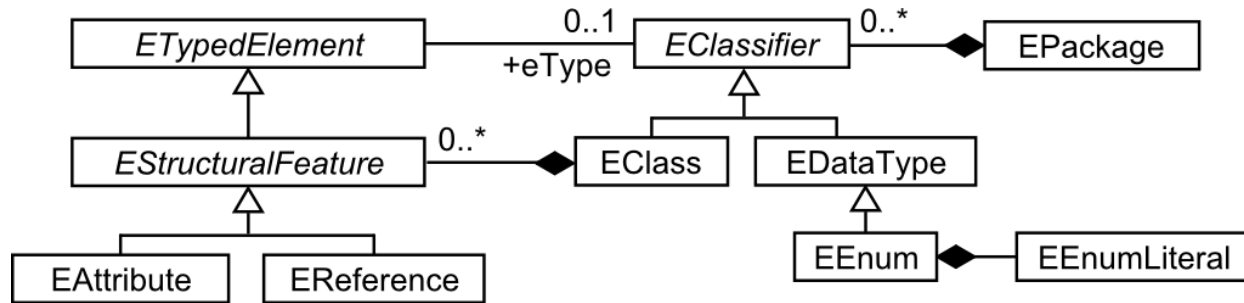
Collaboration

- Suitable environment fostering end-user discussion
- Facilitating voting and decision processes
- Keeping traceability

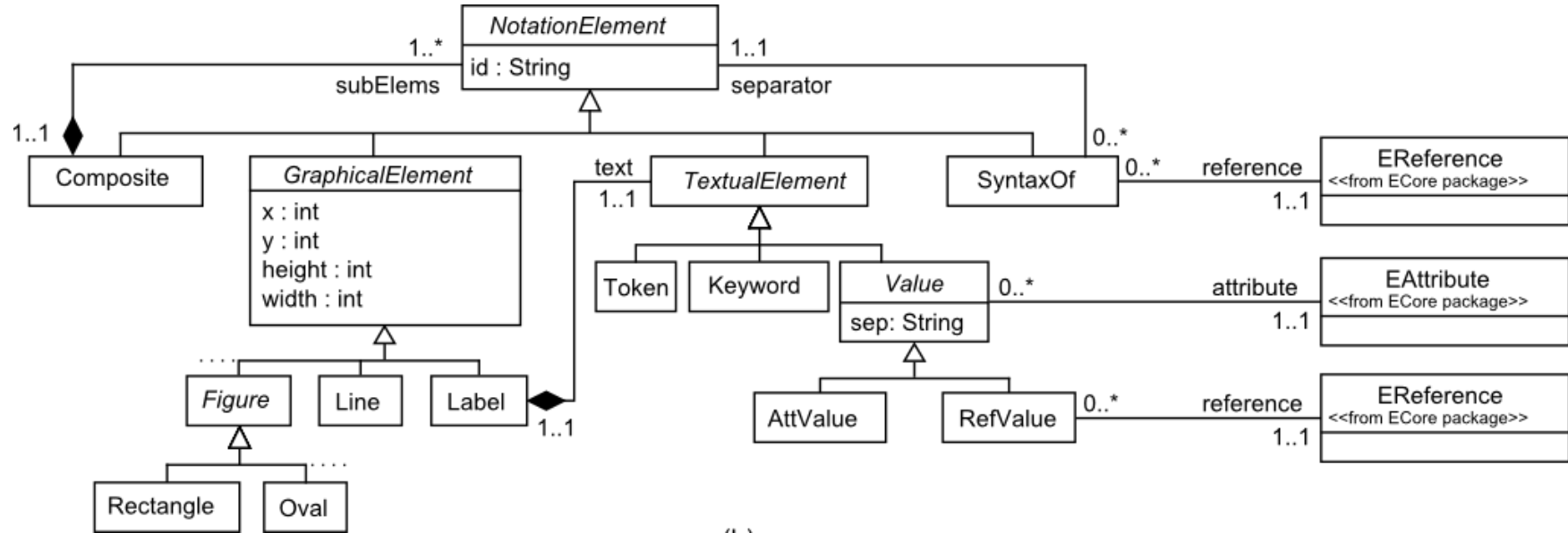
Collaboro process



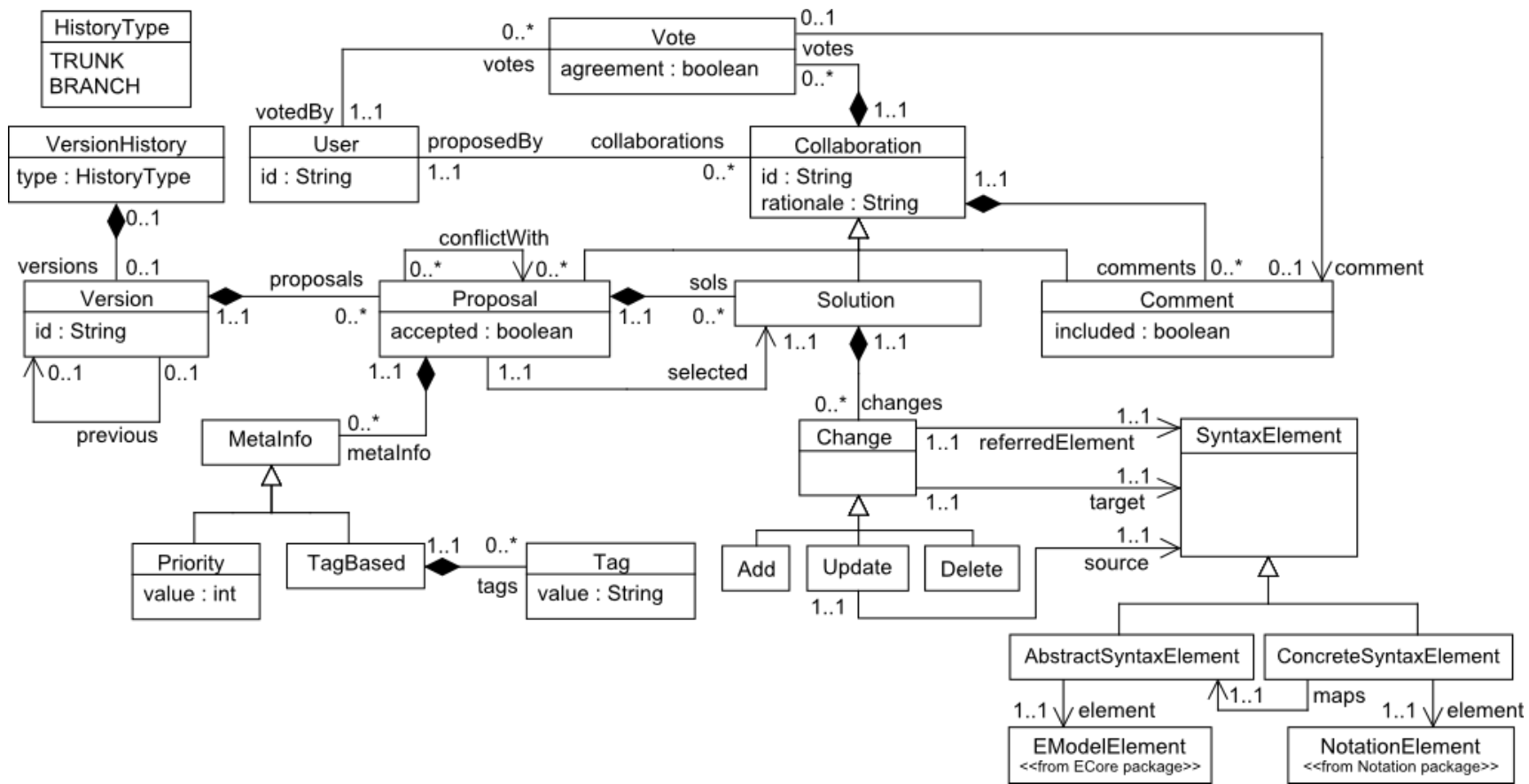
Discussing the abstract syntax



Discussing the concrete syntax



Representing collaborations



Lightweight learning of MDE

Tried **twice** to teach
MDE to undergrads

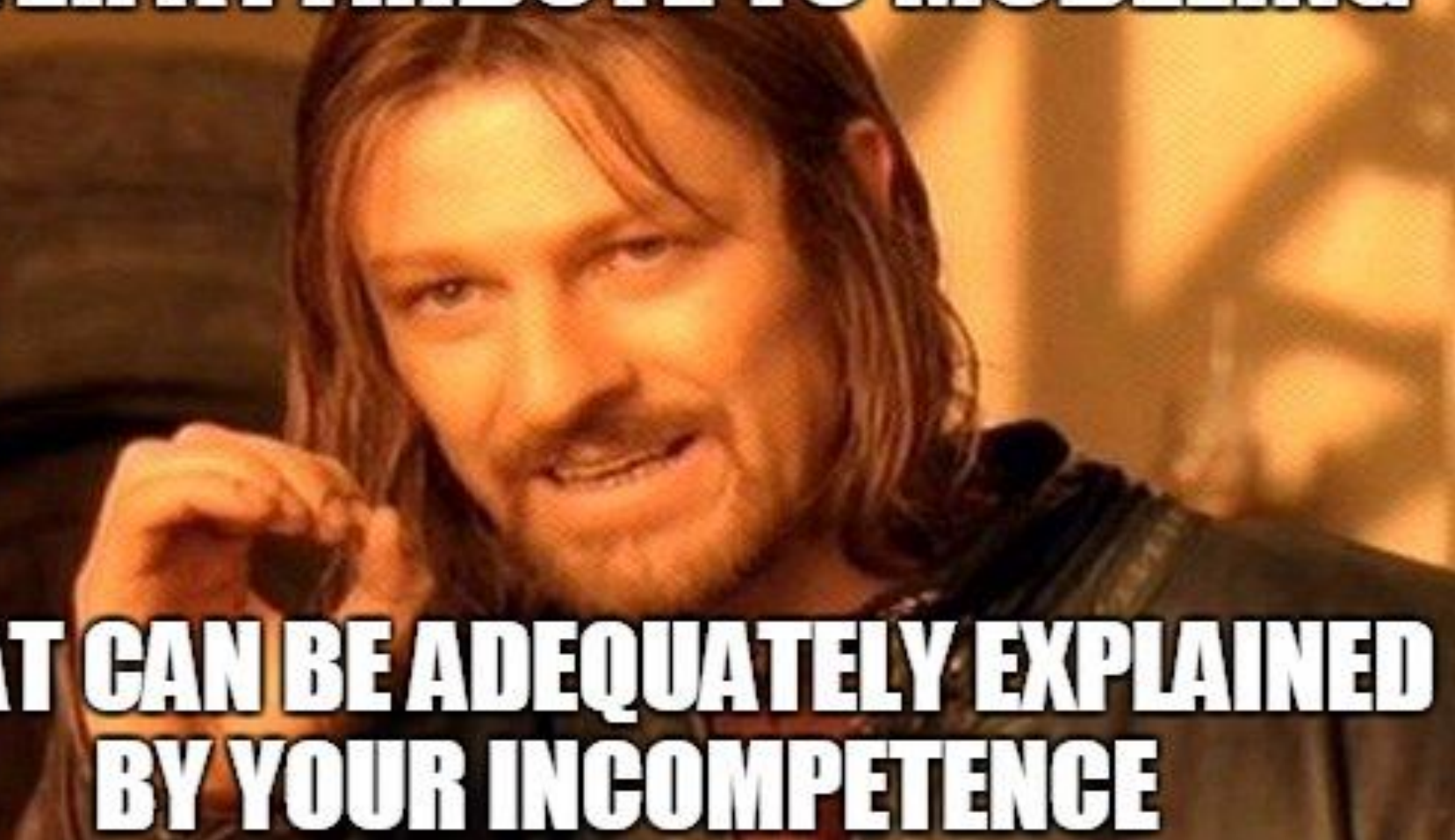
How did it go?



WATCH
FOR
ICE



NEVER ATTRIBUTE TO MODELING



**WHAT CAN BE ADEQUATELY EXPLAINED
BY YOUR INCOMPETENCE**

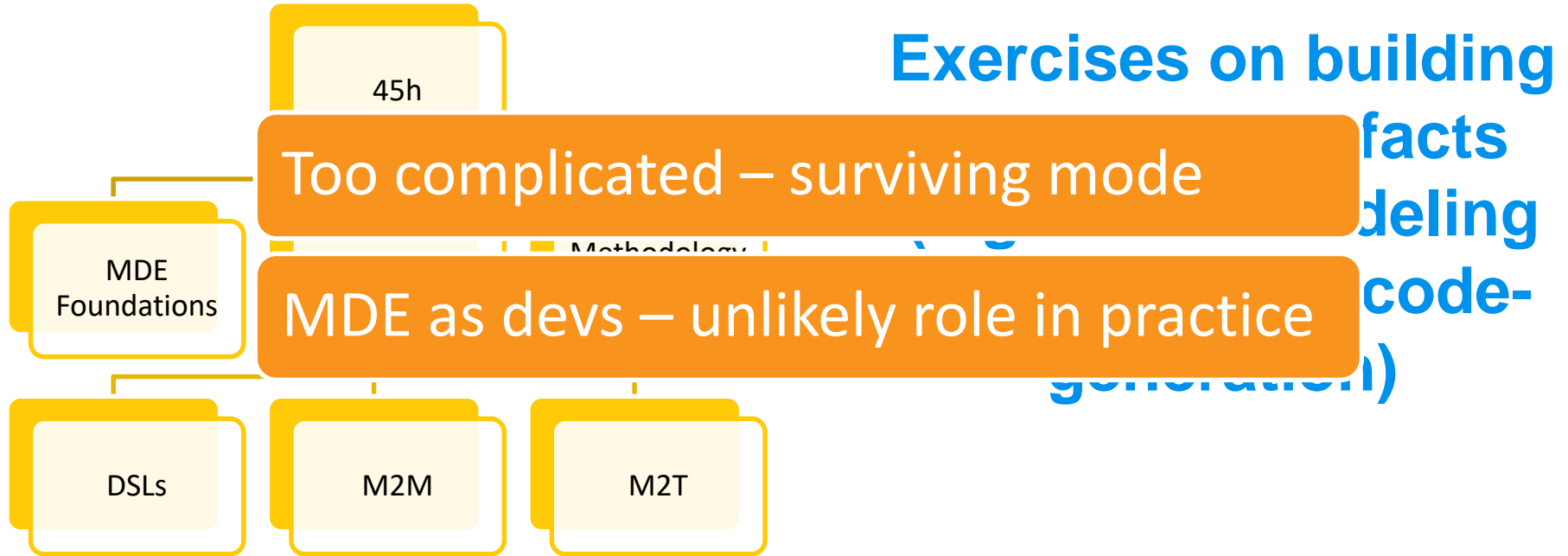


What can we learn
from this? How to
effectively teach
MDE?

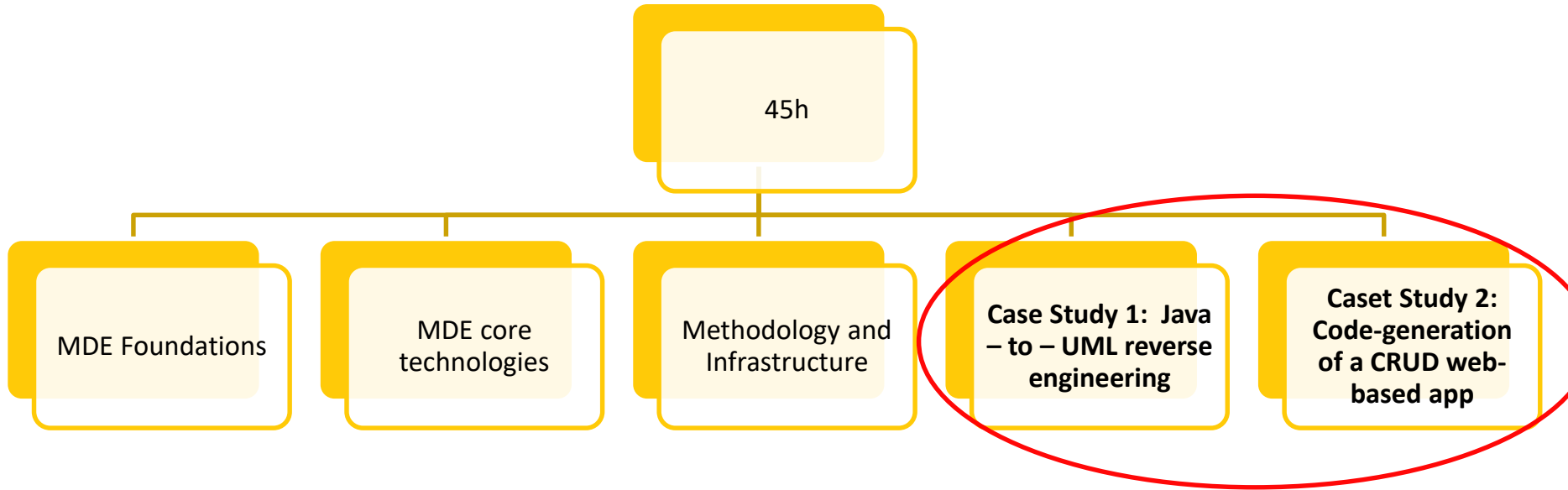


**If we lose them now,
it's unlikely they will
come back!!!!**

1st Attempt: Students as MDE devs



2nd Attempt: Students as MDE users



CSs chosen to highlight the benefits of MDE

Better in theory – Blame the tools for the results

Lots of installation problems

Lack of optimization for the generated app

Tool crashes and corrupted projects

Lack of documentation

Difficult to customize the code

Blame the chosen examples

Maybe good for the database and back-end, not the front-end

This can already be done with current programming frameworks

Missing common pre-implemented patterns (login, social networks)

Difficult trade-off.

- Too expressive and people feel it's a huge investment to learn
- Too simple and people don't perceive the benefits

Recommendations
(but no magic potions)



For instructors

- Start with a very compelling development scenario
- Change the requirements late in the development
- Use a repetitive scenario
- Compile a set of reference examples to give a kickstart
- Keep you target audience in mind

For tool vendors

- Document, document and document
- Hide all underlying technical details (also for errors)
- Offer a well-packaged and standalone installation
- Keep up with the trends in the software industry
- Favour trust over everything else

MDE USE-CASES FOR EDUCATION



Use-cases for teaching model-driven engineering principles and tools.

 [Show me the use-cases](#)



FROM RESEARCH TO INDUSTRY

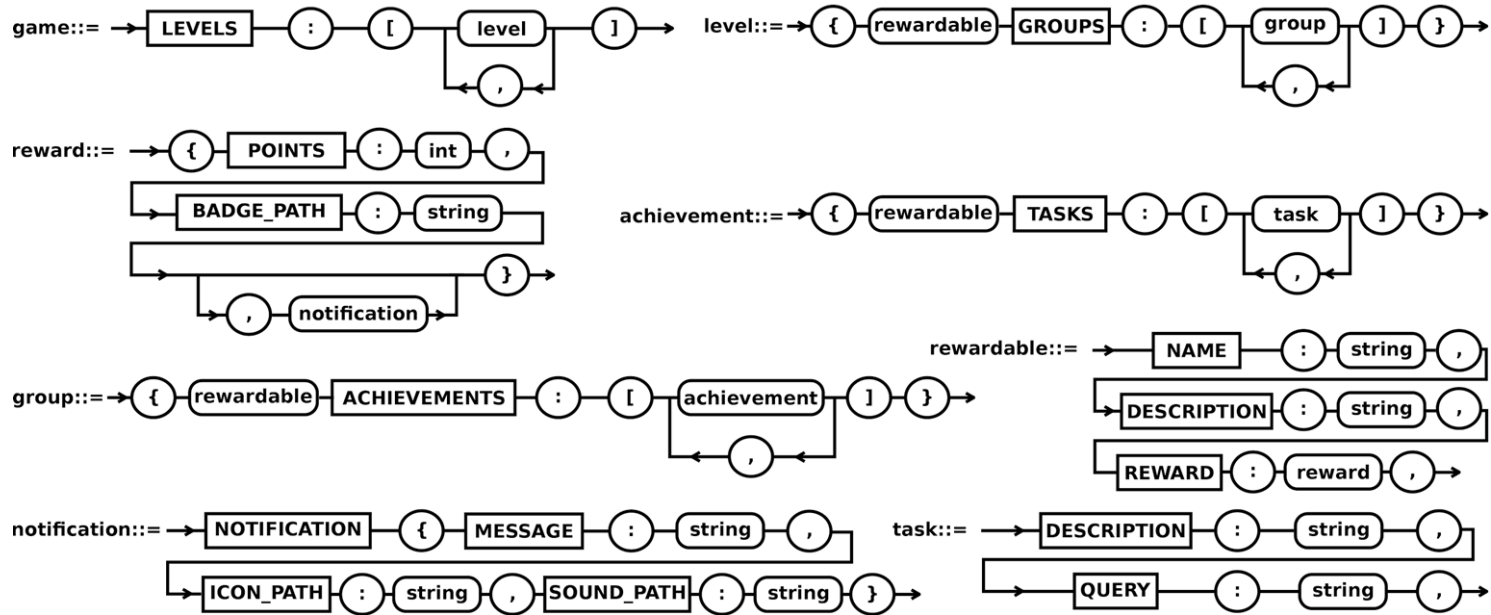
cea tech

list



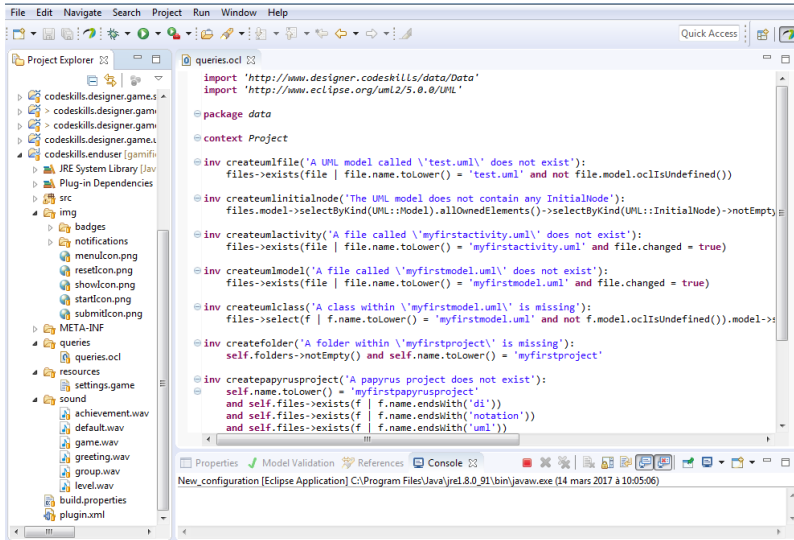
PAPYRUS GAMIFICATION

GAMIFICATION FRAMEWORK FOR END USERS - THE DSL

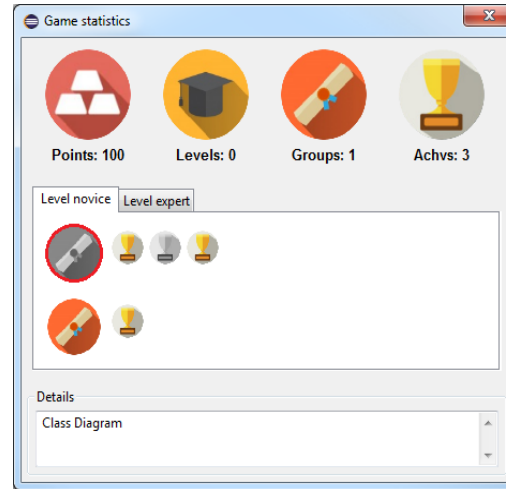


GAMIFICATION FOR END USERS - THE TOOL

QUERY



GAME STATISTICS



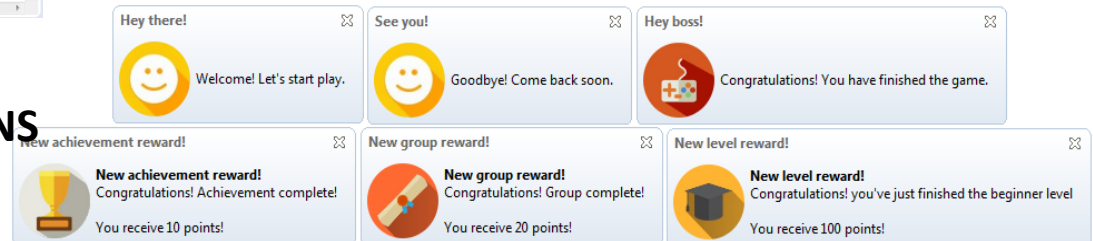
SUBMIT FORM

The 'Submit result' form contains the following fields:

- Server URL:
- Credentials Username:
- Credentials Email:
- Registration Password:
- Registration New user?:
- Registration Repeat Password:
- Registration Date of birth:
- Registration Location:
- Registration Academic title:
- Registration Profession:
- Registration Company/Institution:

Buttons: OK, Cancel, Reset All

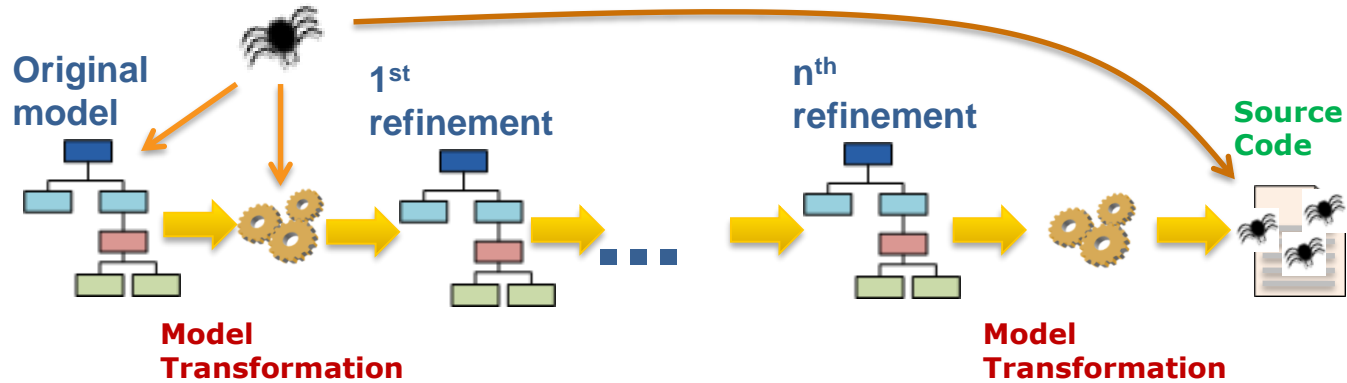
NOTIFICATIONS



Lightweight verification for MDE

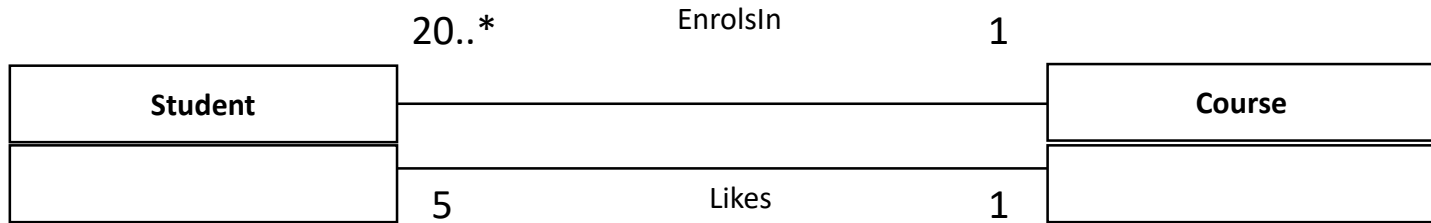
Why model verification

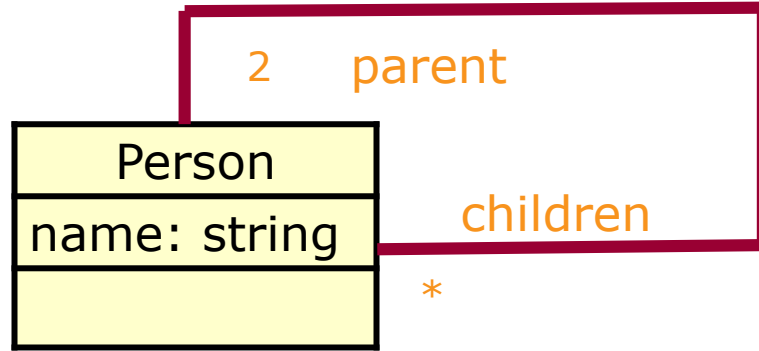
MDE-based software development process



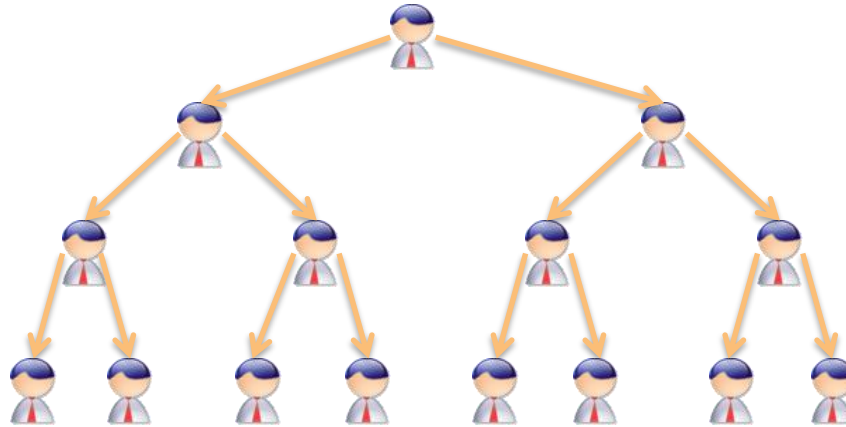
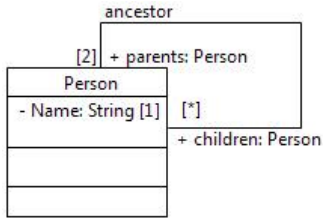
Errors in models breed and generate more errors in the code

Even “trivial” models can be wrong



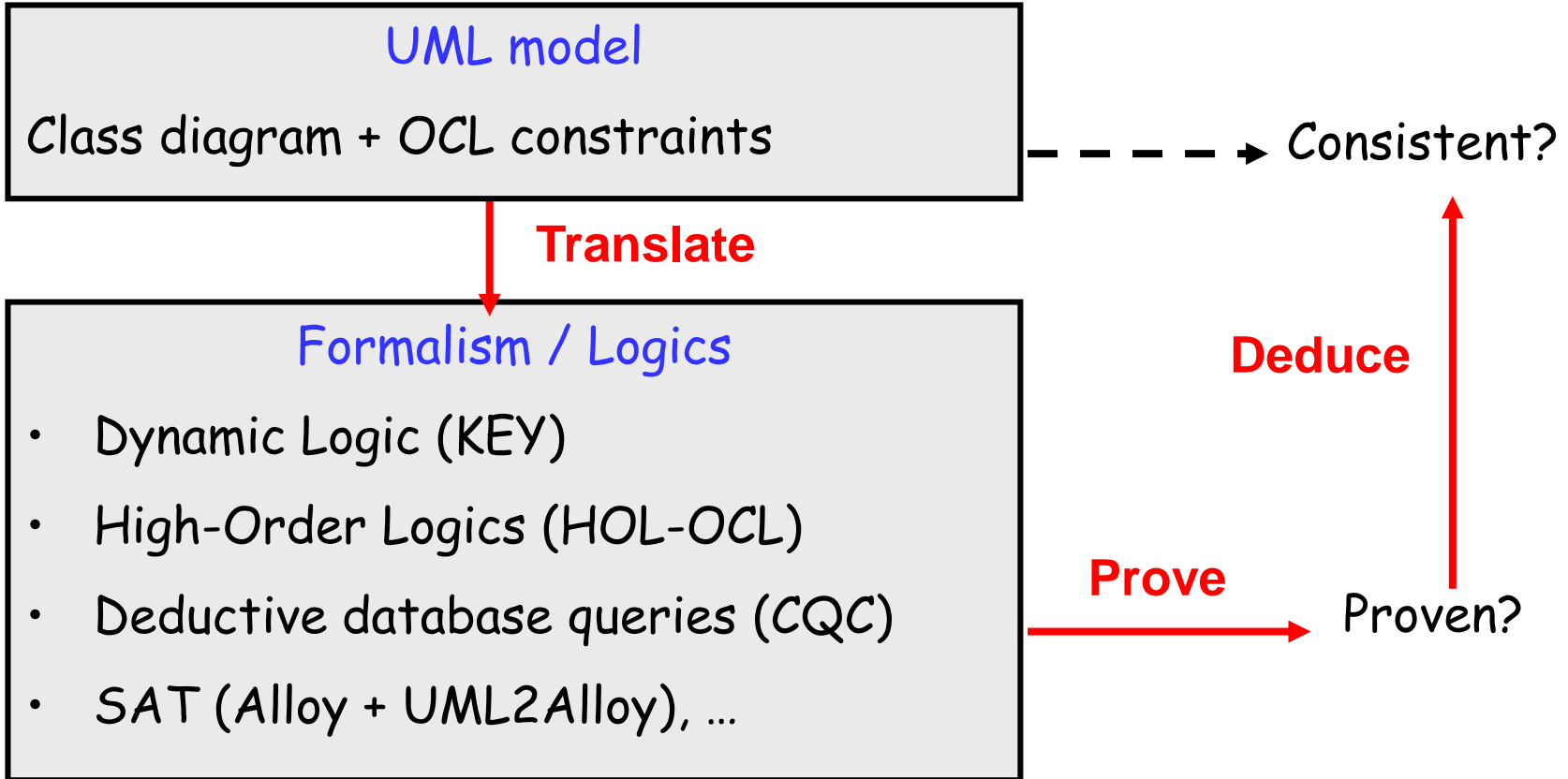


+ constraint : Nobody can be his own ancestor

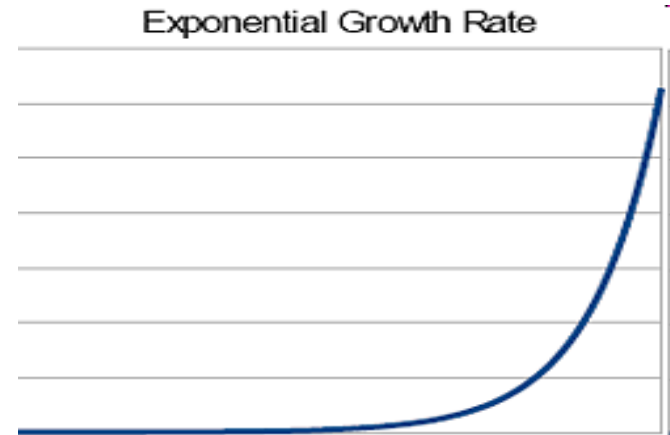
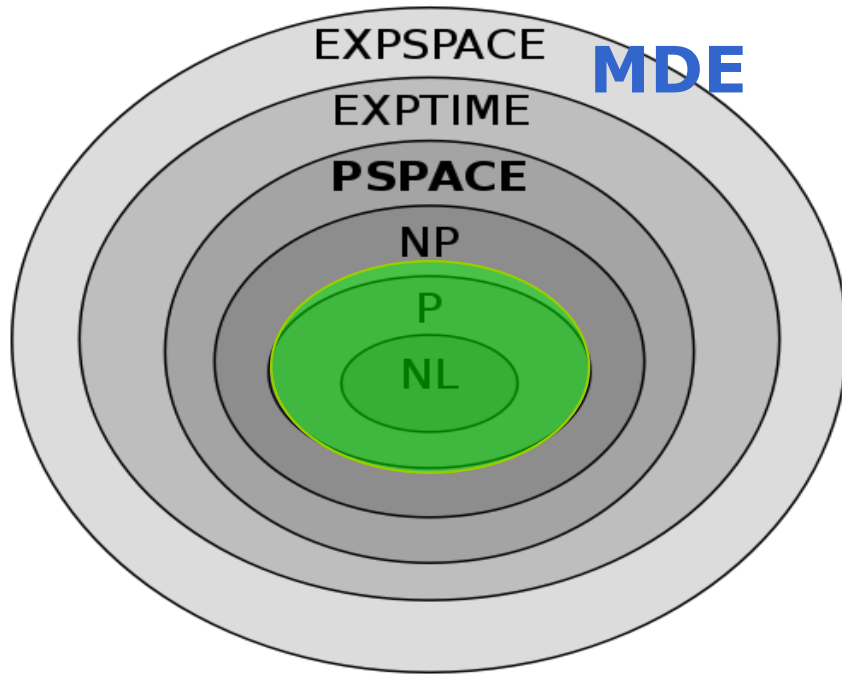


No finite (and non-empty) solution

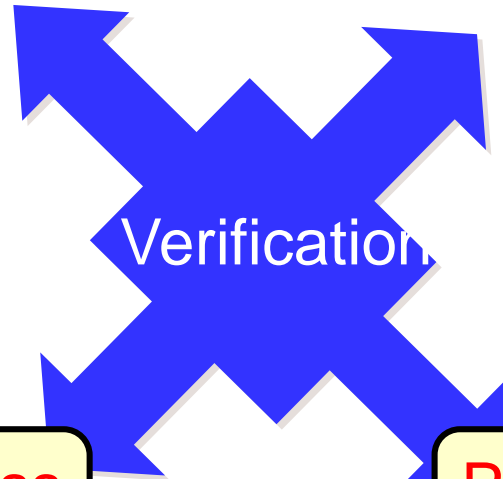
Typical solutions



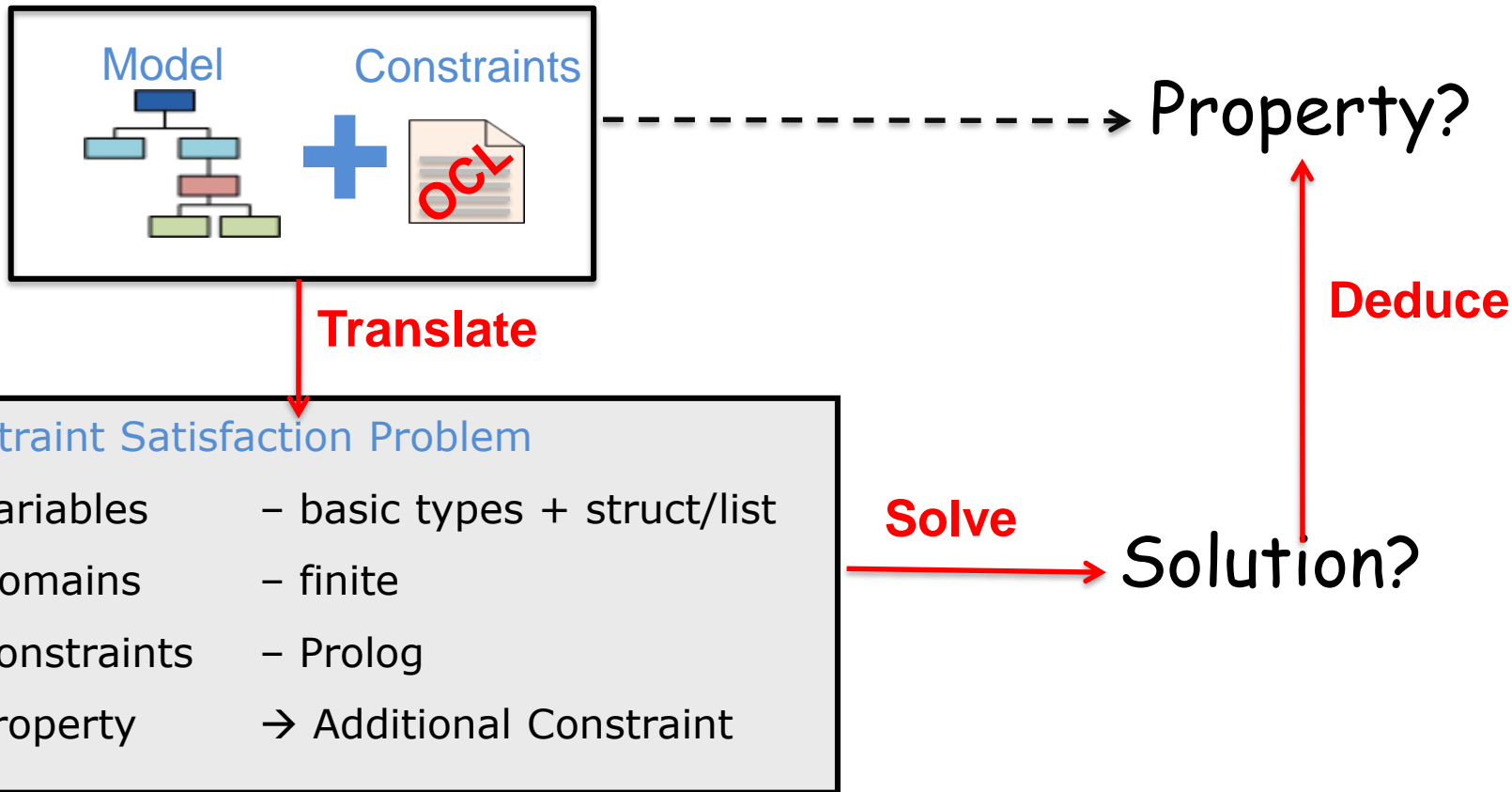
A Grand Challenge



Pick only 2-3



Our pragmatic approach: Bounded verification



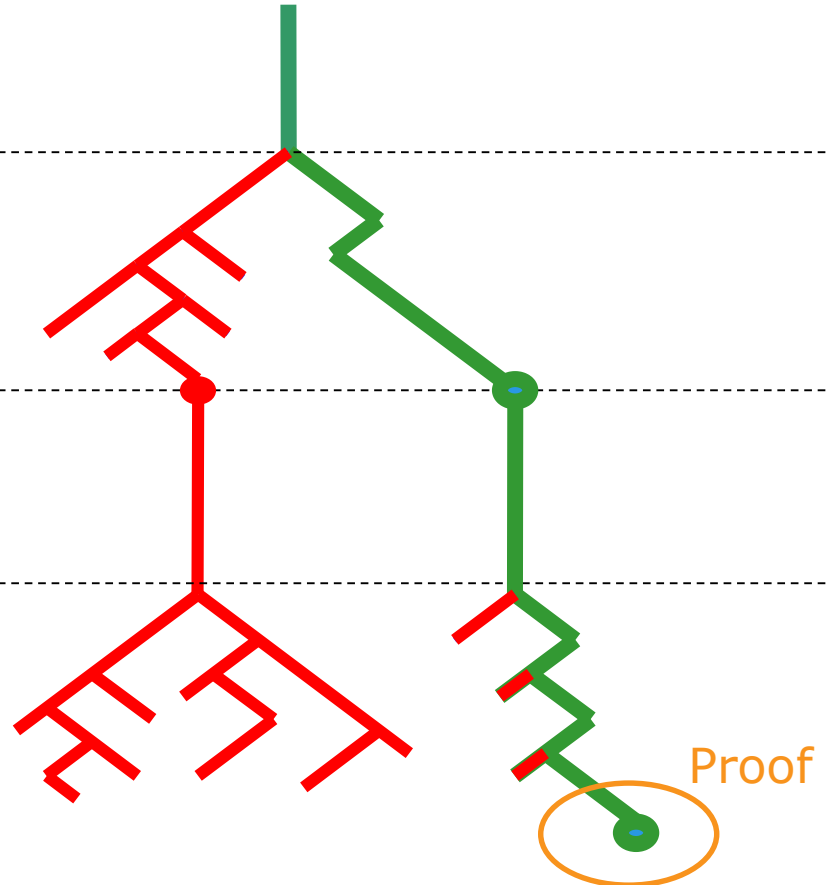
Resolution of the CSP

Define cardinality variables
Constraints on cardinalities

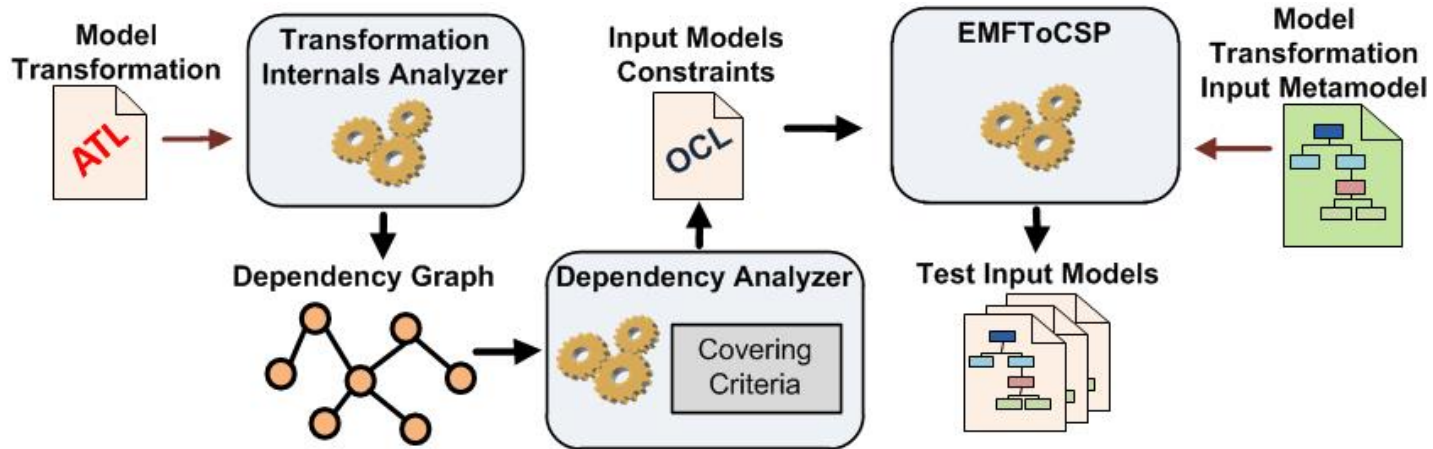
Assign cardinalities

Define attribute variables
Constraints on attributes

Assign attributes



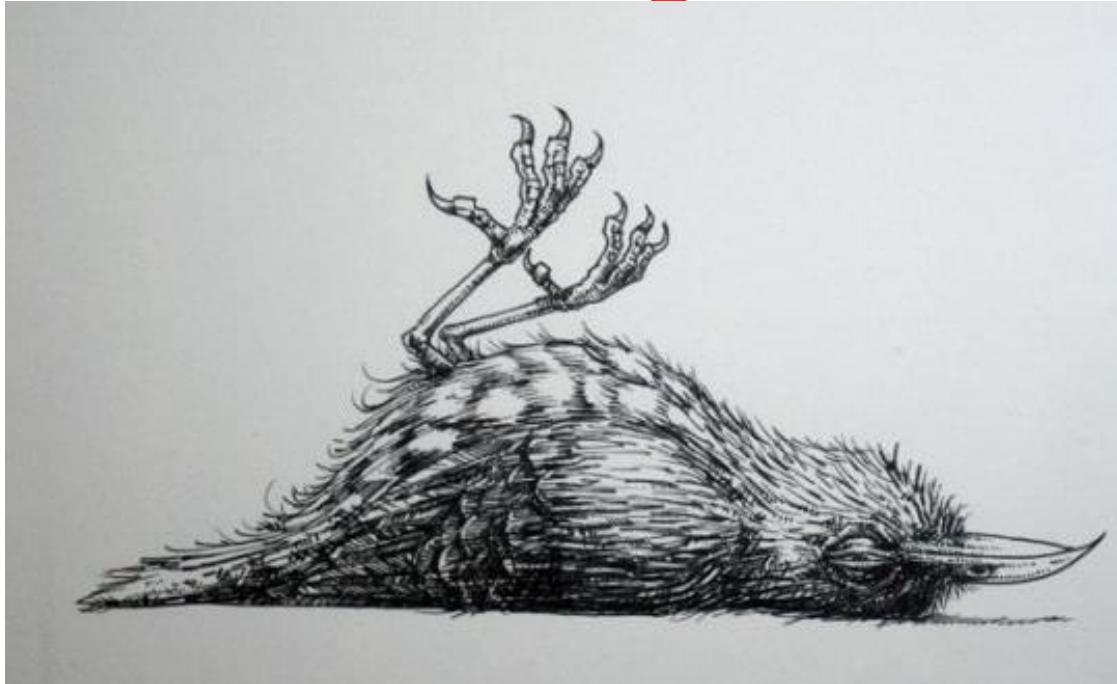
ATLTest (testing of M2M)



White-box approach: Analyzing the ATL code to derive test models that "exercise" it

Lightweight MDE tooling

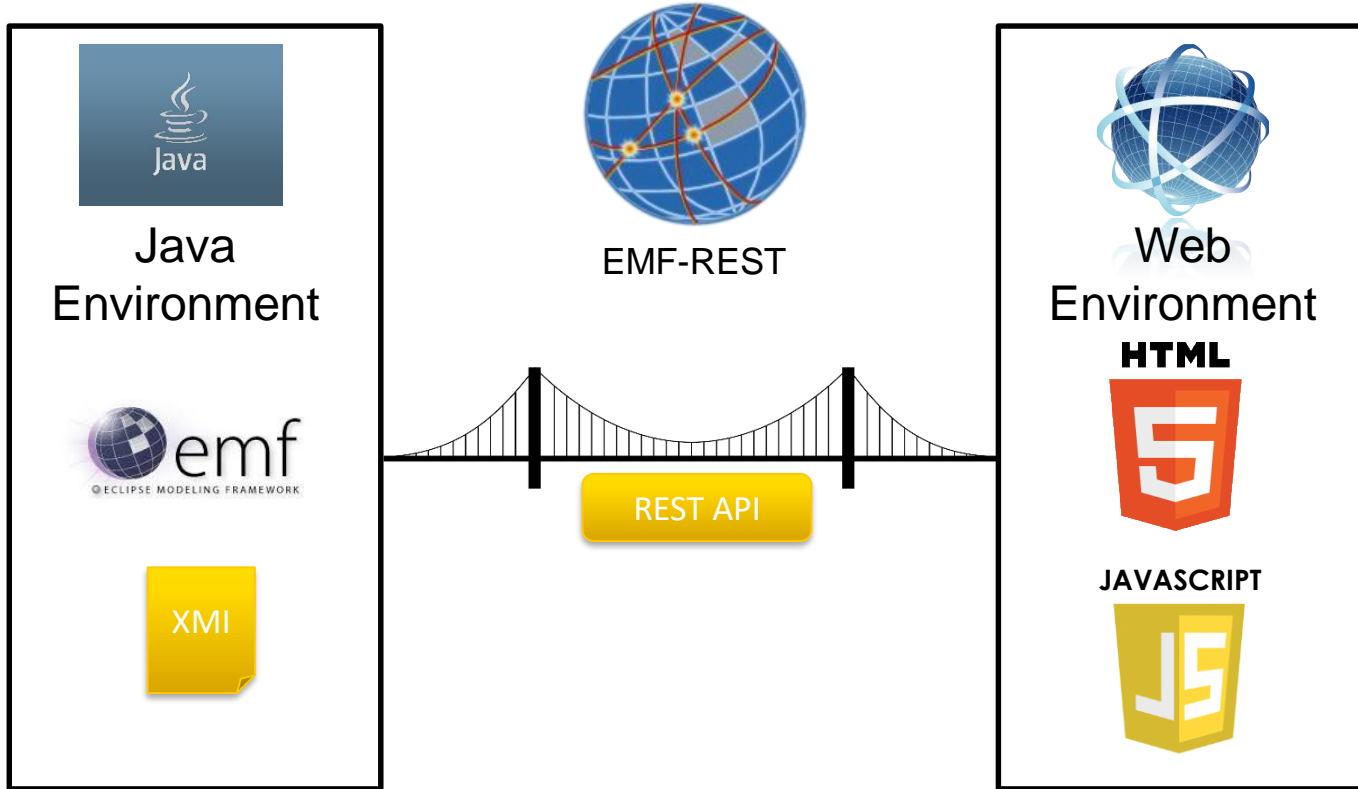
Eclipse, Papyrus... are great for our community



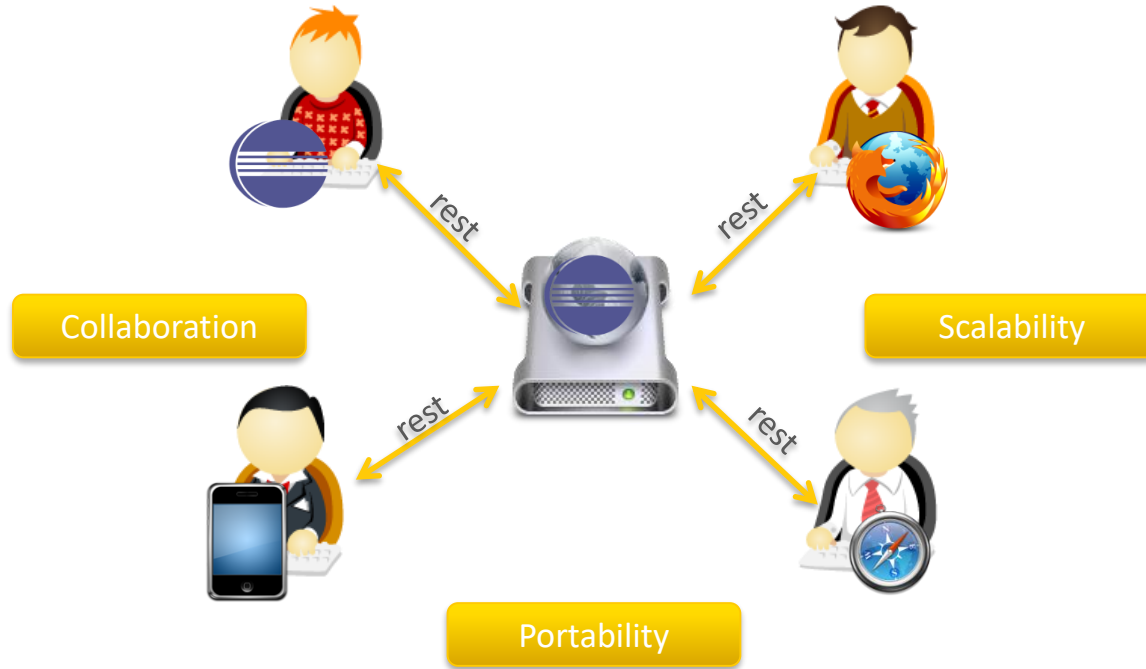
**WORLDWIDE
USED**

Moving to the web: Back-end

EMF-REST proposal



EMF-REST proposal



- **Addressable resources**

- **Eclipse:** `platform:/resource/project/Simpsons.xmi`
- **Web API:** `https://example.com/rest/Family/Simpsons`

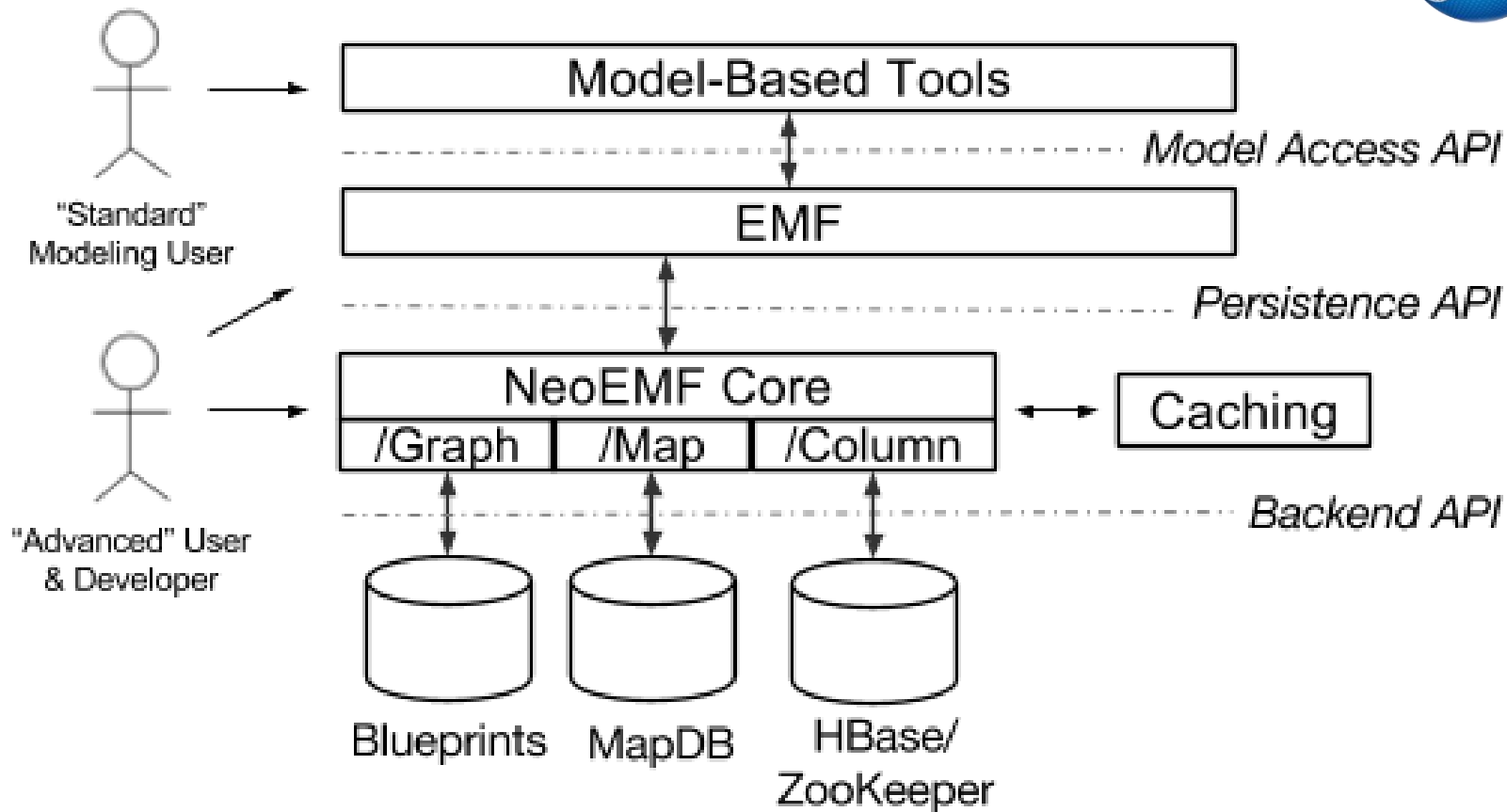
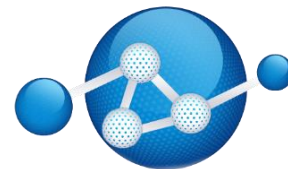
- **Uniform and Constrained Interface & Statelessness**

- CRUD operations using HTTP verbs : POST, GET, PUT, DELETE
 - PUT `https://example.com/rest/Family/Simpsons/parents/Homer`

- **Representation-oriented**

- **JSON:** `{"family":{"address":"742 Evergreen Terrace",...}}`
- **XML:** `<family><address>742 Evergreen Terrace</address></family>`

NeoEMF



Moving to the web: Client-side



Vienna University of Technology



Towards Automatic Generation of Web-based Modeling Editors

Manuel Wimmer, Irene Garrigós, and Sergio Firmenich

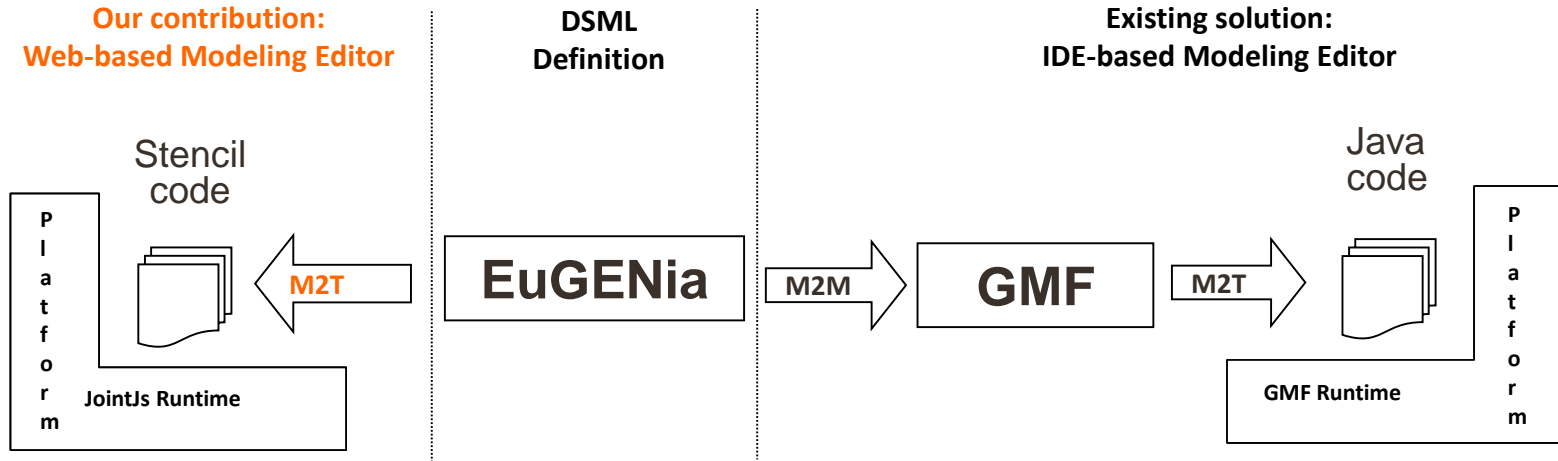


Universidad Nacional de La Plata



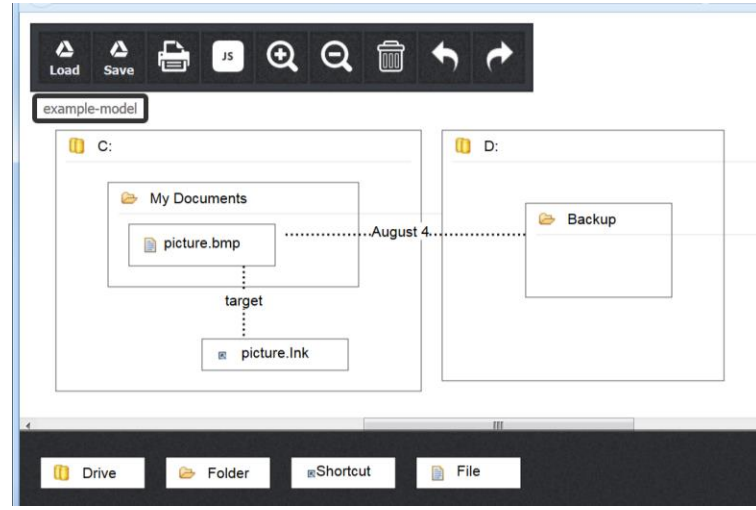
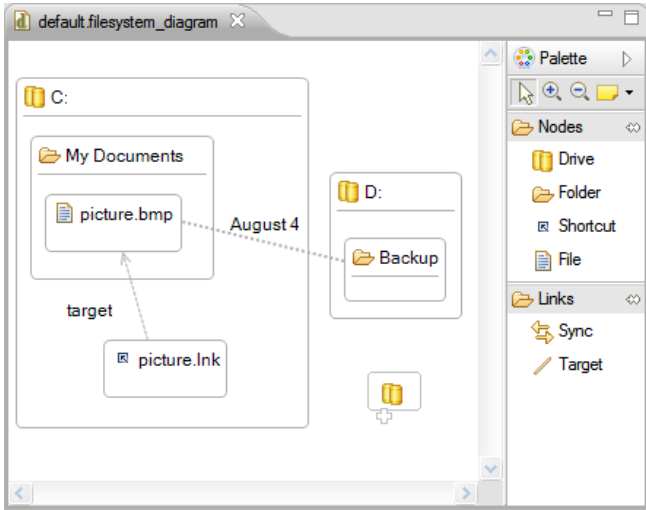
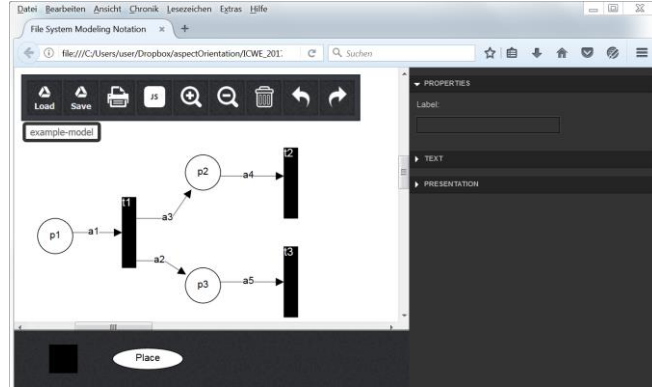
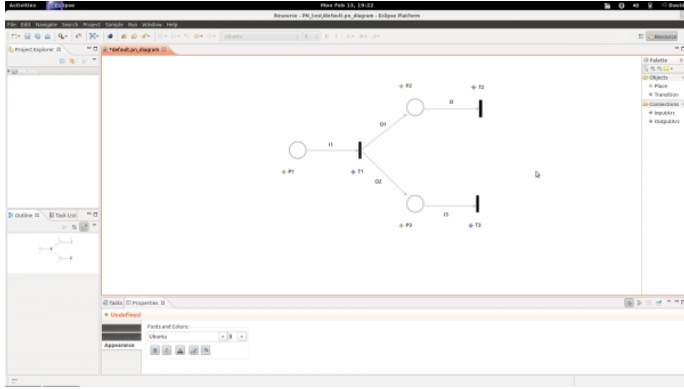
ICWE 2017

JavaScript client




- **Model-to-Text (M2T)** transformation to generate Stencils for the JointJS platform from EuGENia annotated metamodels

Examples Web-based Editor



Show me only what I need to see

EMF Views Documentation Examples Installation Contact



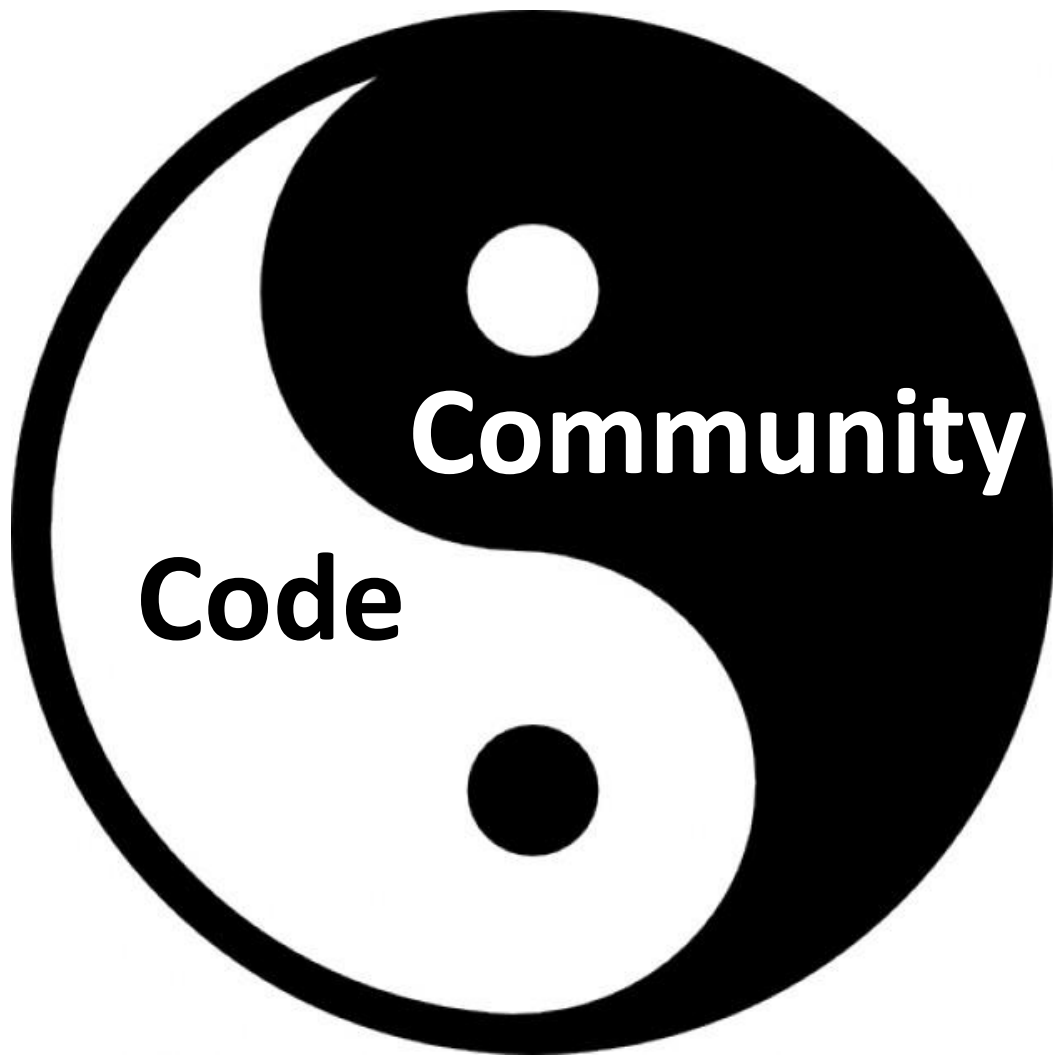
Give good views to your models.

Having to deal with several large heterogeneous and interrelated models? Simply create your own views with EMF Views.



Lightweight MDE in other fields

Governance of open source projects



Code

Community



Gaël

@gael_techfun

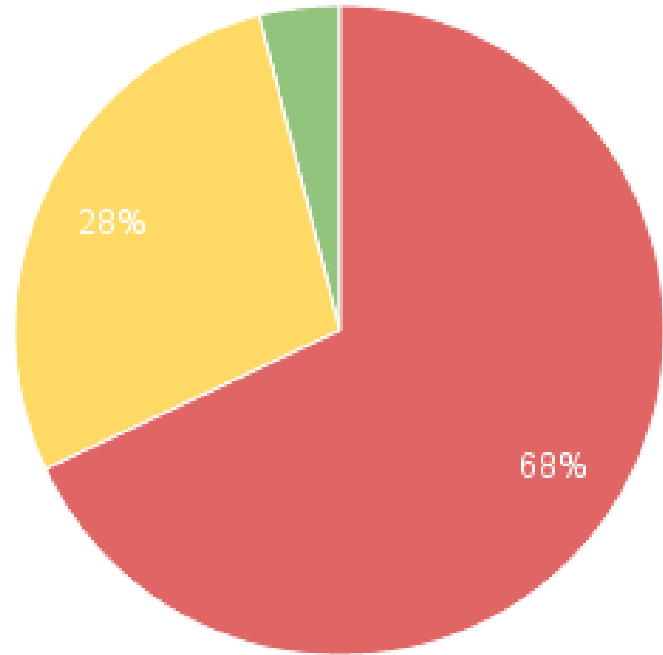


Follow

After 2 years and 500 votes for, undo feature is still even not planned in [#Jira](#). What a shame [@Atlassian](#) ! Implement GHS-7804 !

1:32 PM - 17 Jul 2015

Specification of the governance



● Not existing ● Limited ● Existing

Governance of open source projects is not explicit

CVE-2014-6412 - WordPress (all versions) lacks CSPRNG

From: Scott Arciszewski <scott () arciszewski me>

Date: Tue, 10 Feb 2015 11:50:16 -0500

Ticket opened: 2014-06-25

Affected Versions: ALL

Problem: No CSPRNG

Patch available, competent) WP ma

On June 25, 2014, cryptographically present (although band-aid solution support PHP < 5.3

For the past 8 months, bug, even going for its examination

If anyone with R it, without the the password res completely.

Eight fucking months

Patch available at <https://core.trac>

Scott
<https://scott.ar>
@voodooKobra



SOM-Research / collaboro

Unwatch 10 Star 2 Fork 0


Code Issues 5 Pull requests 0 Pulse Graphs Settings

Collaborative DSL development <http://som-research.github.io/collaboro/#/> — Edit

235 commits 6 branches 3 releases 2 contributors

Branch: master New pull request

Create new file Upload files Find file Clone or download

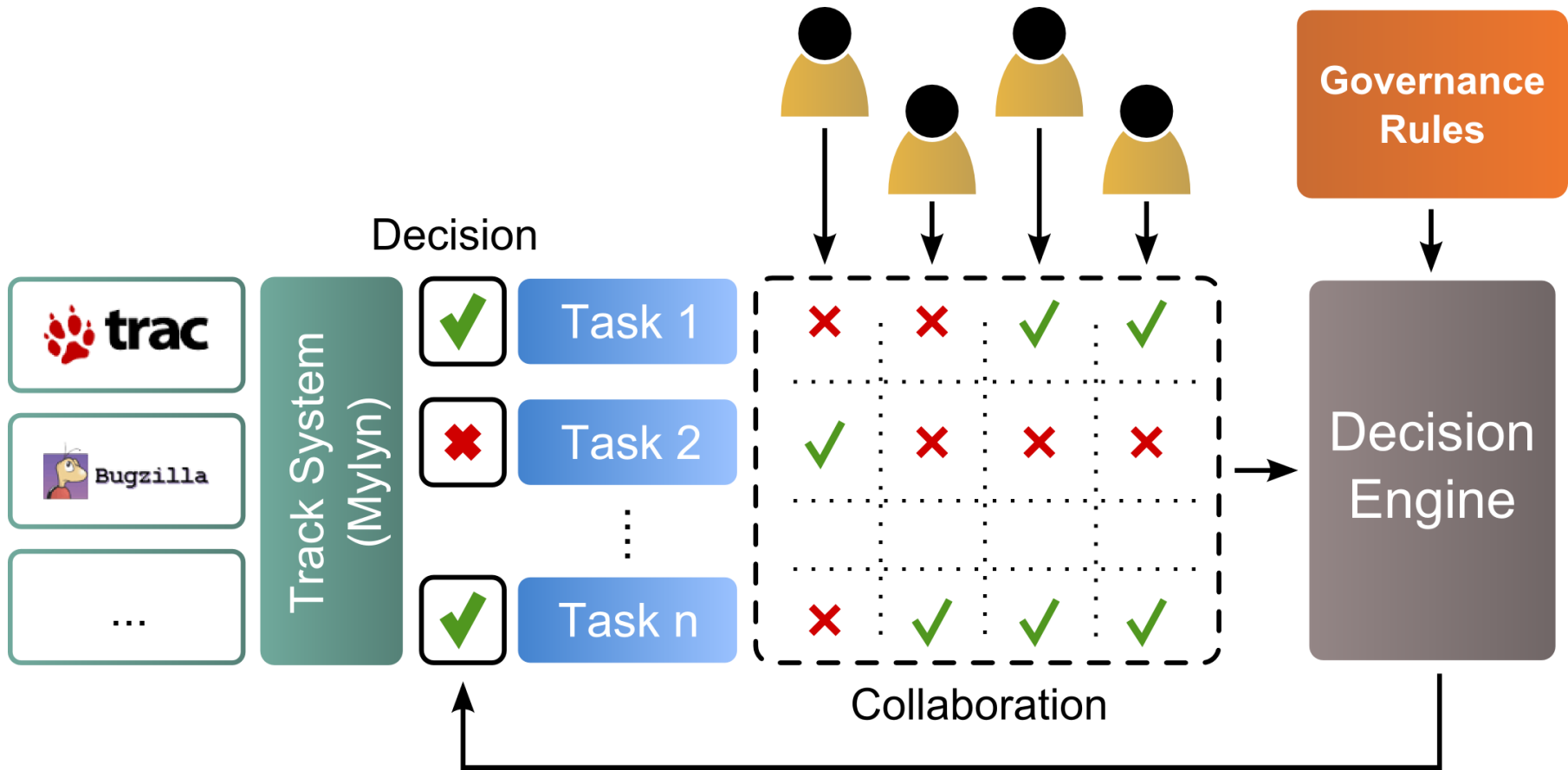
 jlcarnovas updating readme	Latest commit <code>ac0a4dd</code> on 9 Jul 2015
examples	Preparing to marge with master 2 years ago
features	preparing for tag 0.2 4 years ago
plugins	Creating dev branch 2 years ago
.gitignore	Fixed #14 2 years ago
README.md	updating readme a year ago
governance.md	Adding governance description 2 years ago



```
Project myProject {  
  Roles: Committers  
  Deadlines:  
    myDeadline : 7 days  
  Rules:  
    myMajorityRule :  
      Majority {  
        applied to Task  
        when TaskReview  
        people Committers  
        range Present  
        minVotes 3  
        deadline myDeadline  
      }  
}
```

Verbalization

All the proposals for new development tasks will be accepted or rejected in 7 days by the committers of the project.



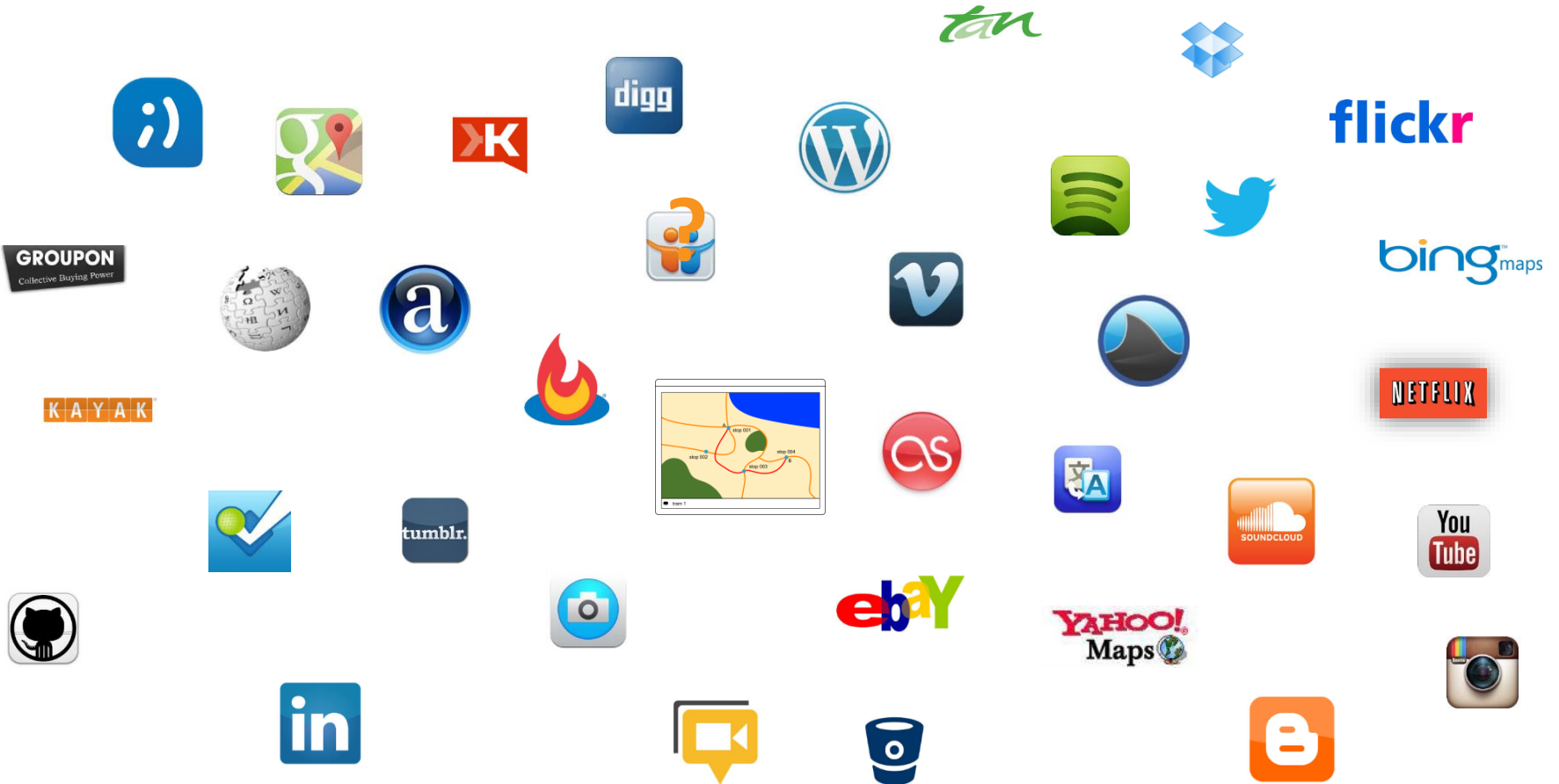
Lightweight MdE for open data



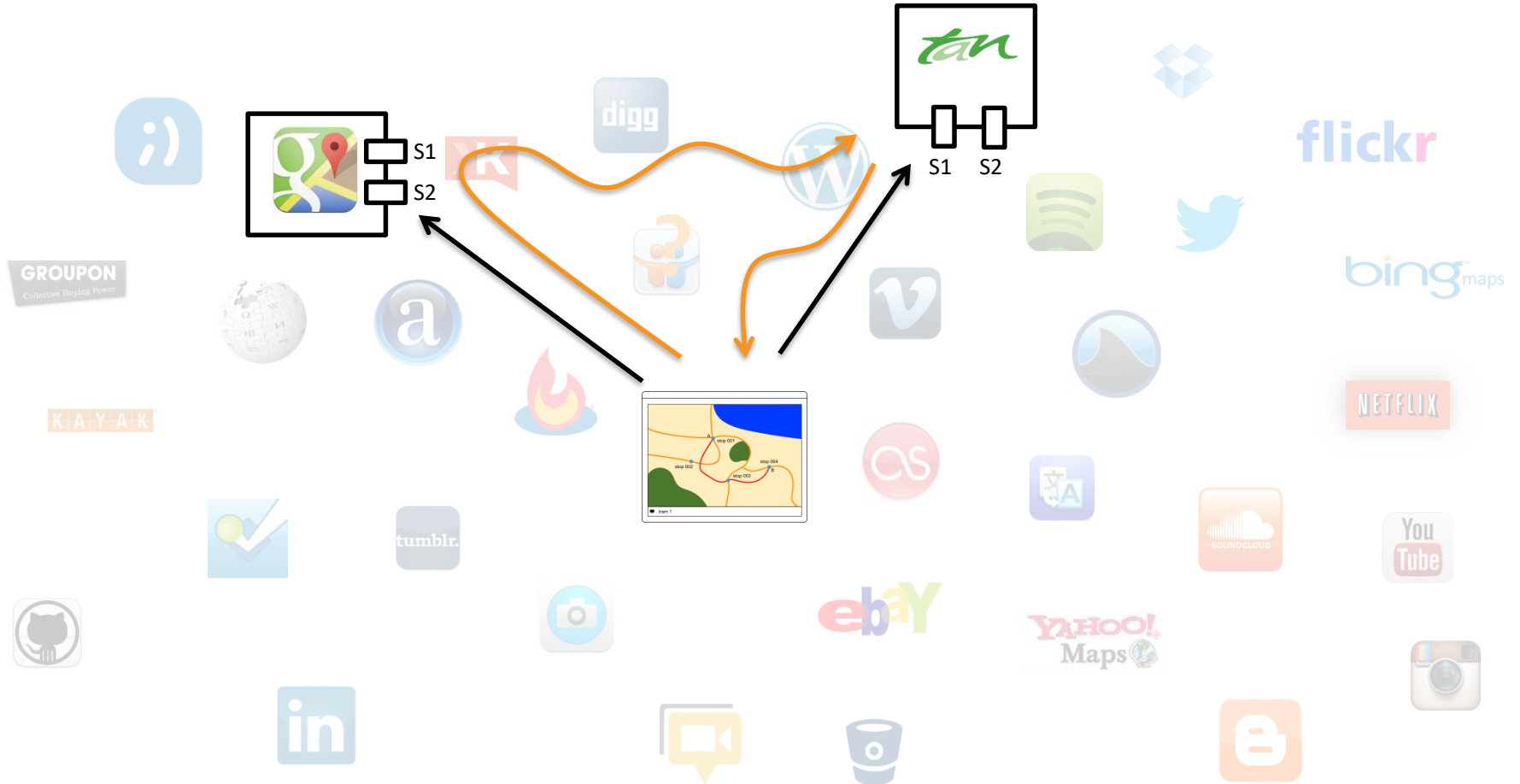
Open
Data
for All

“the goal of the project is to make the promise of open data a reality by giving non-technical users tools they can use to find and compose the information they need”

API Discovery: What APIs / open data sources?



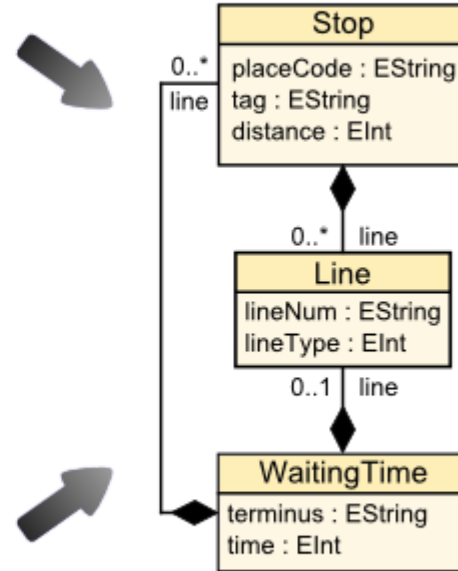
¿Y cómo los puedo combinar?



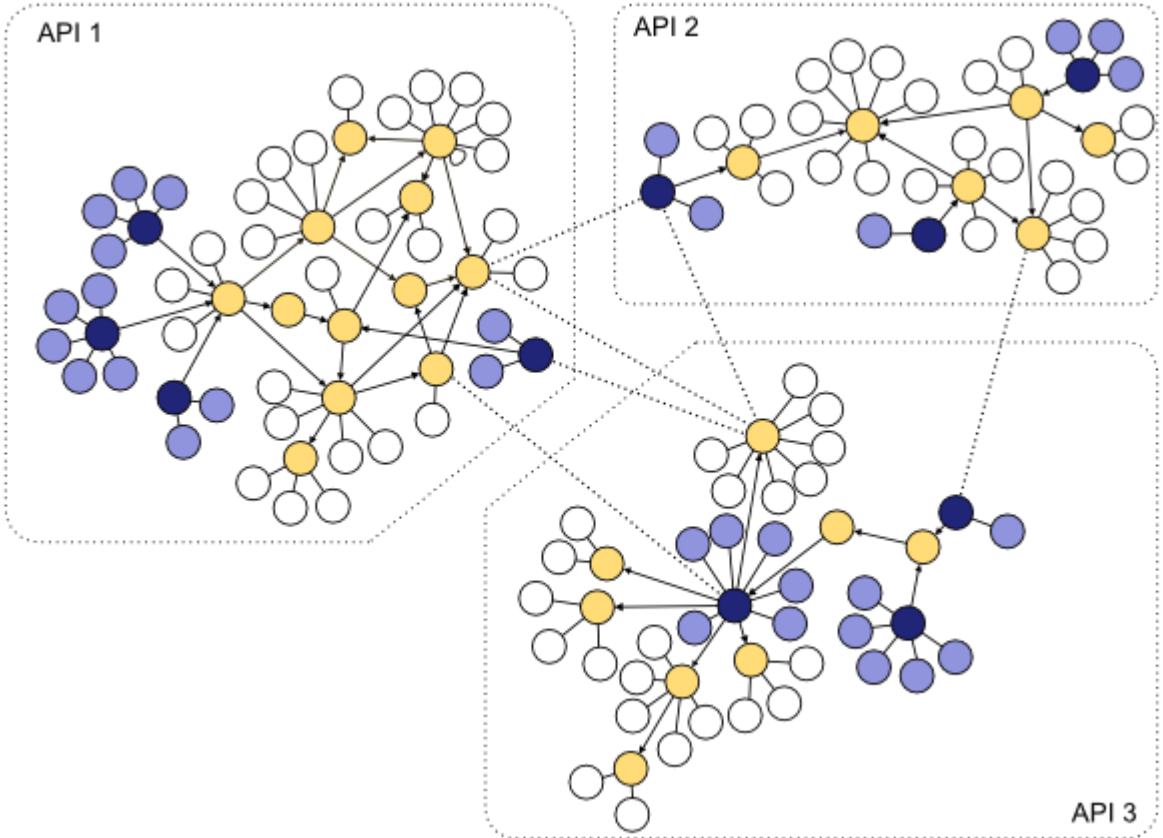
JSON Discoverer – Extracting implicit models in JSON documents

```
{  
  "placeCode": "SNIC",  
  "tag": "St-Nicolas",  
  "distance": 208,  
  "line": {  
    "lineNum": "C3"  
  }  
}...
```

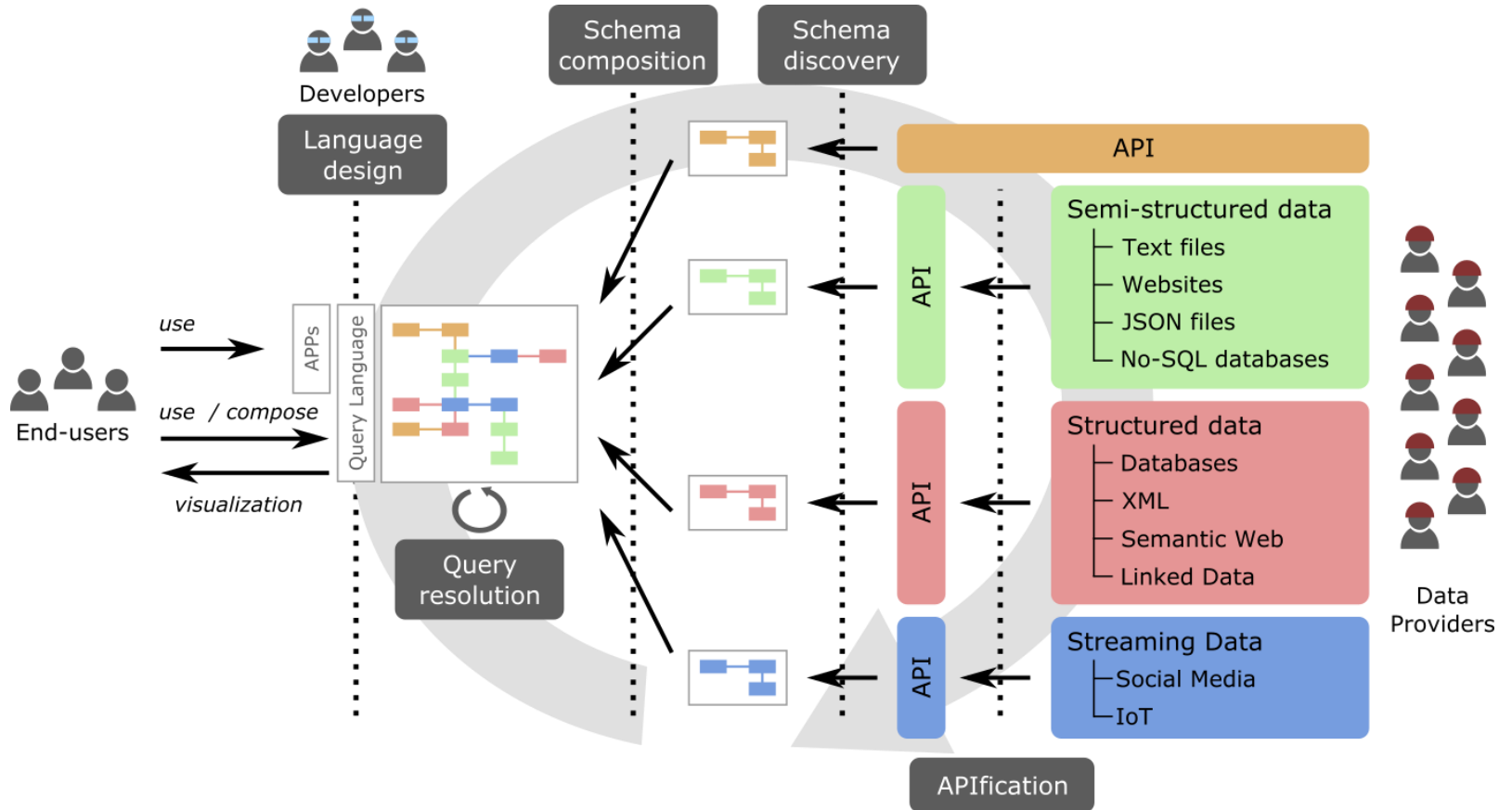
```
{  
  "terminus": "Gare de Chantenay",  
  "time": 5,  
  "line": {  
    "lineNum": "C1",  
    "lineType": 3  
  },  
  "stop": {  
    "stopCode": "CRQ"  
  }  
}...
```

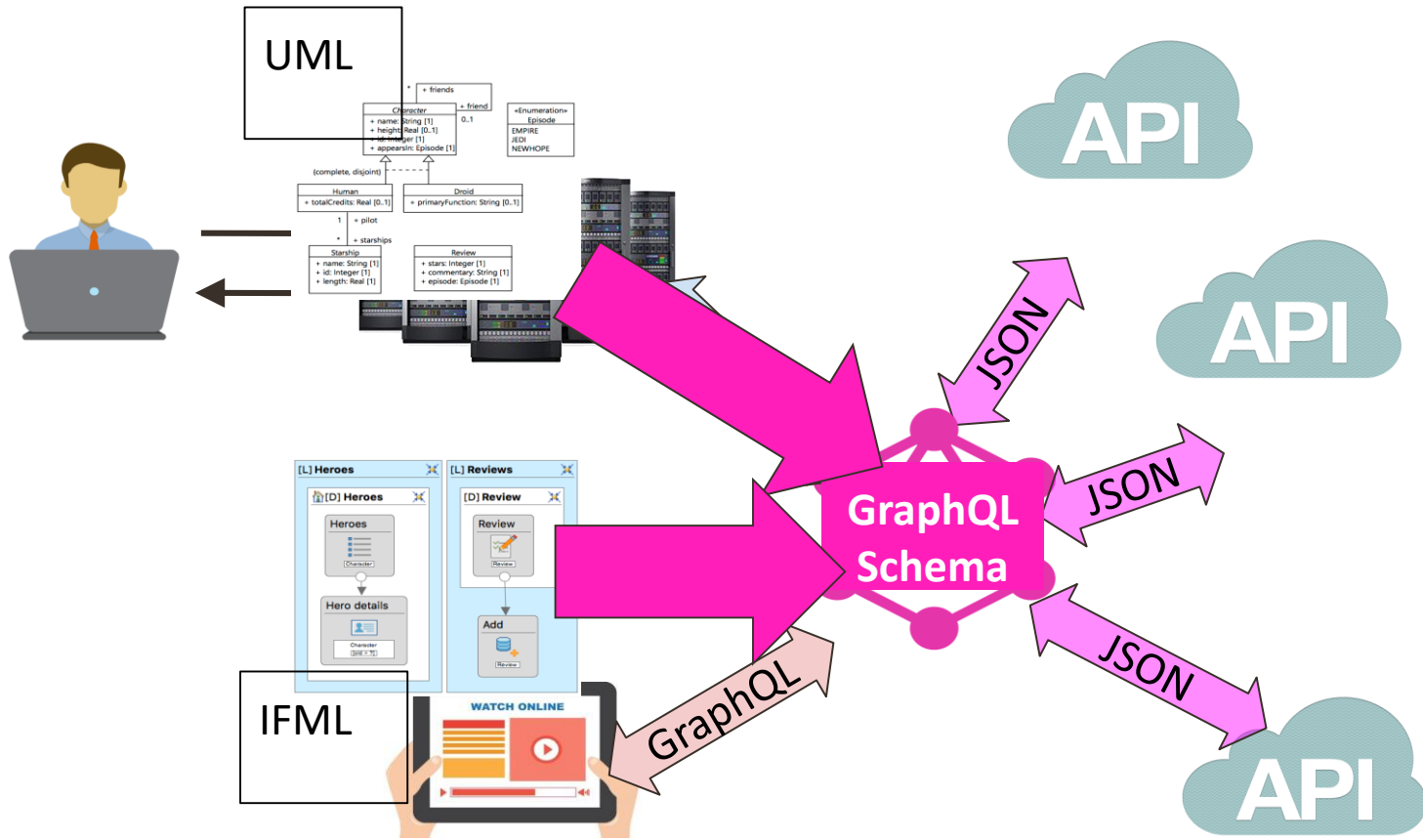


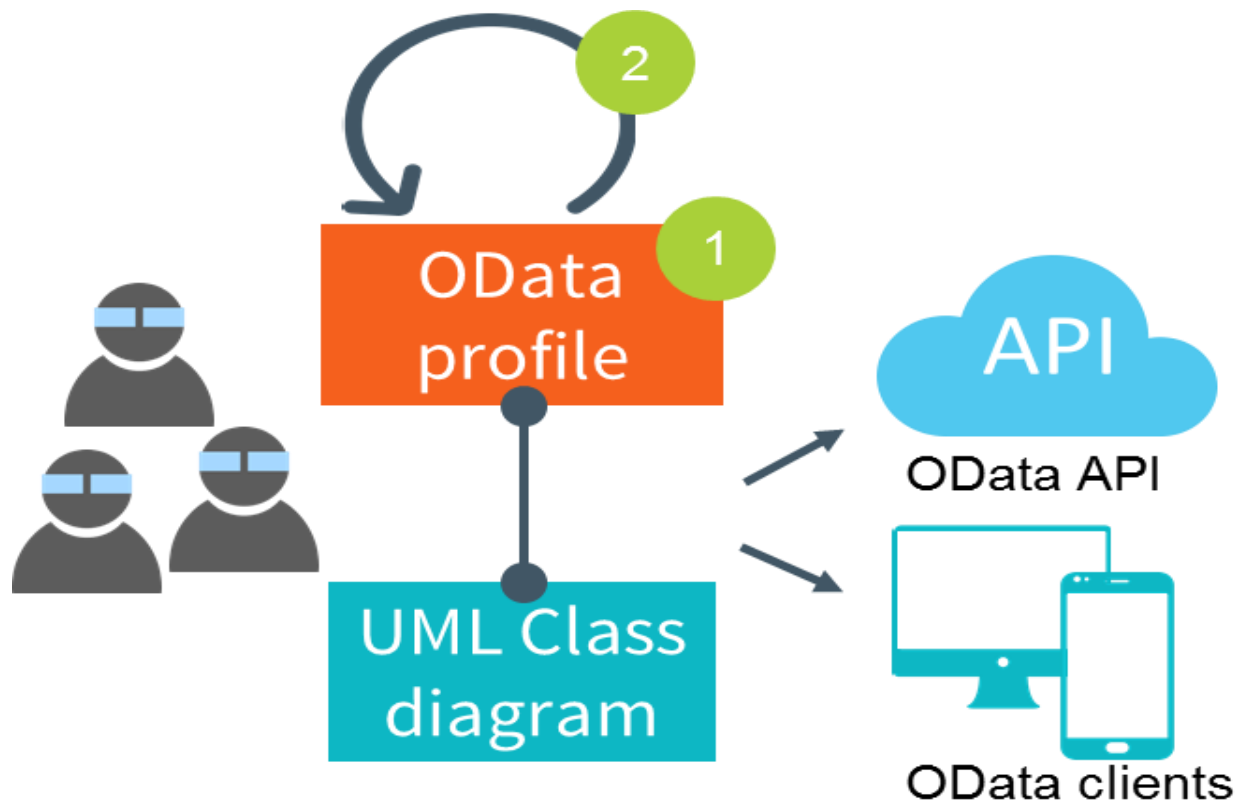
JSON Discoverer



Open Data for All







Lightweight Knowledge to use MDE

NEW YORK TIMES BESTSELLER

THE INEVITABLE

UNDERSTANDING
THE 12 TECHNOLOGICAL
FORCES THAT
WILL SHAPE OUR
FUTURE

KEVIN KELLY

AUTHOR OF *WHAT TECHNOLOGY WANTS*



Cognification:

*The application of knowledge
to boost the performance
and impact of a process*



During the industrial revolution, every machine got an electrified version

The next revolution is the cognificatinof everything via cheap access to specialized AIs

Cognification

ML

Crowdsourcing

Ontologies

Big Data

...



Cognifying MDE: 5 examples

Modeling bot as virtual assistant

Model inferences to discover schema of unstructured data

A code generator that mimicks a company programming style

A real-time model reviewer

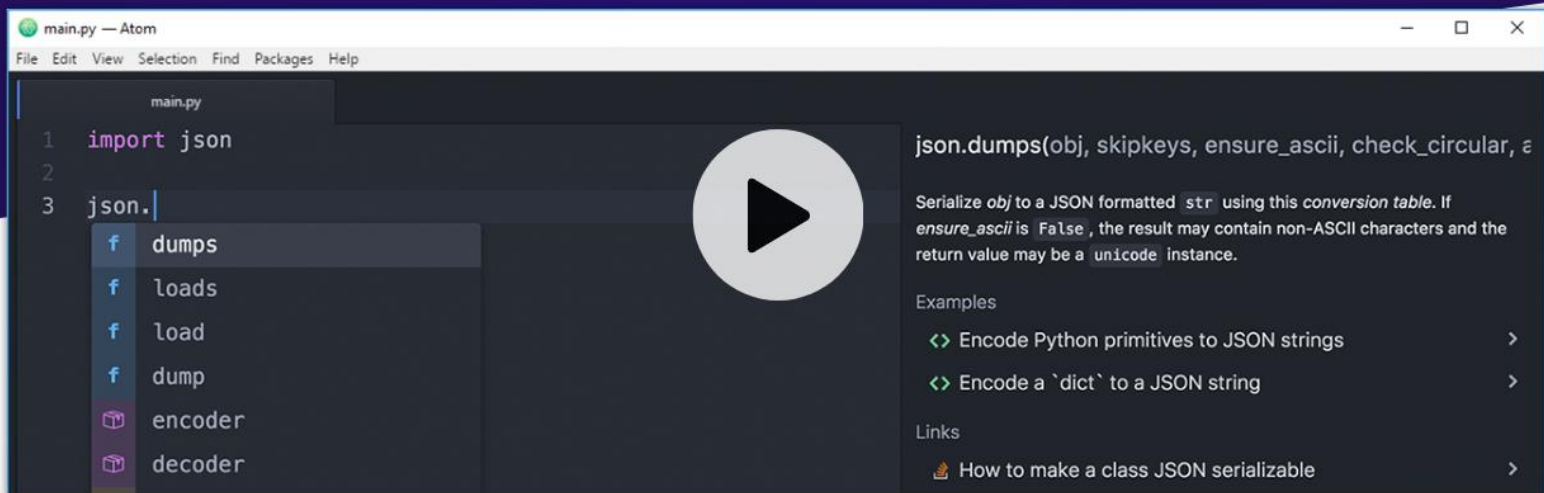
A morphing modeling tool that adapts to the user profile

The smart copilot for programmers

Kite augments your coding environment with all the web's programming knowledge.

 Download Kite for Python

Windows 7 or newer
Supports Atom, Sublime Text 3, IntelliJ, PyCharm
([More languages coming soon](#))



The screenshot shows the Atom code editor with a file named 'main.py'. The code contains the following lines:

```
1 import json
2
3 json.
```

A dropdown menu is visible below the code, listing the following options:

- f dumps
- f loads
- f load
- f dump
- 📦 encoder
- 📦 decoder

In the center of the editor, there is a large play button icon. To the right of the code editor, a documentation panel is open for the `json.dumps()` function. The panel contains the following text:

`json.dumps(obj, skipkeys, ensure_ascii, check_circular, e`

Serialize `obj` to a JSON formatted `str` using this *conversion table*. If `ensure_ascii` is `False`, the result may contain non-ASCII characters and the return value may be a `unicode` instance.

Examples

- ↔ Encode Python primitives to JSON strings >
- ↔ Encode a `'dict'` to a JSON string >

Links

- 🔥 [How to make a class JSON serializable](#) >

We're tired of searching. We just want to code.

PhD Thesis: CEA + SOM








Final Thoughts: Research on Lightweight MDE

But NOT lightweight research on MDE

Most research papers on MDE are completely irrelevant for (most) end-users



Temporal UML

[+] Jordi Cabot     





> Home > Persons

[+] 2010 - today 

2017

■ [j39]     Valerio Cosentino, Javier Luis Cánovas Izquierdo, Jordi Cabot:
A Systematic Mapping Study of Software Development With GitHub. IEEE Access 5: 7173-7192 (2017)

■ [j38]     Jeffrey C. Carver, Jordi Cabot, Rafael Tamila, Henry Muccini:
GitHub, Technical Debt, Code Formatting, and More. IEEE Software 34(2): 105-107 (2017)

■ [c125]     Zinovy Diskin, Abel Gómez, Jordi Cabot:
Traceability Mappings as a Fundamental Instrument in Model Transformations. FASE 2017: 247-263

ATL MapReduce

Category Theory for MT



More
research on
useful
topics!

We live in a MDE multi-verse



**We need to
develop domain-
specific MDEs to
better serve the
needs of users in
different domains**

"Publishing something in the most advanced journal doesn't change the world ... What changes the world is converting research to something that is available in the market, pleases customers and improves the quality of life" – Tharman. Deputy PM. Singapore

A person's hands are visible, holding a white rectangular sign. The sign features the word "MORE!" repeated three times in a large, bold, dark red font, stacked vertically. The background is a soft-focus bokeh of various colors, including red, orange, and green, suggesting a festive or celebratory setting.

MORE!
MORE!
MORE!

GrandMDE at STAF'17

GRAND 2017

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Grand Challenges in Modeling 2017

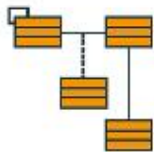
STAF 2017 - Software Technologies: Applications and Foundations

Marburg, Germany, July 17-21, 2017



Objective and scope

The main goal of this workshop is to bring together researchers and practitioners active in the fields of Modeling and Model-Driven Engineering in order to analyze the status of the adoption of Model-Driven Engineering in the different domains, and identify and define the challenges to be met in order to cope with the evolutionary pressure due to the changing landscape



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MDE4EDU - Towards a Corpus of Use-Cases for Model-Driven Engineering Courses

We have embarked on a project to find (and/or define) good use cases for teaching several flavours of model-driven /model-based engineering. Do you want to join us?

Posted by: [Jordi Cabot](#) 10/10/2016

1



NeoEMF: a multi NoSQL Persistence Framework for Very Large Models

In this post we present our latests updates on NeoEMF, our solution to store and access

Posted by: [Gwendal Daniel](#) 1/10/2016

4

SiriusCon 2016



GoJS



**Get in
touch**

**jordi.cabot@
icrea.cat**



@softmodeling