Lightweight Model-Driven Engineering

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About
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.
“As a writer, my job is to change your perspective and make you think outside the box.” - Mary Sage Nguyen
Based on my background ▪ But keynote used as an excuse to reflect about ▪ Algú tirant - se a la piscina
OFFENDED YOU ARE?
A FUCK I DON'T GIVE.
MDE Preliminaries
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
MDE is just the logical next step
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
“Algorithms + Data Structures = Program”

- Niklaus Wirth

The MDE equation
Models + Transformations = Software
Model-to-model Transformation

Requirements → Use Case → Class Diagram → Java Project

Transformations

Original model → 1st refinement

1st refinement → \( n^{th} \) refinement

\( n^{th} \) refinement → Model-to-text Transformation
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

MOF (metametamodel)

UML (metamodel)

ABank.uml

Grammarware

EBNF.g

Java.g

MyProgram.java
(common-sense) code generation

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

- +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
BUT he is saying this since 1985

“Modeling will be commonplace in three years time.”

– Stephen J. Mellor
Is MDE dead?
There is still money to be made on this market.
Do you really think Agile has more market penetration?
MDE Adoption
Programmers

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

— Frank Lloyd Wright —
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

“All models are wrong but some are useful.”
- George Box
Why lightweight MDE
Even if MDE is not dead...

- Increase adoption
- Focus on what matters to users
- Not losing the perspective

We can do better
MDE Research vs User needs & interests
Oh great UML Spirit, please grant me the insight tovaluably use the UML, the strength to challenge its misuse, and the wisdom to see the difference.
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.
Death by UML

ALEX E. BELL, THE BOEING COMPANY
Operación bikini
Revisiting MDE under a lightweight perspective
Lightweight application of MDE
Everything is a model
Models in real development processes

Pull
Push notification

Execute build

CDO
The Model Repository

git

gradle
a better way to build

Apache Ant
Agile Modeling

- Model Storming
- Active Stakeholder Participation
- Prioritized Requirements
- Architecture Envisioning
- Model a bit Ahead

- Just Barely Good Enough
- Requirements Envisioning

- Test-Driven Design (TDD)
- Iteration Modeling

- Executable Specifications
- Document Late
- Multiple Models
- Document Continuously
- Single Source Information

The Best Practices of Agile Modeling

Copyright 2005-2007 Scott W. Ambler
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

Exercises on building new MDE artefacts (e.g. a new modeling language with code-generation)

MDE Foundations

- DSLs
- M2M
- M2T

- 45h

Too complicated – surviving mode

MDE as devs – unlikely role in practice
2nd Attempt: Students as MDE users

- MDE Foundations
- MDE core technologies
- Methodology and Infrastructure
- Case Study 1: Java to UML reverse engineering
- Case Study 2: Code-generation of a CRUD web-based app

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 your 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
GAMIFICATION FRAMEWORK FOR END USERS - THE DSL

game::= LEVELS [ level ] level::= { rewardable } GROUPS [ group ]

reward::= { POINTS : int } BADGE_PATH : string

achievement::= { rewardable } TASKS [ task ]

rewardable::= NAME : string DESCRIPTION : string REWARD : reward

notification::= NOTIFICATION { MESSAGE : string } ICON_PATH : string SOUND_PATH : string
task::= DESCRIPTION : string QUERY : string
GAMIFICATION FOR END USERS - THE TOOL

QUERY

GAME STATISTICS

SUBMIT FORM

NOTIFICATIONS

https://github.com/SOM-Research/gamification-modeling-learning
Lightweight verification for MDE
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

UML model
Class diagram + OCL constraints

Consistent?

Formalism / Logics
- Dynamic Logic (KEY)
- High-Order Logics (HOL-OCL)
- Deductive database queries (CQC)
- SAT (Alloy + UML2Alloy), ...

Prove
Deduce

Proven?
A Grand Challenge
Pick only 2-3

- Automation
- Efficiency
- Expressiveness
- Precision (completeness)
Our pragmatic approach: Bounded verification

1. Variables – basic types + struct/list
2. Domains – finite
3. Constraints – Prolog
4. Property → Additional Constraint
Resolution of the CSP

Define cardinality variables
Constraints on cardinalities

Assign cardinalities

Define attribute variables
Constraints on attributes

Assign attributes

Proof
White-box approach: Analyzing the ATL code to derive test models that “exercise” it
Lightweight MDE tooling
Eclipse, Papyrus... are great for our community
Moving to the web: Back-end
EMF-REST proposal

Java Environment

EMF-REST

Web Environment

HTML

JAVASCRIPT

81
EMF-REST proposal

Collaboration

Scalability

Portability
• **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>`
Moving to the web: Client-side
Towards Automatic Generation of Web-based Modeling Editors

Manuel Wimmer, Irene Garrigós, and Sergio Firmenich
Our contribution: Web-based Modeling Editor

Existing solution: IDE-based Modeling Editor

- Model-to-Text (M2T) transformation to generate Stencils for the JointJS platform from EuGENia annotated metamodels
Lightweight MDE in other fields
Governance of open source projects
After 2 years and 500 votes for, undo feature is still even not planned in #Jira. What a shame @Atlassian! Implement GHS-7804!
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, if competent) WP may

On June 25, 2014, cryptographicallypresent (although
band-aid solution support PHP < 5.

For the past 8 months, I've been bug, even going
for its examination.

If anyone with PHP can use it, without the
the password resolution

Eight fucking months later, the
Patch available
https://core.trac.wordpress.org/ticket/3712

Scott https://scott.arciszewski.me
@voodooKobra
Project `myProject` {
  Roles: Committers
  Deadlines:
    myDeadline : 7 days
  Rules:
    myMajorityRule :
      Majority {
        applied to Task
        when TaskReview people Committers range Present
        minVotes 3
        deadline myDeadline
      }
}
Lightweight MdE for open data
“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

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

{
  "terminus":"Gare de Chantenay",
  "time": 5,
  "line":{
    "lineNum":"C1",
    "lineType":3
  },
  "stop":{
    "stopCode":"CRQ"
  }
}...
```
The advanced mode analyzes sets of JSON definitions and discovers the common schema among them.
Lightweight Knowledge to use MDE
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 cognification of 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.

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.

Category Theory for MT

Temporal UML

ATL MapReduce


Zinovy Diskin, Abel Gómez, Jordi Cabot: Traceability Mappings as a Fundamental Instrument in Model Transformations. FASE 2017: 247-263
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
MORE! MORE! MORE!
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.
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

NeoEMF: a multi NoSQL Persistence Framework for Very Large Models

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

Posted by: Gwendal Daniel 1/10/2016

SiriusCon 2016

GoJS
Get in touch

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