Making EMF polyglot

Virtual Meetup Strumenta community, 25 February 2021

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Making EMF polyglot

Agenda

1. Introduction to / recap of EMF (Meinte, 10')
2. Horacio (JSOI), and Vincent (PyEcore) talk about their work (10' each)
3. Discussion about which feature to make polyglot first (15')
   Contenders:
   - Ecore as metamodeling standard
   - Definition and standardization of JSON-variant of XMI
   - JVM-agnostic standardization of EMF
4. Discussion about the way forward (15')

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Introduction and recap of EMF

- EMF = Eclipse Modeling Framework, alternatively the “Ed Merks Framework”
- Used in lots of software:

  Acceleo, Obeo, Xtext, CDO, GMF, ATL, Sirius, Rational Software Modeler, EMF.cloud, Sprotty, etc.

- Mostly bound to the JVM.

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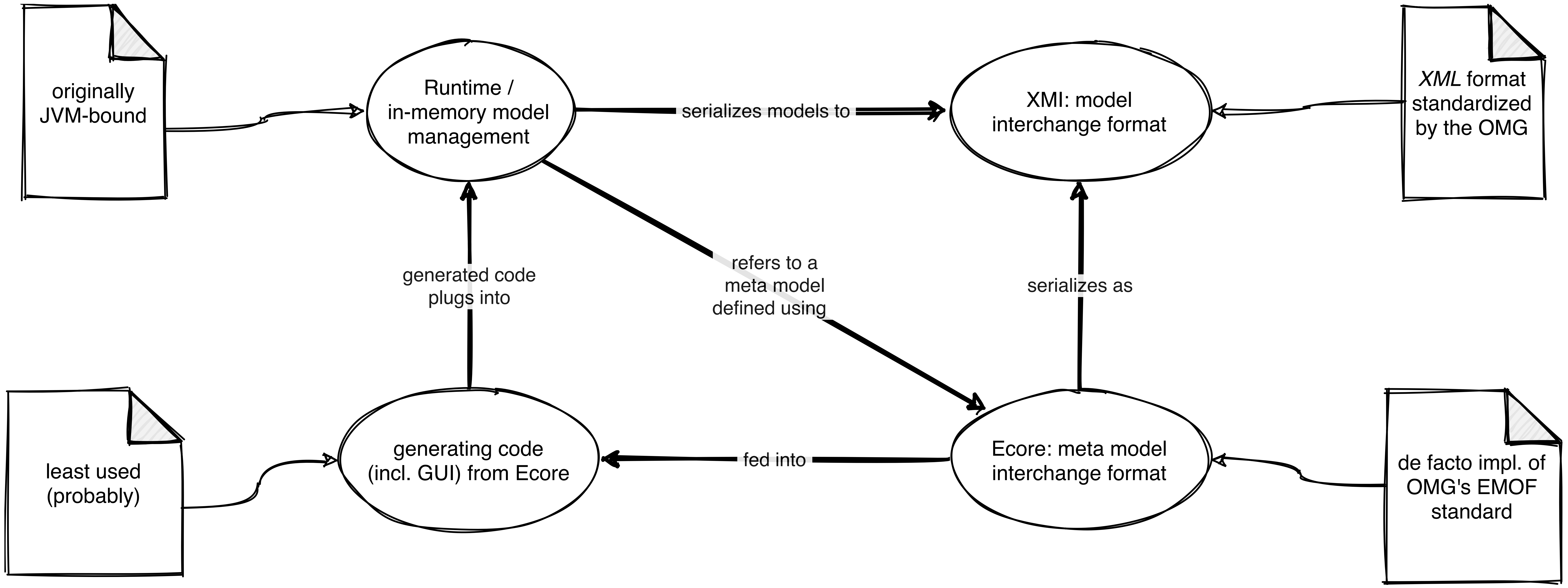
Introduction and recap of EMF


originally JVM-bound
Runtime / in-memory model management
serializes models to
XMI: model interchange format
XML format standardized by the OMG
generated code plugs into
refers to a meta model defined using
serializes as
least used (probably)
generating code (incl. GUI) from Ecore
fed into
Ecore: meta model interchange format
de facto impl. of OMG's EMOF standard

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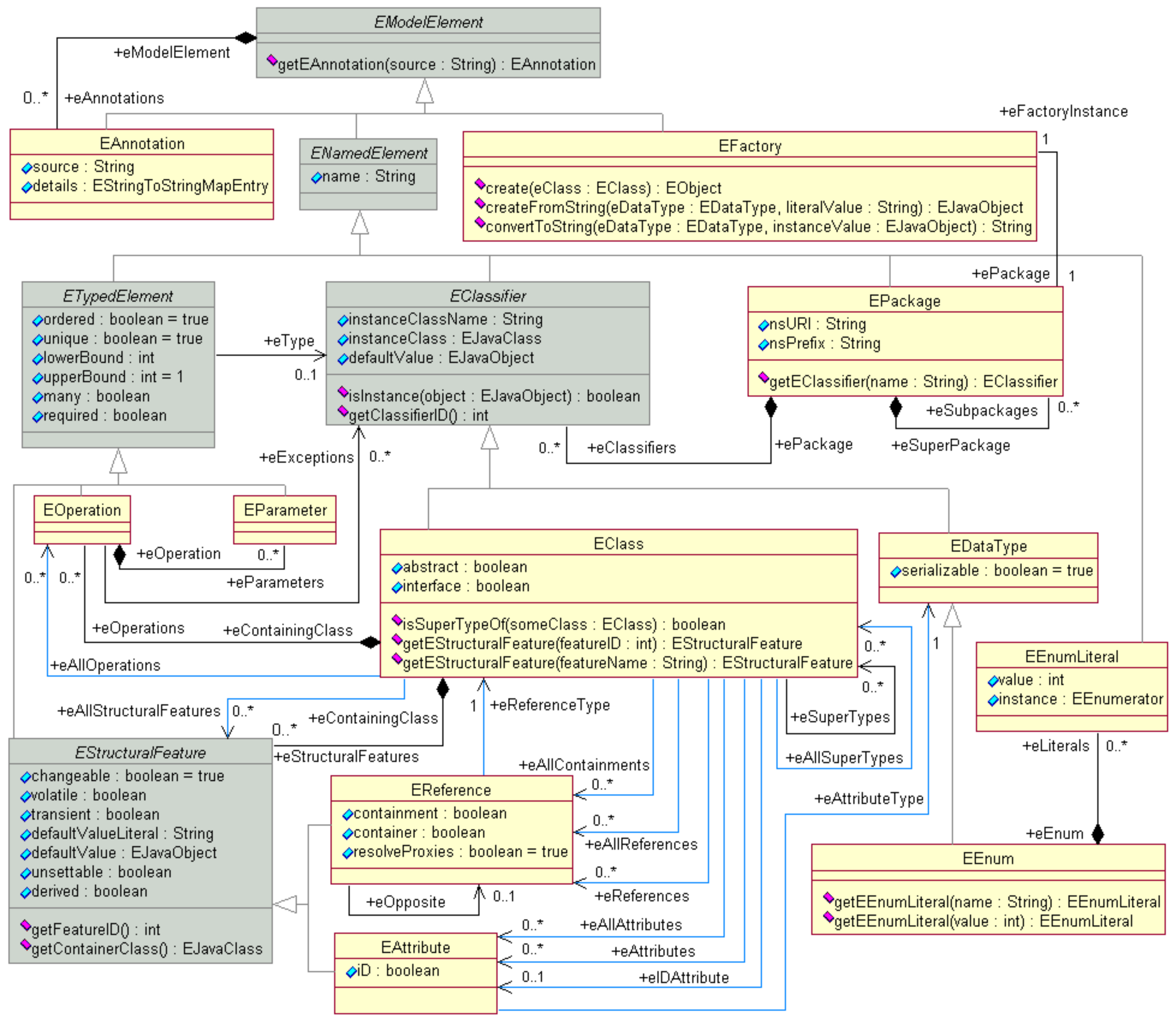
Meta modeling with Ecore



Ecore as Ecore model

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Meta modeling with Ecore

- It's “precisely enough”.
- Persisted in XMI format.
- Already has a degree of interoperability: tool support, generators.
- (Textual variant: Xcore).

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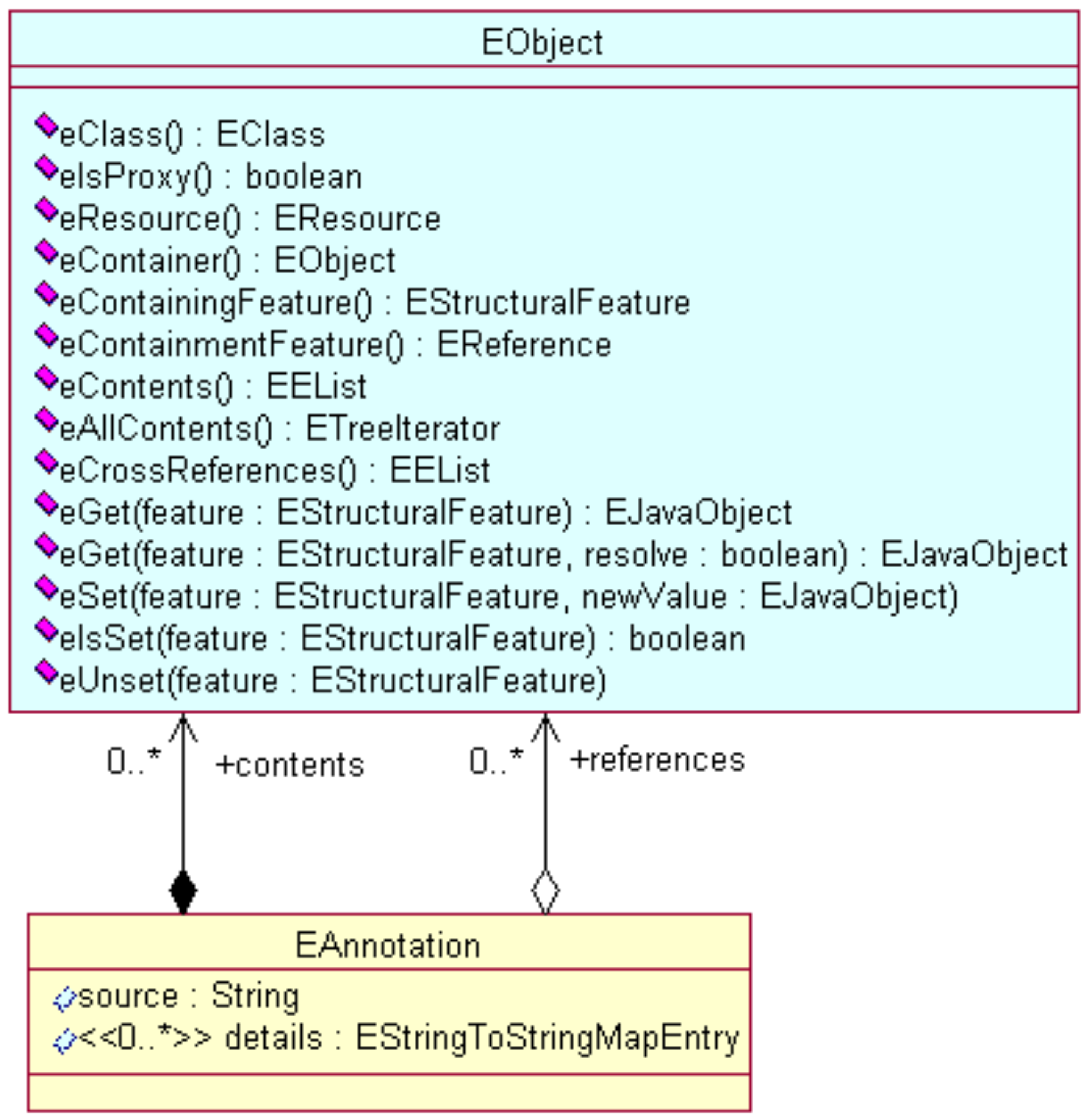
Runtime model management - typical usage

1. Load model (`EResource`) from XMI file into memory.
2. Model is backed by an Ecore model.
3. An `EResource` is a collection of `EObjects`.
4. Save `EResource` back to XMI again.

- Features: reverse references, notifications, annotations, dynamic usage, etc.
- Large-scale solution: CDO = Connected Data Objects.


EObject
eClass() : EClass
eIsProxy() : boolean
eResource() : EResource
eContainer() : EObject
eContainingFeature() : EStructuralFeature
eContainmentFeature() : EReference
eContents() : EEList
eAllContents() : ETreeIterator
eCrossReferences() : EEList
eGet(feature : EStructuralFeature) : EJavaObject
eGet(feature : EStructuralFeature, resolve : boolean) : EJavaObject
eSet(feature : EStructuralFeature, newValue : EJavaObject)
eIsSet(feature : EStructuralFeature) : boolean
eUnset(feature : EStructuralFeature)
0..*
+contents
0..*
+references
EAnnotation
source : String
<<0..*>> details : EStringToStringMapEntry

Ecore representation of EObject

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XMI: model interchange format

```xml
<?xml version="1.0" encoding="UTF-8"?>
<xmi:XMI xmi:version="2.1" xmlns:uml="http://schema.omg.org/spec/UML/2.0" xmlns:xmi="http://schema.omg.org/spec/XMI/2.1">
    <xmi:Documentation exporter="StarUML" exporterVersion="2.0"/>
    <uml:Model xmi:id="AAAAAAFjzEc8LY39RtY=" xmi:type="uml:Model" name="RootModel">
        <packagedElement xmi:id="AAAAAAFF+qBWK6M3Z8Y=" name="Model" visibility="public" xmi:type="uml:Model">
            <packagedElement xmi:id="AAAAAAFjy7/FJY0kKh8=" name="StateMachine1" visibility="public" isReentrant="true" xmi:type="uml:StateMachine">
                <region xmi:id="AAAAAAFjy7/FJo0lkWM=" visibility="public" xmi:type="uml:Region">
                    <subvertex xmi:id="AAAAAAFjy7/ZDo0reHg=" name="A" visibility="public" xmi:type="uml:State">
                        <entry xmi:id="AAAAAAFjy7/ssI1RuOM=" name="eA" visibility="public" isReentrant="true" xmi:type="uml:OpaqueBehav
                        <exit xmi:id="AAAAAAFjy8ASyY1f3qw=" name="xA" visibility="public" isReentrant="true" xmi:type="uml:OpaqueBehavi
                        <doActivity xmi:id="AAAAAAFjy7//q41YmXc=" name="dA" visibility="public" isReentrant="true" xmi:type="uml:Opaque
                    </subvertex>
                    <subvertex xmi:id="AAAAAAFjy8AqOI1m7+A=" visibility="public" xmi:type="uml:Pseudostate" kind="initial"/>
                    <subvertex xmi:id="AAAAAAFjy8A7RY2ICY8=" visibility="public" xmi:type="uml:FinalState"/>
                    <subvertex xmi:id="AAAAAAFjzEbnL43DlLY=" name="B" visibility="public" xmi:type="uml:State"/>
                    <transition xmi:id="AAAAAAFjy8AqzY13yCY=" visibility="public" xmi:type="uml:Transition" source="AAAAAAFjy8AqOI1m7+A=" t
                    <transition xmi:id="AAAAAAFjzEXaD42uNpg=" visibility="public" xmi:type="uml:Transition" source="AAAAAAFjy7/ZDo0reHg=" t
                        <effect xmi:id="AAAAAAFjzEXmBo3Atuk=" name="final" visibility="public" isReentrant="true" xmi:type="uml:OpaqueB
                    </transition>
                    <transition xmi:id="AAAAAAFjzEb74o3pJ2c=" visibility="public" xmi:type="uml:Transition" source="AAAAAAFjy7/ZDo0reHg=" t
                        <ownedMember xmi:id="AAAAAAFjzEcBq437tuw=" name="EV" visibility="public" xmi:type="uml:AnyReceiveEvent"/>
                        <trigger xmi:id="AAAAAAFjzEc8Lo3+Y3Q=" xmi:type="uml:Trigger" name="EV" event="AAAAAAFjzEcBq437tuw="/>
                        <trigger xmi:id="AAAAAAFjzEcBq437tuw=" name="EV" visibility="public" xmi:type="uml:AnyReceiveEvent"/>
                    </transition>
                </region>
            </packagedElement>
        </packagedElement>
    </uml:Model>
</xmi:XMI>
```

Some UML as XMI

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XMI: model interchange format

- OMG standard.
- Used in many modeling tools, e.g. for UML.
- *Con:* it's XML...
  (JSON is more prevalent these days).

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Existing work outside of Eclipse

- PyEcore (Python) by *Vincent Aranega* (see next slides)
- JSOI (JVM) by *Horacio Hoyos Rodríguez*
- ecore.js (JS) and emfjson-jackson (JVM) by Guillaume Hillairet

PyEcore

Ecore in Python

https://github.com/pyecore/pyecore

Quick stuffs about me

- Assistant professor at University of Lille -- 2018 - now
  - Working on Pharo/Smalltalk about dynamic language, language interoperability, debugging, virtual machines
  - Software evolution, MDE and code/AST transformations
- R&D Project Manager at GenMyModel -- 2011 - 2018
  - worked on real-time modeling collaboration, modeling, codegen and language engineering in the cloud.
- PhD on test/debugging models and transformation chains -- 2008 - 2011

Why PyEcore

WARNING

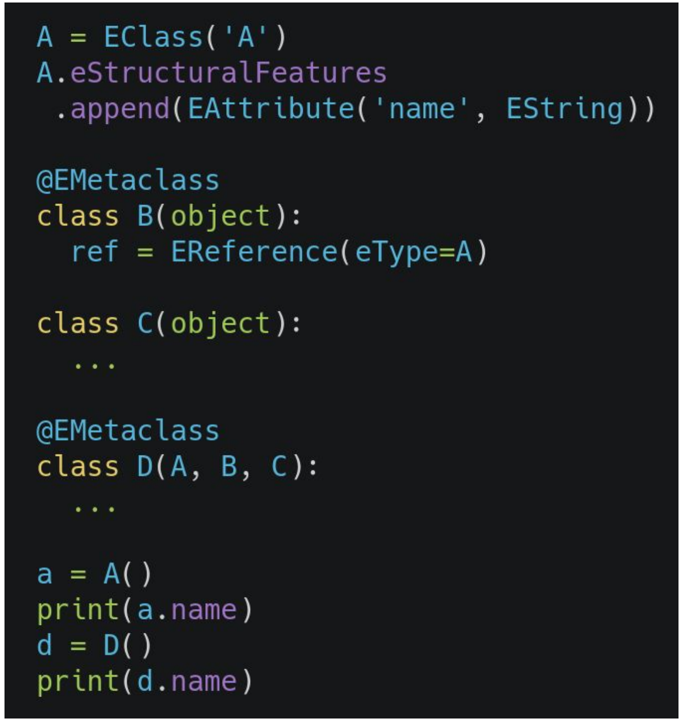
With real non-objective and non-relevant opinions

- EMF is great but
  - Heavy to use (Eclipse, dependency, Java)
  - Static and dynamic flavours induce different way of coding
  - Doing quick experiments with is painful
  - Not suited for some experiments relying on dynamicity (because of Java)
  - Eclipse EMF tooling sometimes painful to use or to reuse in a non-Eclipse environment
  - Back in the days (2011 to 2018...), hell of multiple same? artifacts in maven central
- Python
  - Suits well for software development and quick scripts
  - OCL like syntax
  - Dynamic language, reflexive layer (introspection/intercession), open classes, ...
  - Huge collection of libraries
  - Easy to deploy

PyEcore

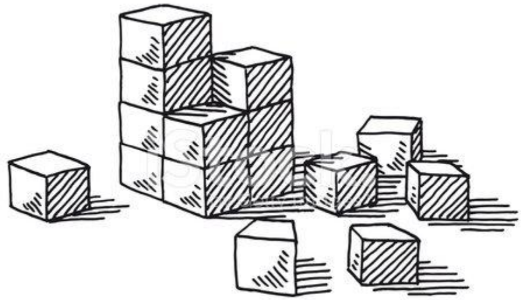
- First version in 2017
- Full Python with few dependencies
- 11 direct or indirect contributors

- Ease manipulation of EMF models
- Align dynamic and static metamodels
- Keep dynamic Python nature (model DU)
- See what dynamic language can bring to MDE
- Experiment with Models/Metamodels
- XMI/JSON (json emf-Jackson format)



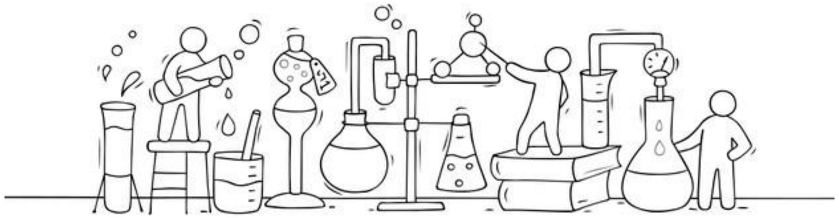
```
A = EClass('A')
A.eStructuralFeatures
 .append(EAttribute('name', EString))

@EMetaclass
class B(object):
  ref = EReference(eType=A)

class C(object):
  ...

@EMetaclass
class D(A, B, C):
  ...

a = A()
print(a.name)
d = D()
print(d.name)
```

Built on or use PyEcore



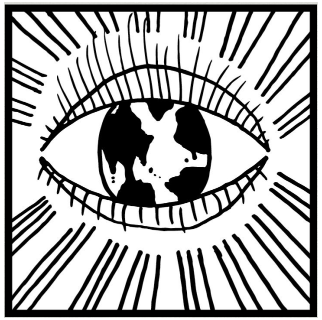
- PyEcoregen: code generator from Ecore to Python
- PyUML2: implementation of UML2 compatible with Eclipse UML2
- PyGeppetto (MetaCell): brain-cells simulation (serialization and API)
- NetPyNE (MetaCell): development, parallel simulation and analysis of biological neuronal networks
- ESDL: modelling language created to describe energy systems (serialization and API)
- Essential Object Query (EOQ): a language to interact remotely with object-oriented models
- Bridge between Fame MetaMeta in Smalltalk and Ecore (gen using Mako)
- Internal tooling in some companies of the automotive/aeronautic sector

Experimental projects



- TextX + PyEcore
- Motra: Model to model transformation lib for Python inspired by QVTo
- Advanced Traceability for Motra
- PyEcoreOCL: a library giving a more OCL like feeling for Python and
  a transpiler from OCL to Python
- PlantUML2UML2: create your UML model from plantUML syntax
- TUI Generic Editor: a generic Textual User Interface tree like editor
- SysML implementation
- Generic codegen lib
- Experimentations around self-modifying metamodels/models (for fun)

Future features



- Copy-paste
- Effective clone and deep-clone (already prototypes from contributors)
- JSOI and EMF binary resource implementation (tricky)
- Reimplementation of a concept I provided for GMM for command/model manipulation by transactions
- Stabilizing Motra (M2M library) for a first open release
- Better M2T library/framework (currently using either Jinja2 or Mako)
- Waiting to play with new pattern matching feature from Python
- Look at Python dataclasses
- Always improving performances

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Idea / motivation

- EMF works very well, but is bound mostly to JVM.
- Idea: make EMF more polyglot.
- Questions:
  - Does this idea make sense?
  - What use cases would be served?
  - What aspect of EMF provides the most value?

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Topics “wall”

Which topic would we like to discuss:

1. Ecore as metamodeling standard
2. Definition and standardization of JSON-variant of XMI
3. JVM-agnostic standardization of EMF

The meeting voted for #3

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Links to other links

- The Strumenta forum thread that started it all
- GitHub repo with lots of links: https://github.com/dslmeinte/polyglot-emf/

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Post-meeting recap

(This is quite a subjective, personal recap!)

- There's a lot of value created through the ability to exchange models, including their meta models, across multiple languages/ecologies/platforms, especially by combining the features of the language with accessing exchanged models in an standard “EMF-idiomatic” way.

- Idea: have a list/“prioritized Backlog” of requirements, and/or a comprehensive test suite, to help with porting the most important parts of EMF to other languages.

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Imploration

Please share your experiences with exchanging with and consuming EMF models on other platforms than the JVM/Eclipse.

You can share them in the Strumenta forum thread that started it all.

I'll make sure to record a link (to the post or a blog post) in the polyglot-emf GitHub repo.

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