Practical aspects for mutation testing of model transformations?

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Who am I?

Short history

- 2007–2008: Started work on mutation testing as a student research assistant
- 2008–2010: Substitute Lecturer at UCA
- 2010–2014: PhD on MDE for performance test generation
- 2014–ongoing: Research Assistant at UCA

Participation in open source tool development

- MuBPEL: a mutation testing tool for Web Service compositions in BPEL
- EUnit: a unit testing framework for Epsilon
- Also, an Eclipse-based generic UI for mutation analysis tools (only MuBPEL so far)

Some of the current mutation analysis lines in UCASE

Mutation testing for WS-BPEL

- 30+ operators implemented and evaluated
- Current work: automatic test case generation

Mutation testing for C++

- AST-based operators using Clang
- Tooling under development

Mutation testing for model transformations

- We'd like to apply our techniques and generic tooling to a model transformation language
- But first, the operators need to be defined and implemented: which approach should be taken?

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Mutation testing for model transformations

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Previous works on mutation analysis for MT

Mottu (2006): semantic mutation operators

- Language-independent "semantic" mutation operators
- Based on model navigation, filtering and creation/modification
- STVR '14 paper: Kermeta, test improvement w/traceability

Fraternali (2009): stacked HOTs to implement operators

- A simple HOT is turned into a m. operator using a HOT
- Paper has example for Mottu's CFCD operator for ATL
- There is some code, but it seems like an early prototype

Khan (2013): operators for ATL

- 10 concrete operators for ATL (seem to be focused on syntax)
- Prototype implementation: MuATL (availability?)

Suggestions for discussion

Requirements for a "practical" tool

- What do we want from mutation analysis?
  - Measuring test effectiveness?
  - Finding irrelevant code?
- What kind of UI/tool integration would be useful?
- Could the tool be used to mutate any DSL too?

Technical details about mutation

- How to define mutants: language spec, typical mistakes, emulation of structural coverage criteria?
- How to determine if a mutant is killed? Most approaches use one-to-one comparisons, but it might be useful to compare the interpretations of the models.

End of the slides

Thank you for your attention!

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`@antoniogado`

References

- J.-M. Mottu, B. Baudry, Y. Le Traon
  Mutation analysis testing for model transformations
  Model Driven Architecture – Foundations and Applications, 2006, 376–390.

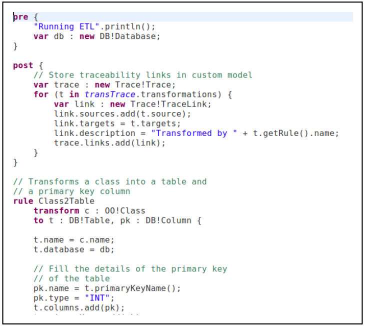
- P. Fraternali, M. Tisi.
  Mutation Analysis for Model Transformations in ATL.
  MtATL 2009 Proceedings, pp. 145–149.

- Y. Khan, J. Hassine.
  Mutation Operators for the Atlas Transformation Language
  ICSTW 2013 Proceedings, pp. 43–52.

- Vincent Aranega, Jean-Marie Mottu, Anne Etien et al.
  Towards an automation of the mutation analysis dedicated to model transformation.
  Software Testing, Verification and Reliability, 2014.

What is a Higher Order Transformation?

Transformation source



```
pre {
    "Running ETL".println();
    var db : new DB!Database;
}

post {
    // Store traceability links in custom model
    var trace : new Trace!Trace;
    for (t in transTrace.transformations) {
        var link : new Trace!TraceLink;
        link.sources.add(t.source);
        link.targets = t.targets;
        link.description = "Transformed by " + t.getRule().name;
        trace.links.add(link);
    }
}

// Transforms a class into a table and
// a primary key column
rule Class2Table
    transform c : OO!Class
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    t.name = c.name;
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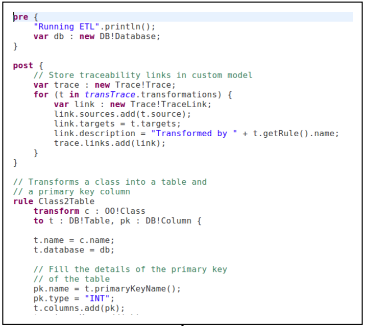

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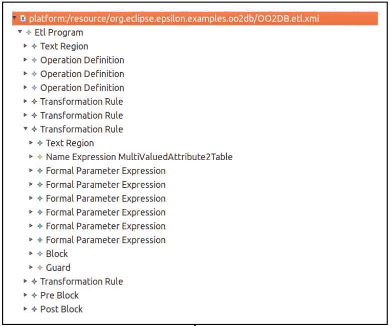
Transformation model



```
▾ platform:/resource/org.eclipse.epsilon.examples.oo2db/OO2DB.etl.xmi
  ▾ Etl Program
    ▸ Text Region
    ▸ Operation Definition
    ▸ Operation Definition
    ▸ Operation Definition
    ▸ Transformation Rule
    ▸ Transformation Rule
    ▾ Transformation Rule
      ▸ Text Region
      ▸ Name Expression MultiValuedAttribute2Table
      ▸ Formal Parameter Expression
      ▸ Formal Parameter Expression
      ▸ Formal Parameter Expression
      ▸ Formal Parameter Expression
      ▸ Formal Parameter Expression
      ▸ Formal Parameter Expression
      ▸ Block
      ▸ Guard
    ▸ Transformation Rule
    ▸ Pre Block
    ▸ Post Block
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parse

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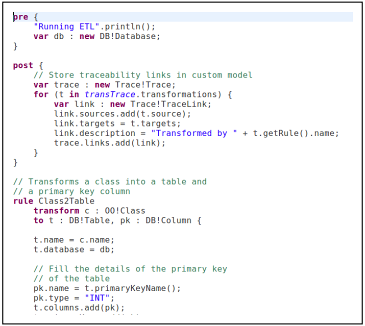

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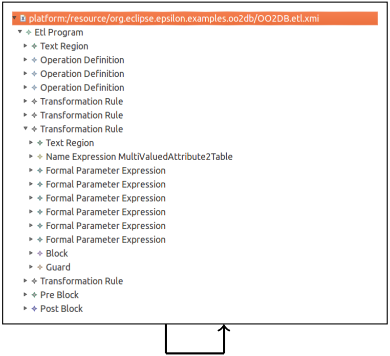

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transform

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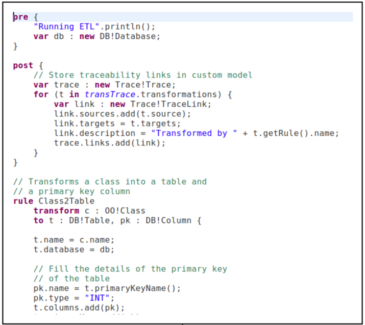

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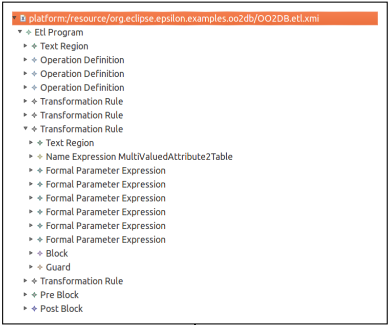

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regenerate