



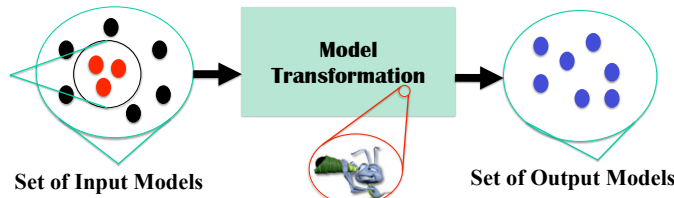
CARTIER : A TOOL FOR AUTOMATIC TEST MODEL SYNTHESIS

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The Problem

What are the test models ...



...that can detect bugs in the transformation ?

The Challenges

- Test models are inter-connected graph of objects
- Test models must conform to heterogeneous sources of knowledge
- Manual specification is tedious or impossible due to complexity of creating a large number of conforming test models

The Solution

Cartier: A systematic methodology and tool to automatically synthesize test models

Cartier Architecture



EMF Ecore
Input meta-model



OCL 2.0
Invariants
Pre-condition

Synthesis Strategy

- Generate-and-test
- AllRanges
- AllPartitions
- Partial Model Completion

Parameters

- Type Scopes
- # of test models



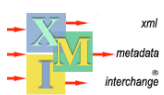
Cartier Transformation

- 1 EMF input meta-model to Alloy Signatures and Facts
- 2 OCL Invariants to Alloy Facts (Automation is future work)
- 3 Testing strategy to Alloy Predicates and Run Commands

Cartier Test Model Generation

- 1 Invoking KodKod to transform Alloy model to Boolean CNF formulae
- 2 Invoking SAT Solver for # of solutions
- 3 Alloy Instances to XMI solutions conforming to input meta-model.

Set of Test Models



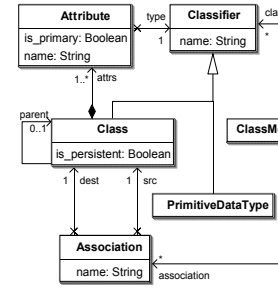
Set of Input Models



Kermeta Alloy

Representative Case Study

Ecore Meta-model



(a)

OCL Invariants

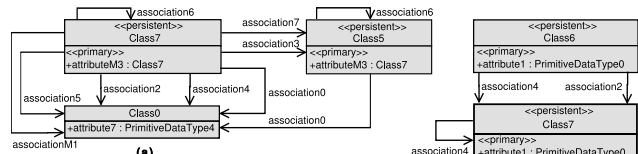
```

context Class
  inv noCyclicInheritance:
    not self.allParents()->includes(self)
  inv uniqueAttributesName:
    self.attrs->forAll( att1, att2 |
      att1.name=att2.name implies att1=att2)

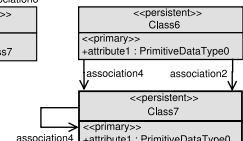
context ClassModel
  inv uniqueClassifierNames:
    self.classifier->forAll( c1, c2 |
      c1.name=c2.name implies c1=c2)
  inv uniqueClassAssociationSourceName :
    self.association->forAll( ass1, ass2 |
      ass1.name=ass2.name implies
      (ass1=ass2 or ass1.src != ass2.src))
  
```

(b)

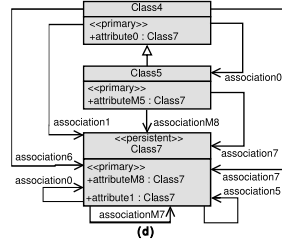
Input meta-model for Simple UML Class Models to RDBMS Models



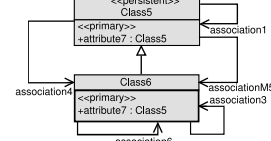
(a)



(b)



(d)



(e)

Some generated UML class models...

Conclusion

- Cartier generates small models that can detect bugs as shown in the representative case study
- We demonstrate how knowledge from different sources can be combined in Cartier using extensibility features of Kermeta
- We conform to major standardization efforts such as EMF, XMI, and OCL

References

- [1] Sen, S.; Baudry, B. & Mottu, J. On Combining Multi-formalism Knowledge to Select Test Models for Model Transformation Testing, *IEEE International Conference on Software Testing*, 2008
- [2] Sen, S.; Baudry, B. & Mottu, J. Automatic Test Model Generation Strategies for Model Transformation Testing, *IEEE International Conference on Model Transformation*, 2009
- [3] Bezin, J.; Rumpe, B.; Schurr, A. & Tratt, L. Model Transformations in Practice Workshop, October 3rd 2005, part of MoDELS 2005, *Proceedings of MoDELS*, 2005

Download: <http://www.irisa.fr/triskell/Softwares/protos/Cartier>