Verification of uml/ocl class diagrams using-constraint programming

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Introduction

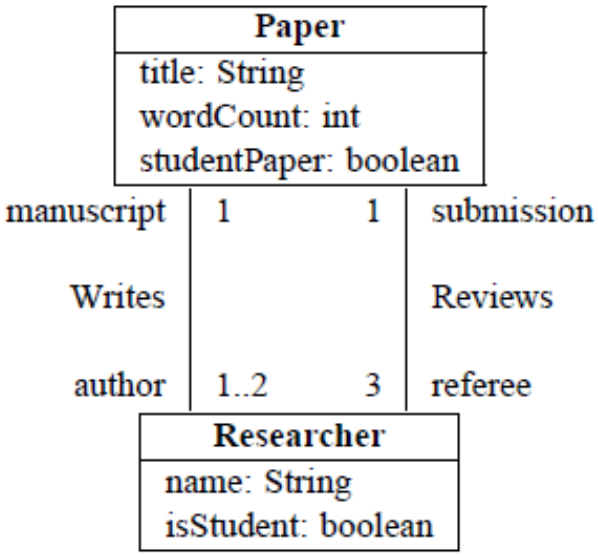
- Motivation?
  - Model driven development and architecture
  - Ensure the quality of the final application - find design issues before development stage

Ideea

- Transform UML/OCL diagrams into Constraint Satisfaction Problem

- Check satisfiability

Example



context Researcher **inv** NoSelfReviews:
self.submission−>excludes(self.manuscript)

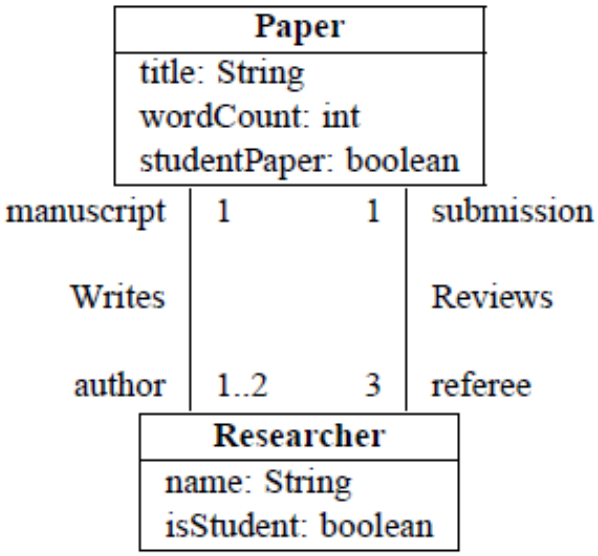
context Paper **inv** PaperLength:
self.wordCount < 10000

context Paper **inv** AuthorsOfStudentPaper:
self.studentPaper = self.author−>exists(x | x.isStudent)

context Paper **inv** NoStudentReviewers:
self.referee−>forAll(r | not r.isStudent)

context Paper **inv** LimitsOnStudentPapers:
Paper::allInstances()−>exists(p | p.studentPaper) and
Paper::allInstances()−>select(p | p.studentPaper) −>size() < 5

Example



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- A Review requires exactly 3 Researcher
- Writes requires either 1 or 2 Researcher

  -> we can’t satisfy the constraints

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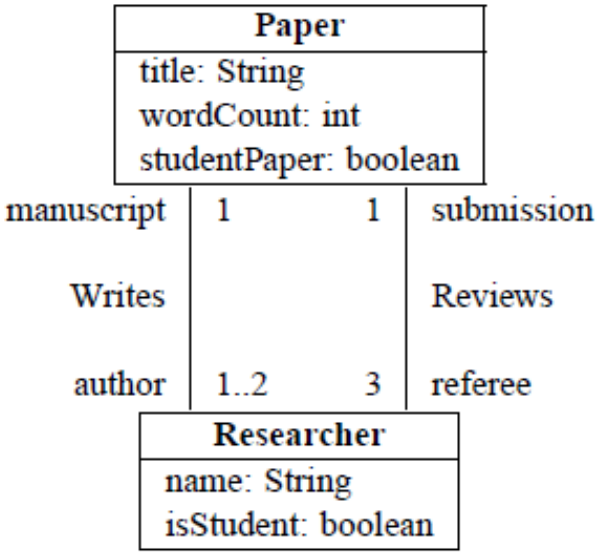

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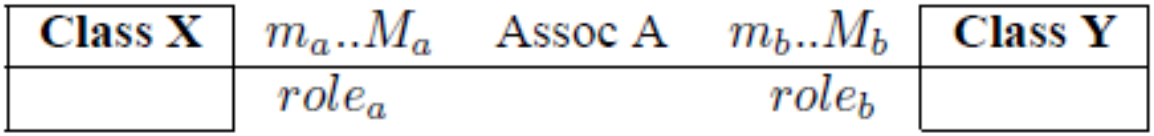
- NoStudentReviewers: Students cannot be referees
- Writes: all Researchers are authors (multiplication)
- Review: all authors must review Papers
- At least one student paper with a student author
  -> we can't satisfy the constraints

Translation of uml/ocl class diagrams

- Translate each element into a set of variables, domains and constraints
- Ensure that each domain is bounded, the referenced objects are existing
- Discard every attribute that does not participate in any constraints

Translation of uml/ocl class diagrams



$$Size_A \leq Size_X \cdot Size_Y$$
$$m_a \cdot Size_Y \leq Size_A \leq M_a \cdot Size_Y$$
$$m_b \cdot Size_X \leq Size_A \leq M_b \cdot Size_X$$

- Implicit cardinality constraints due to the association multiplicities

Translation of uml/ocl class diagrams

```
context Paper inv PaperLength:
Paper::allInstances−>
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```
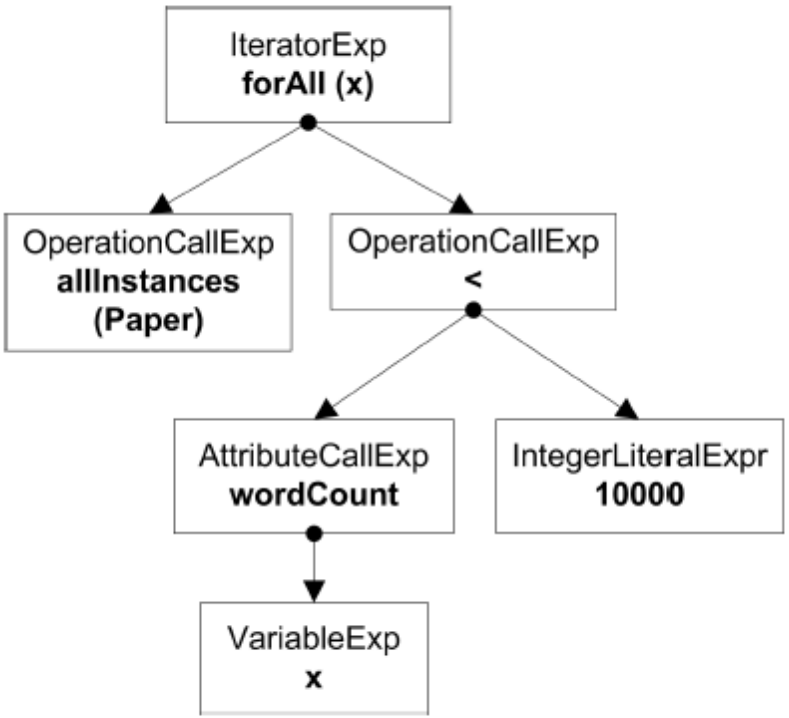

(a)



(b)

- Parse textual OCL and transform it to a tree using a toolkit
- With a post-order traversal transform each node into a Prolog compound term

Evaluation of the CSP

- Check if the model can be instanciated
- The designer has to check the satisfiability of the model
- Remove constraint redundancies

Thanks for the attention