

EVALUATION OF SEMI-AUTOMATED ONTOLOGY INSTANCE MIGRATION

Maxim Davidovsky

Zaporozhye National University

✉ Vadim Ermolayev

Vyacheslav Tolok

Wolf-Ekkehard Matzke

Cadence Design Systems GmbH



**4-th International Symposium on
Intelligent Distributed Computing**

Tangier, Morocco, 16 September, 2010



cadence™

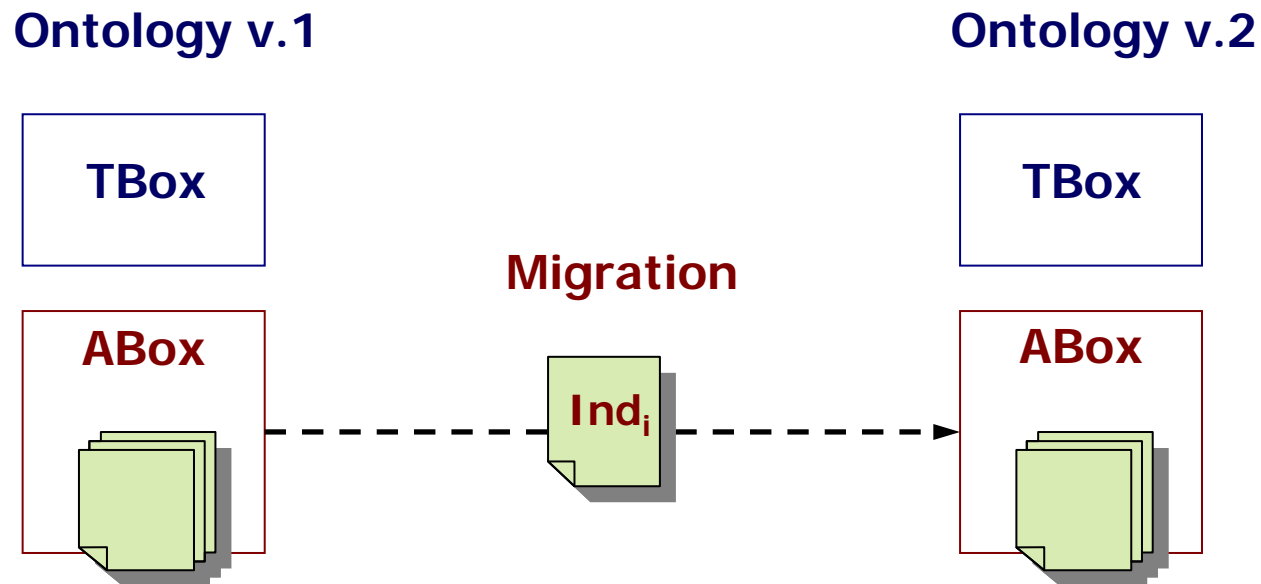
Agenda

- More details on the technical approach
 - That are not fully explained in the paper
- Motivation
- Problem statement and solution
 - Illustrative example
- Typical problems and ways to solve
- Evaluation Experiment
 - Set-up
 - Results for two different sets of ontologies
- Summary and future work

Motivation

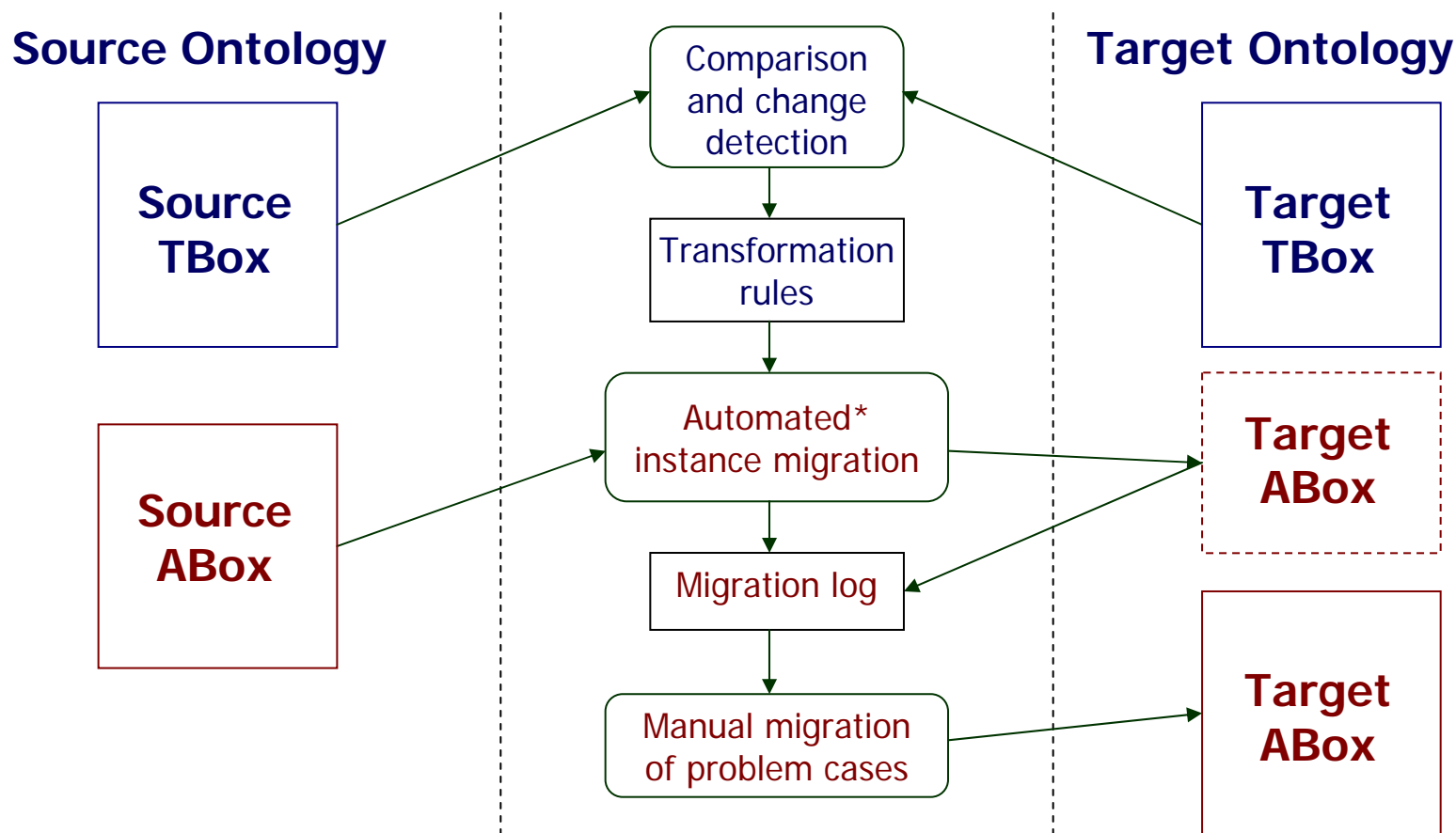
Need for Migration:

1. Evolving ontologies
2. Ontologies with overlapping domains



Problem Statement

Migration Process



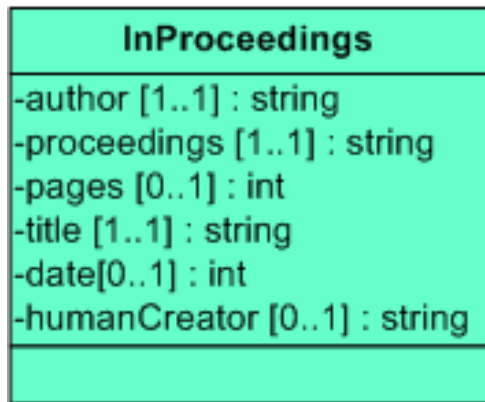
*In the sense that the action does not require user intervention.
But NOT in the sense that all instances are migrated automatically.

Illustrative Example

OAEI ontologies*

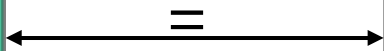
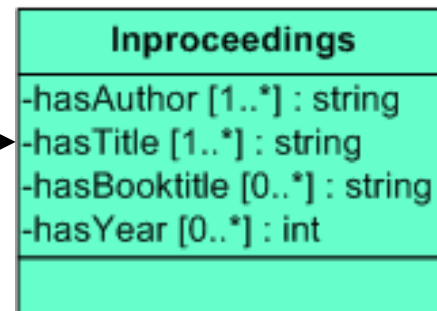
Bibliographic references ontology

InProceedings,
An article in a conference proceedings



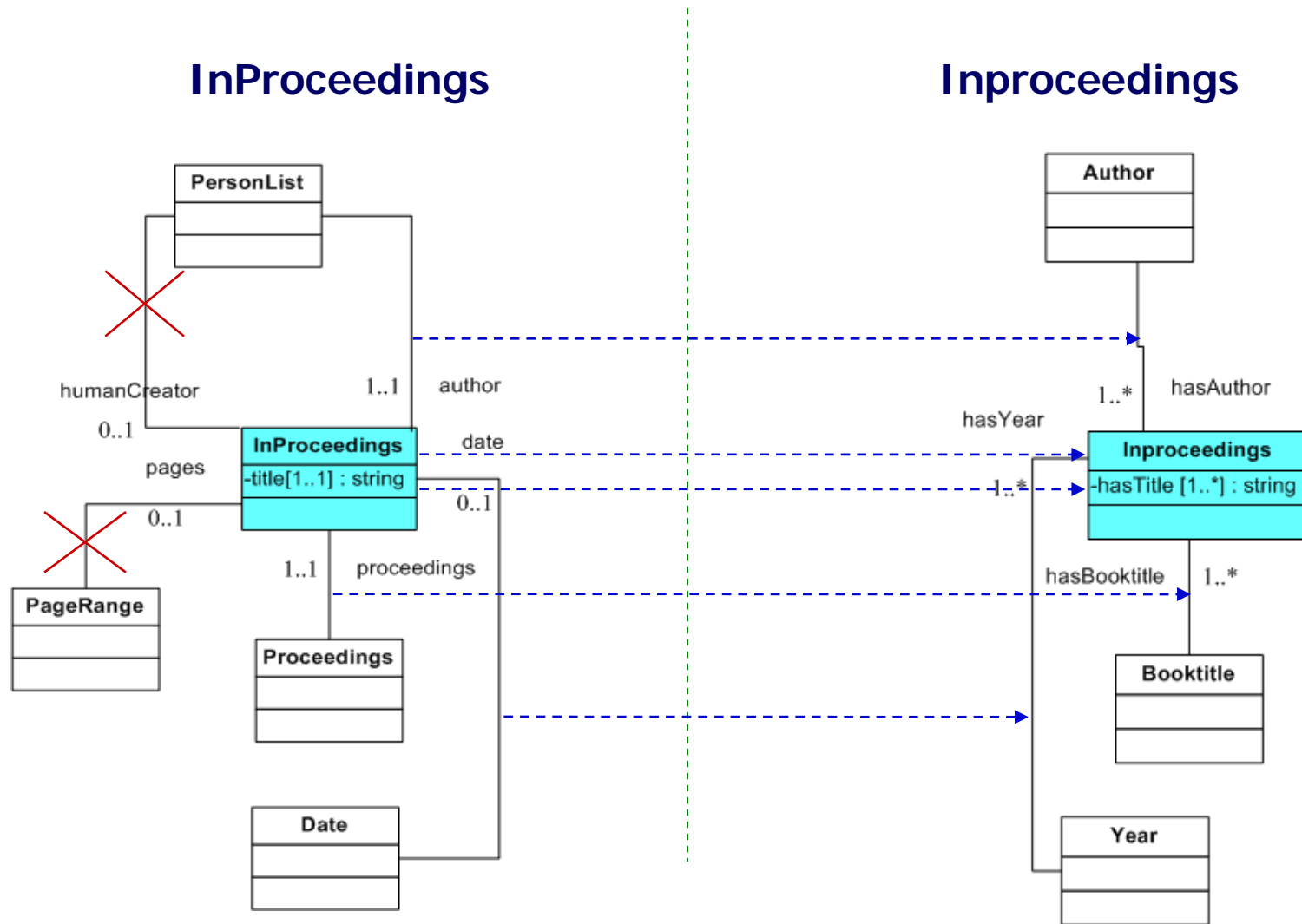
Bibtex ontology

Inproceedings,
An article in a conference proceedings



* Ontology Alignment Evaluation Initiative – <http://oaei.ontologymatching.org/2009/benchmarks>

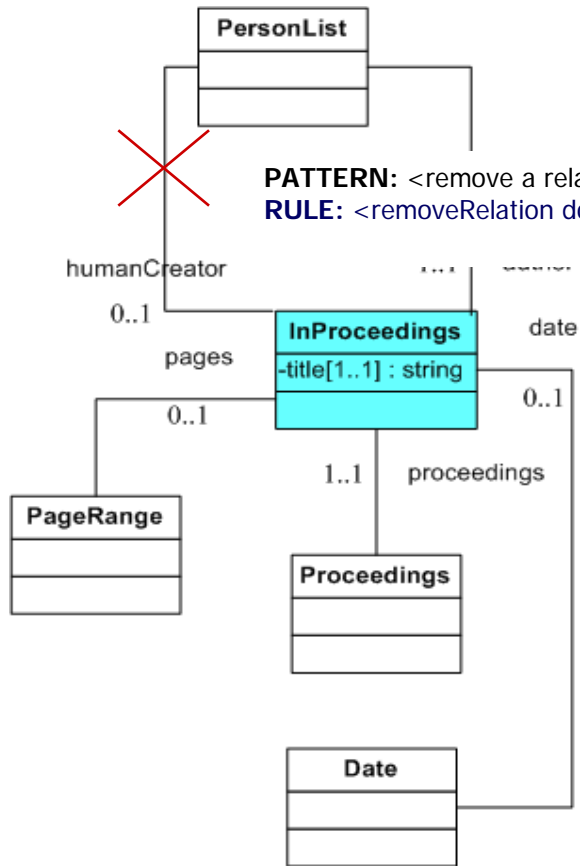
Illustrative Example



Illustrative Example

TRANSFORMATION TYPE: remove relation

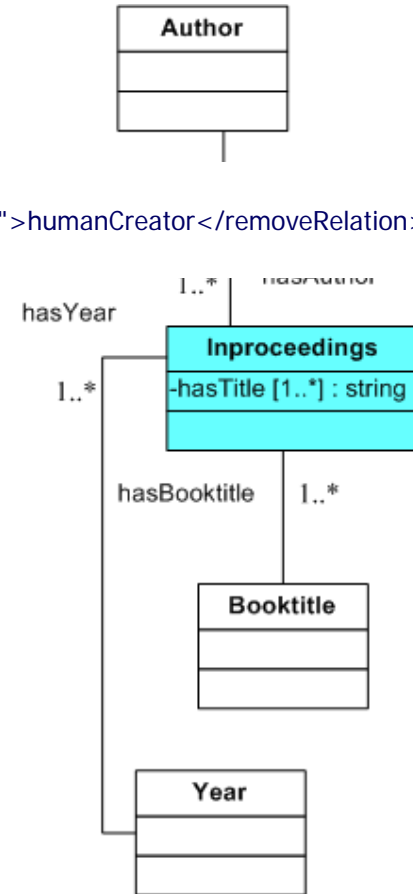
InProceedings



PATTERN: <remove a relation>

RULE: <removeRelation domain="InProceedings" range="PersonList">humanCreator</removeRelation>

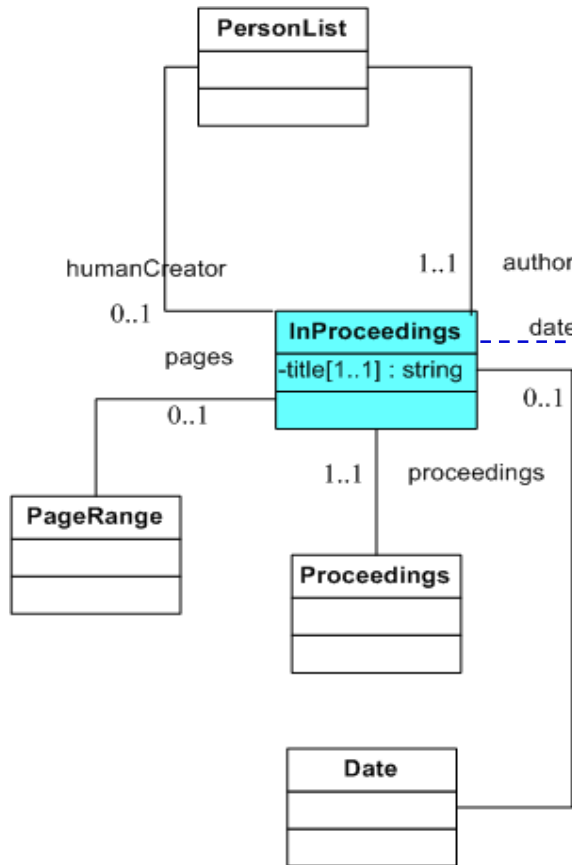
Inproceedings



Illustrative Example

TRANSFORMATION TYPE: rename concept

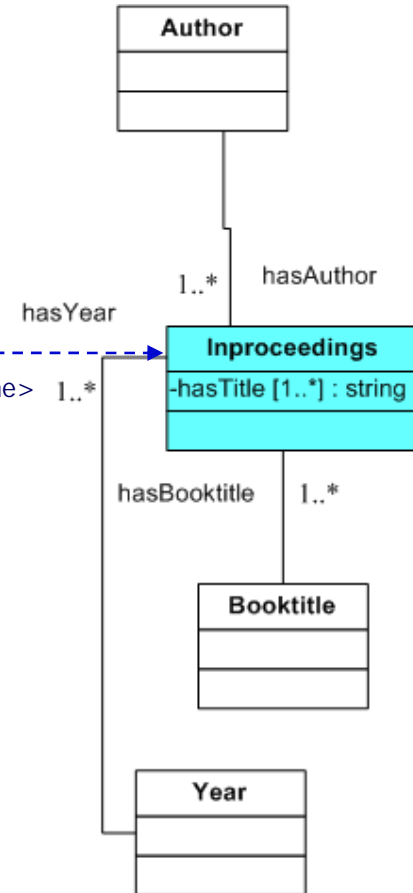
InProceedings



PATTERN: <rename>

RULE: <rename> Inproceedings </rename>

Inproceedings

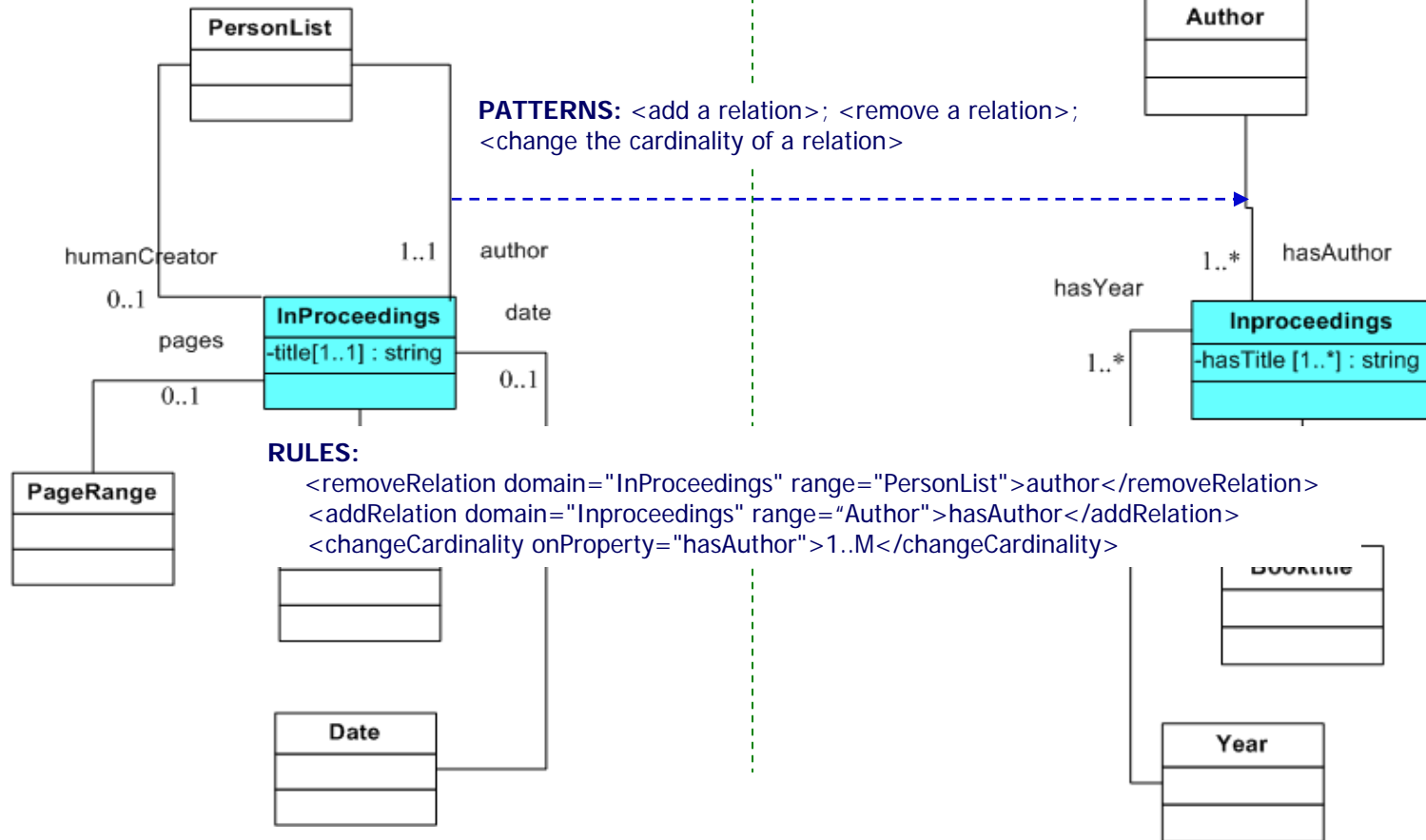


Illustrative Example

TRANSFORMATION TYPE: change object property

InProceedings

Inproceedings

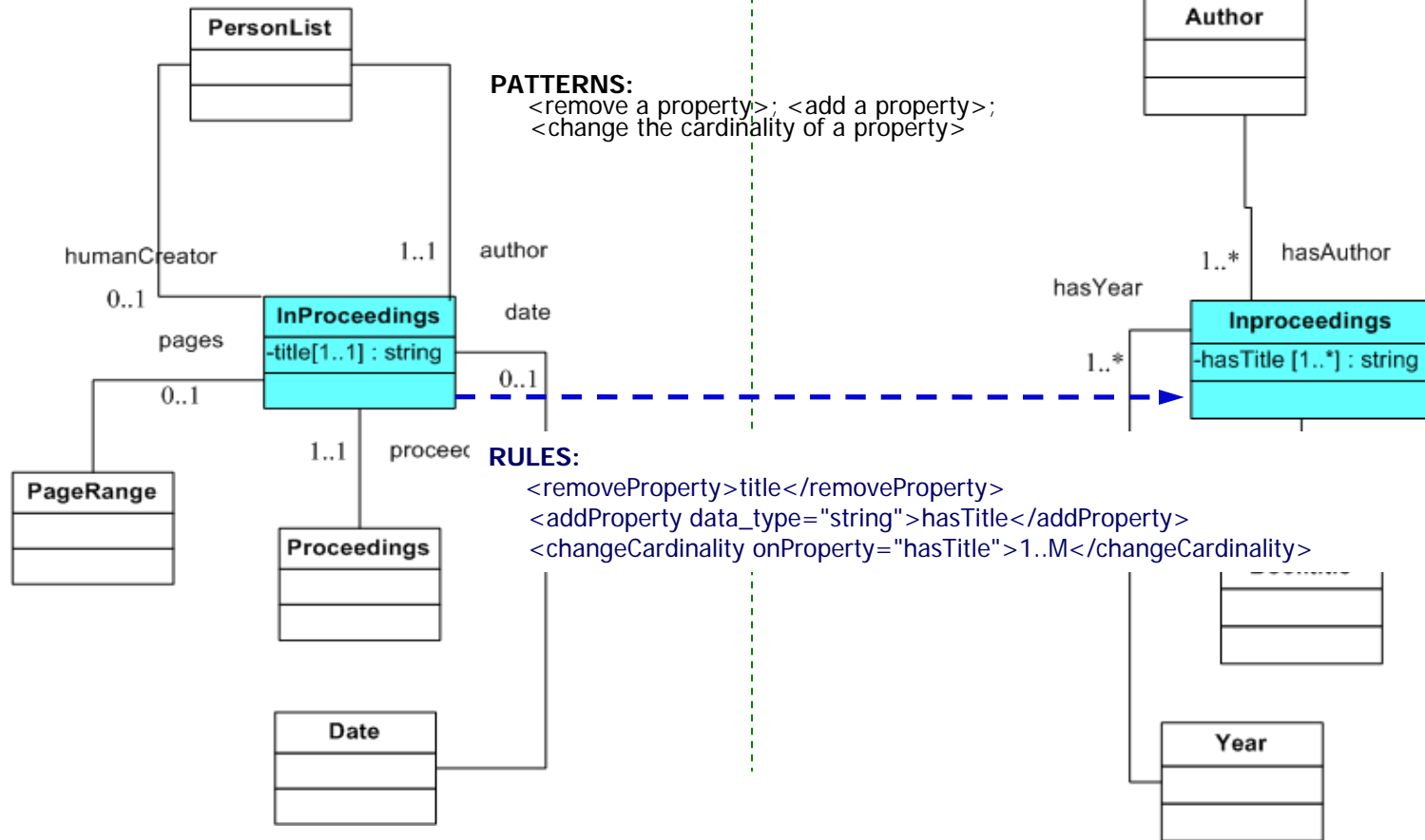


Illustrative Example

TRANSFORMATION TYPE: change datatype property

InProceedings

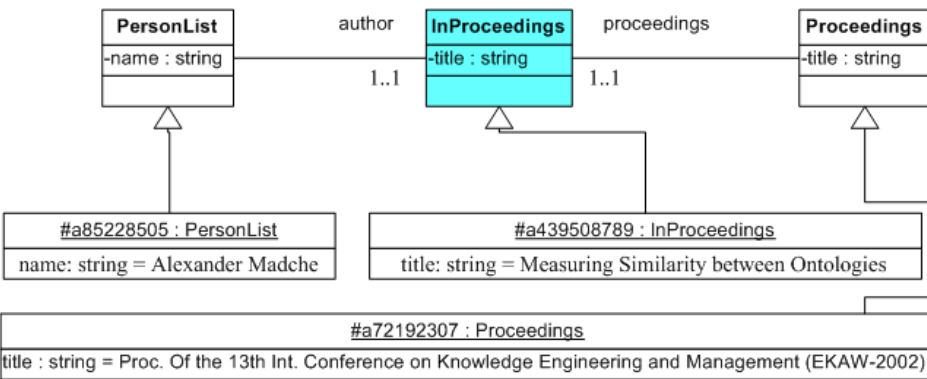
Inproceedings



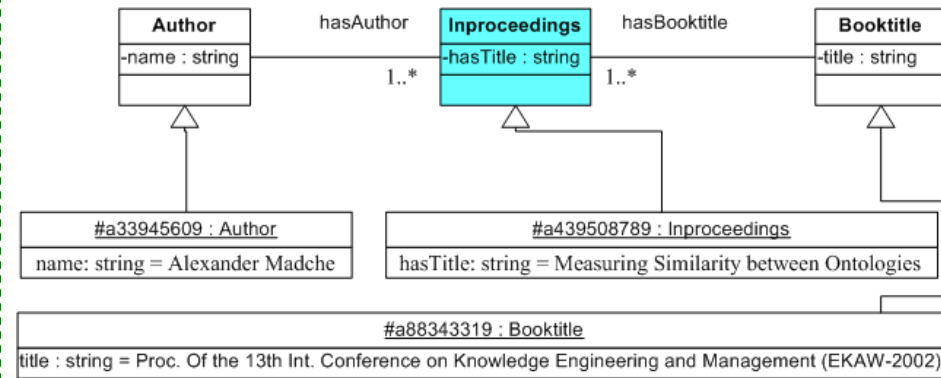
Instance Migration Results

InProceedings -----> Inproceedings

UML



UML



OWL

```
<InProceedings rdf:about="#a439508789">
  <author>
    <PersonList>
      <rdf:first rdf:resource="#a85228505"/>
    </PersonList>
  </author>
  <proceedings rdf:resource="#a72192307"/>
  <title>Measuring Similarity between Ontologies</title>
  ...
</InProceedings>
```

OWL

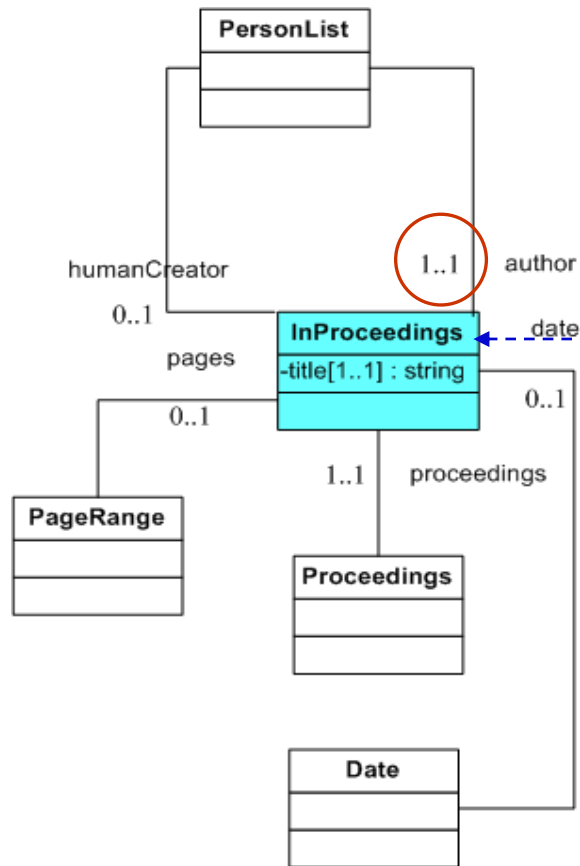
```
<Inproceedings rdf:about="#a439508789">
  <hasAuthor rdf:resource="#a33945609"/>
  <hasBooktitle rdf:resource="#a88343319">
    <hasTitle>Measuring Similarity between Ontologies</hasTitle>
  ...
</Inproceedings>
```

Typical Migration Problems

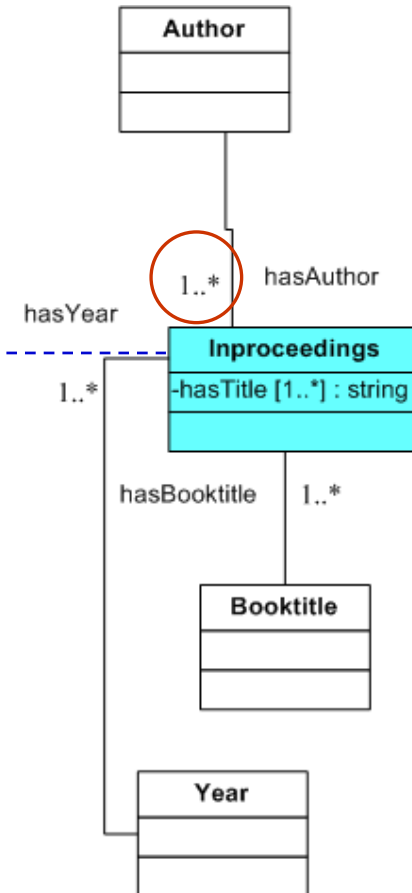
- **Can not be resolved automatically:**
 - Decreasing the cardinality of a relation
 - Less individuals – which to remove? (discussed in detail >)
 - Adding a relationship with [1..1] or [1..*] cardinality
 - Which instances to relate?
 - Current solution: do not add object property values, inform the user
- **Can be resolved automatically**
 - Adding a datatype property
 - The value of added property instance?
 - Solution: default value
 - **Equivalent concepts become non-equivalent**
 - Equivalence of classes in a source ontology and non-equivalence (disjointness in extreme) in the target ontology
 - Solution: only the proprietary instances of each source class are migrated to the corresponding target class

Typical Migration Problems

InProceedings (OWL)

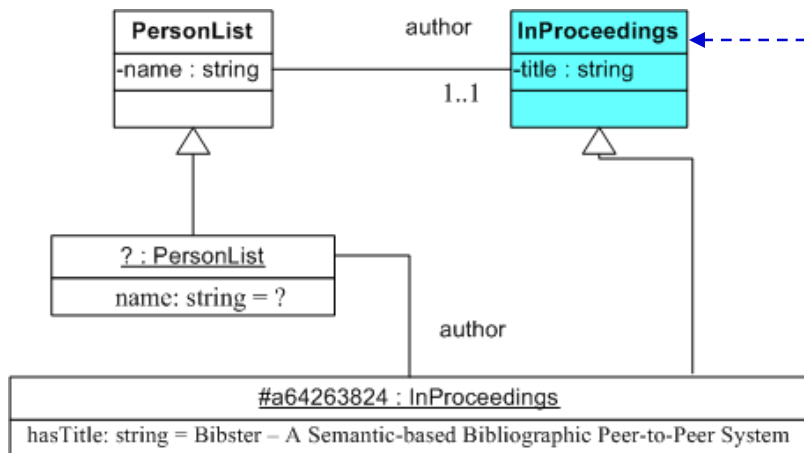


Inproceedings (OWL)

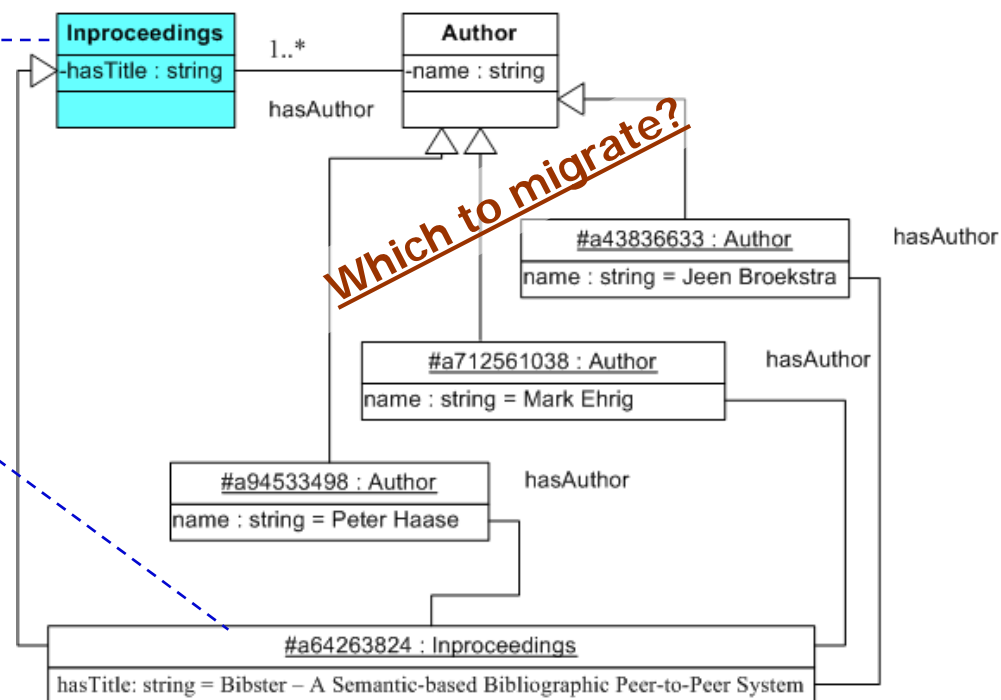


Typical Migration Problems

InProceedings (OWL)



Inproceedings (OWL)



—▷ - Instance of

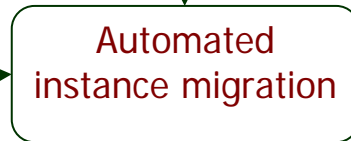
Such a situation signals about a possible error in the target TBox.
Current solution: write a migration log entry for informing a user.

Evaluation Set-up

Source Ontology



Target Ontology



Evaluation and analysis

Evaluation Metrics

Contingency table:

	Relevant	Irrelevant
Migrated	true positives (tp)	false positives (fp)
Not migrated	false negatives (fn)	true negatives (tn)

Precision (P): $P = tp / (tp + fp)$

Recall (R): $R = tp / (tp + fn)$

Accuracy (A): $A = (tp + tn) / (tp + fp + fn + tn)$

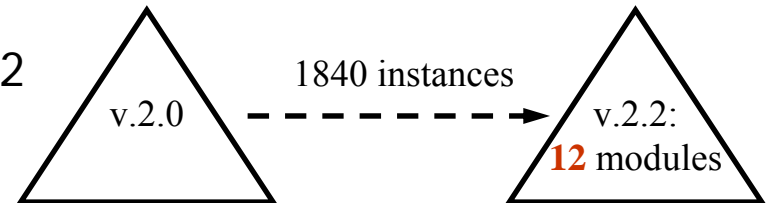
F measure:
$$F = \frac{1}{\alpha \frac{1}{P} + (1 - \alpha) \frac{1}{R}} = \frac{(\beta^2 + 1) P R}{\beta^2 P + R}, \text{ where } \beta^2 = \frac{1 - \alpha}{\alpha}$$
$$\alpha \in [0, 1], \Rightarrow \beta^2 \in [0, \infty]$$

Balanced F measure: $\alpha = 1/2$ or $\beta = 1$
$$F_{\beta=1} = \frac{2 P R}{P + R}$$

Evaluation Results

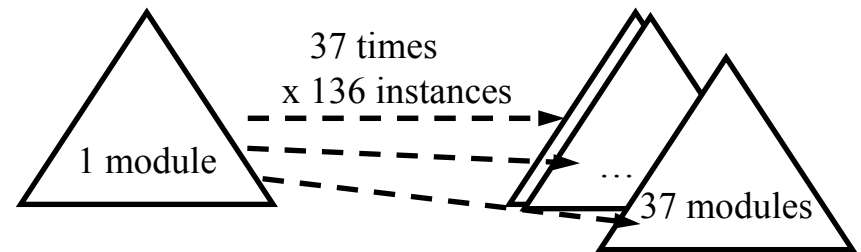
- **Experiment 1**

- PSI Suite of Ontologies v.2.0 -> v.2.2
- Focus: ontology versions



- **Experiment 2**

- OAEI Ontologies (2009 Campaign)
- Source: Bibliographic References Ontology
- Focus: distributed ontologies



- **Results* :**

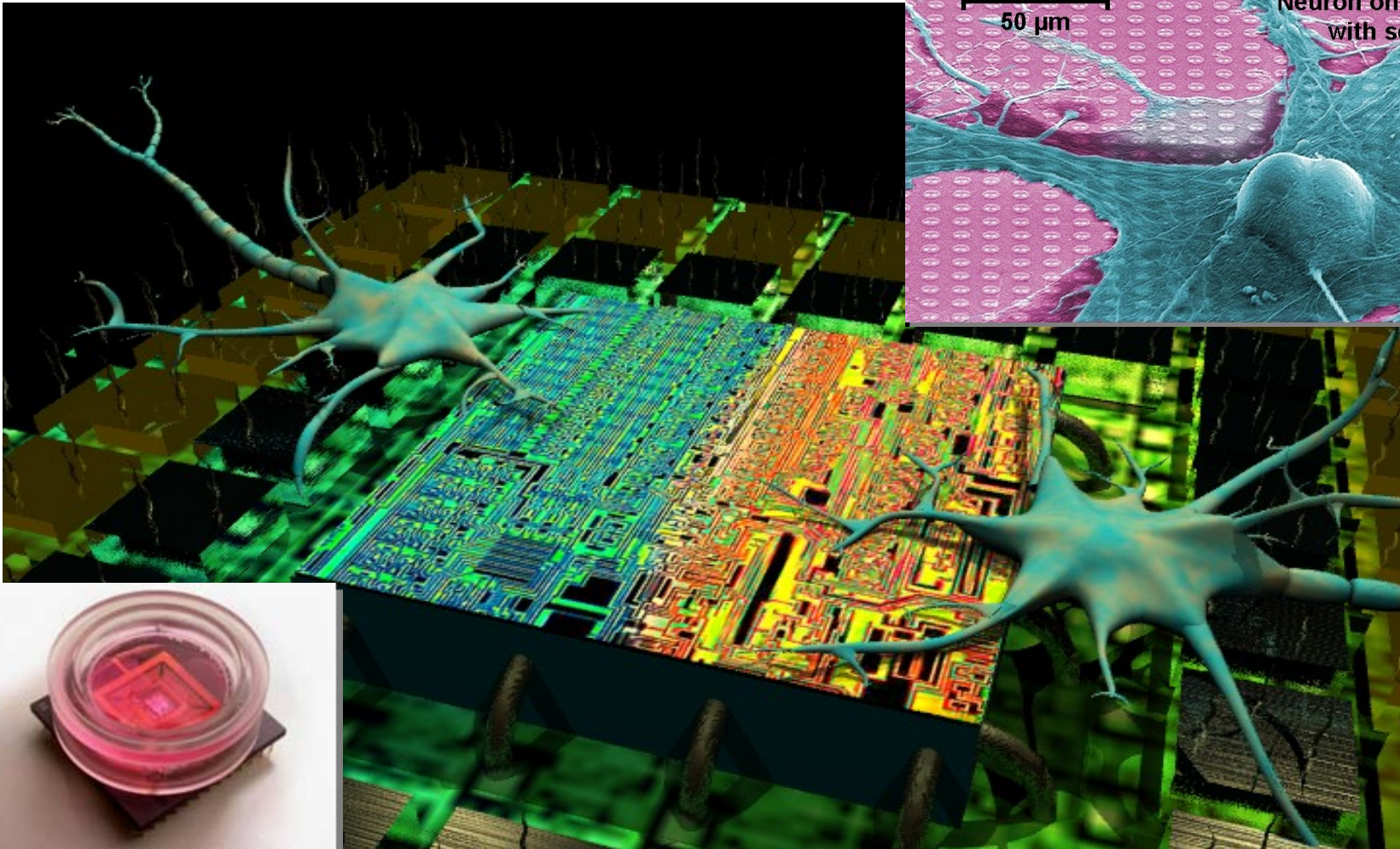
Testset	Contingency table			Precision	Recall	Accuracy	Balanced F measure
		relevant	irrelevant				
PSI	migrated	tp = 360	fp = 2	0.99447513	0.88163265	0.97337330	0.93466032
	not migrated	fn = 48	tn = 1480				
OAEI	migrated	tp = 4472	fp = 12	0.99732381	0.98415493	0.98162729	0.99069561
	not migrated	fn = 72	tn = 16				

* Differ from the paper. The transformation rules have been refined and now solve some of the migration problems

Results and Future Work

- **Issues to be solved**
 - Automation of TBox mapping
 - Automation of problem resolution
- **Current state**
 - Using robust mapping tools (3-d party)
 - Resolving typical migration problems in the transformation rules manually
 - The basic editor for instance migration rules
- **Future work**
 - Complementation with tools for structural differences detection and mapping tools
 - Automated detection of typical **migration problems and semi-automated resolution (where possible)**
 - Semi-automated generation of instance migration rules; visual representation

Questions Please



BACKUP SLIDES

☒ Evaluation of Semi-Automated Ontology Instance Migration



**4-th International Symposium on
Intelligent Distributed Computing**

Tangier, Morocco, 16 September, 2010

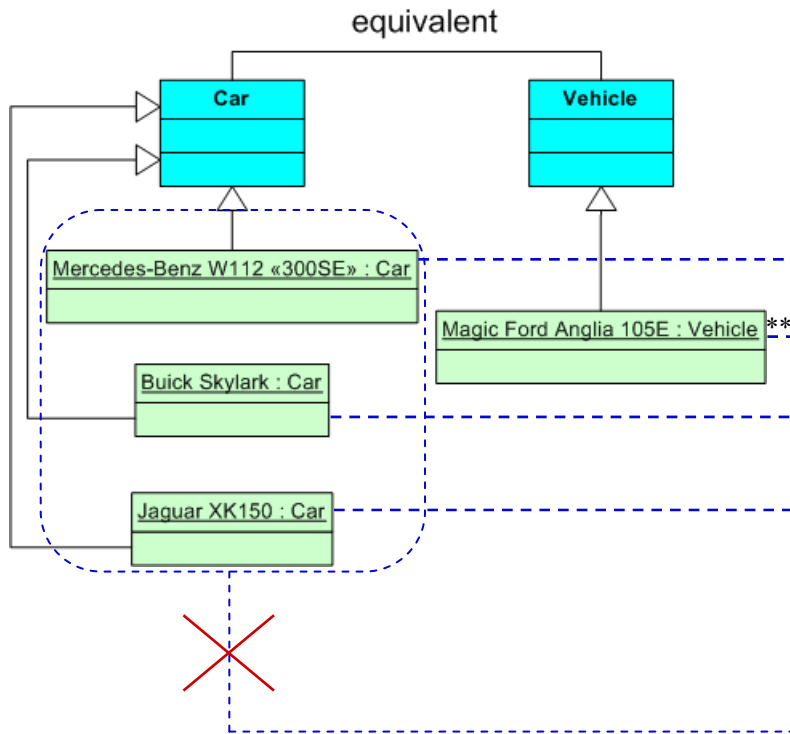


cādence™

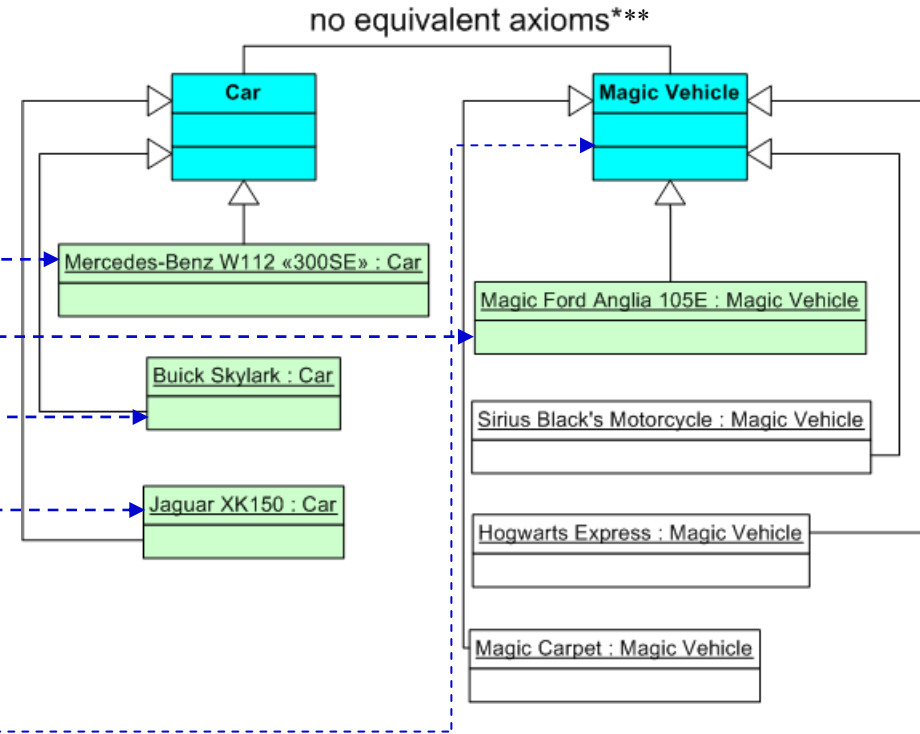
Typical Migration Problems

Equivalent concepts become non-equivalent

Wizards World* Transport Ontology v.1



Wizards World Transport Ontology v.2



—▷ - Instance of

* <http://www.universalorlando.com/harrypotter/>

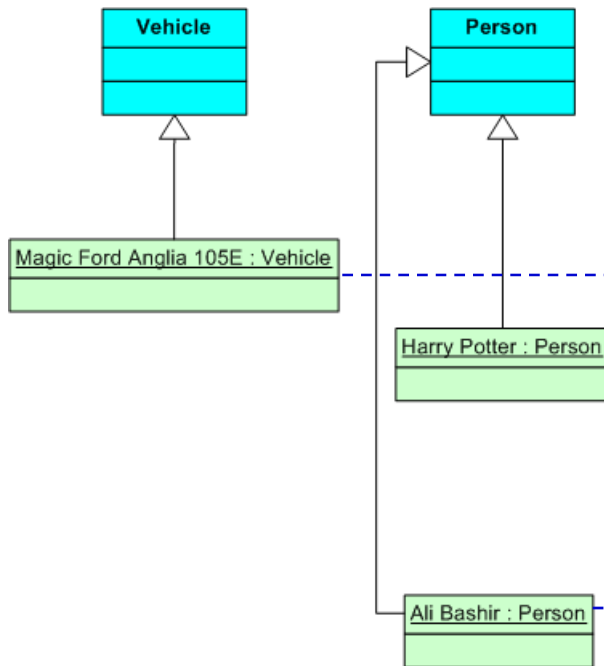
** http://en.wikipedia.org/wiki/Magical_objects_in_Harry_Potter

*** Disjointness is the extreme case

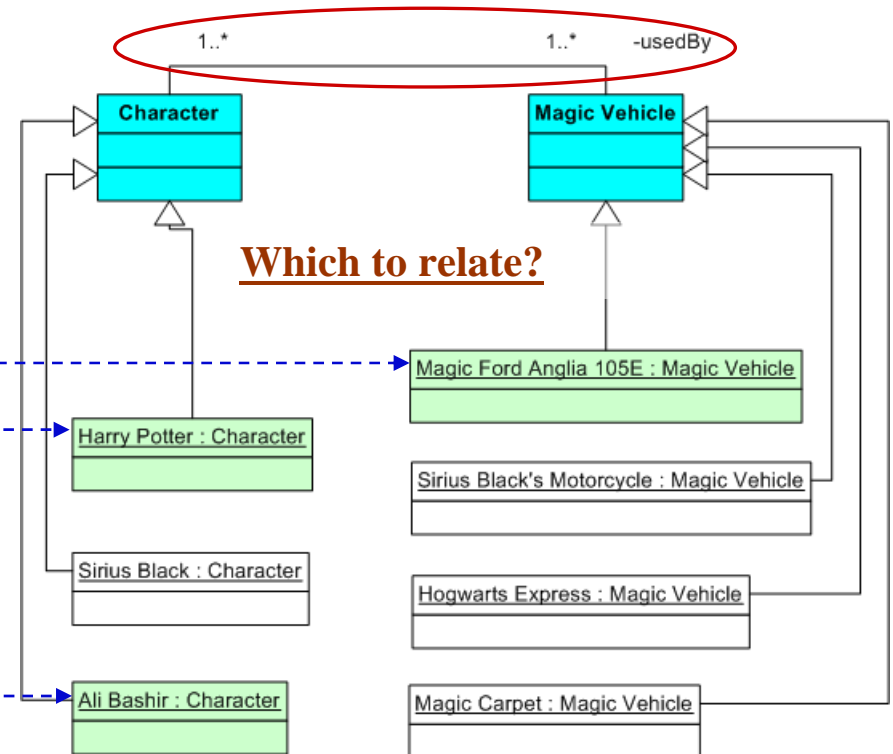
Typical Migration Problems

Adding a relationship with [1..1] or [1..*] cardinality

Wizardsing World Transport Ontology v.1



Wizardsing World Transport Ontology v.2



→ - Instance of