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Inconsistency Management in Model-Driven Engineering

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Inconsistency Management in Model-Driven Engineering

- Model-driven Engineering
  - Primary assets are models
  - Model: views on the software system on a certain level of abstraction
- Inconsistency Management
  - Inconsistencies
    - Different models developed by different persons
    - Interdependencies between models poorly understood
    - Requirements unclear or ambiguous
    - Models are incomplete

How to manage inconsistencies?

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Overview

- THE PAST
  - Classification of inconsistencies
  - Description Logics for detection and resolution
  - Graph Transformation for interdependencies
  - Tool Support

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Classification of Inconsistencies

	Behavioural	Structural
Specification	Invocation interaction Observation interaction	Dangling type reference Inherited cyclic composition Connector specification missing
Specification - Instance	Specification incompatibility Specification behaviour incompatibility Invocation behaviour Observation behaviour	Instance specification missing
Instance	Invocation inheritance Observation inheritance Instance behaviour incompatibility	Disconnected model

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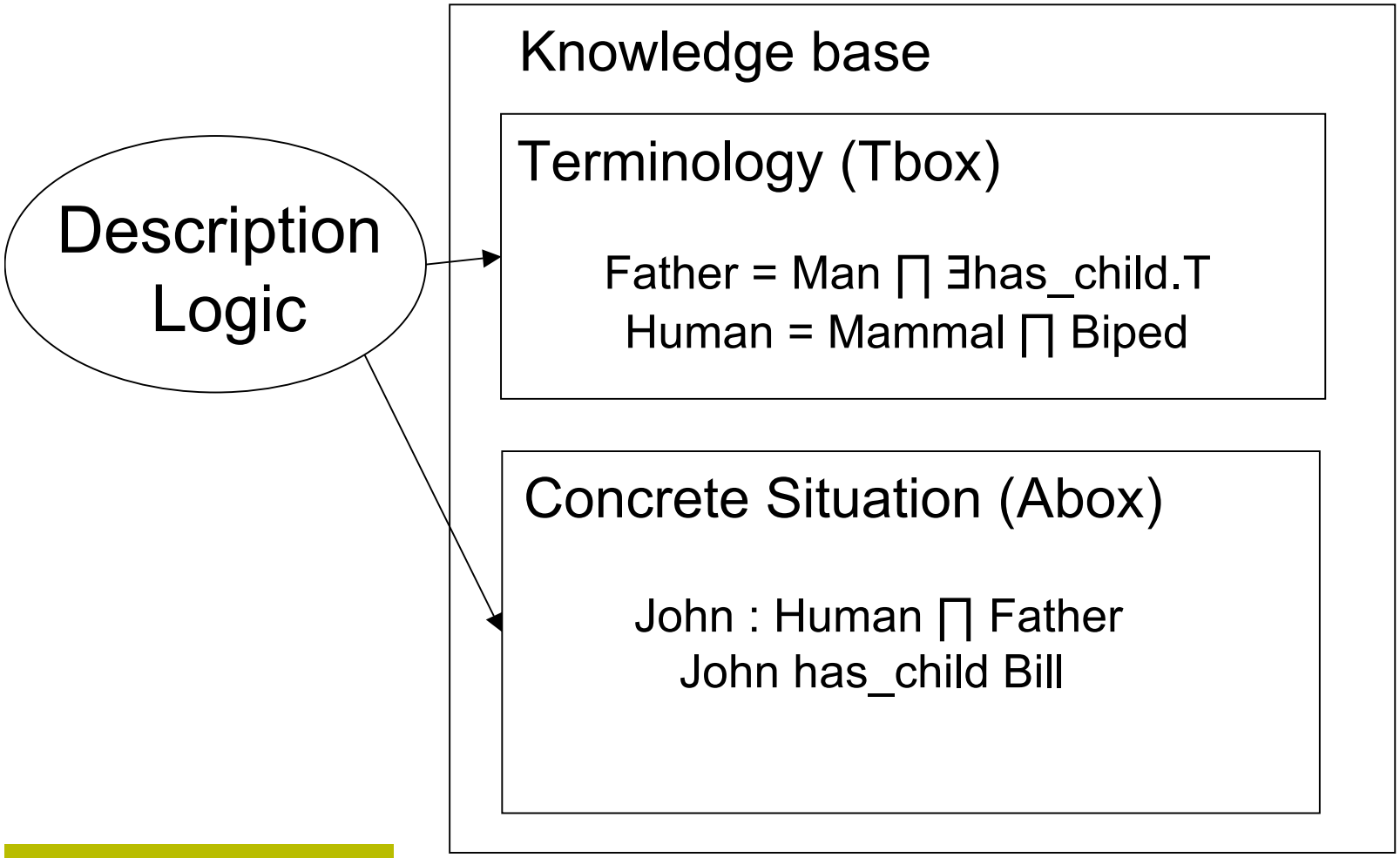
Description Logics



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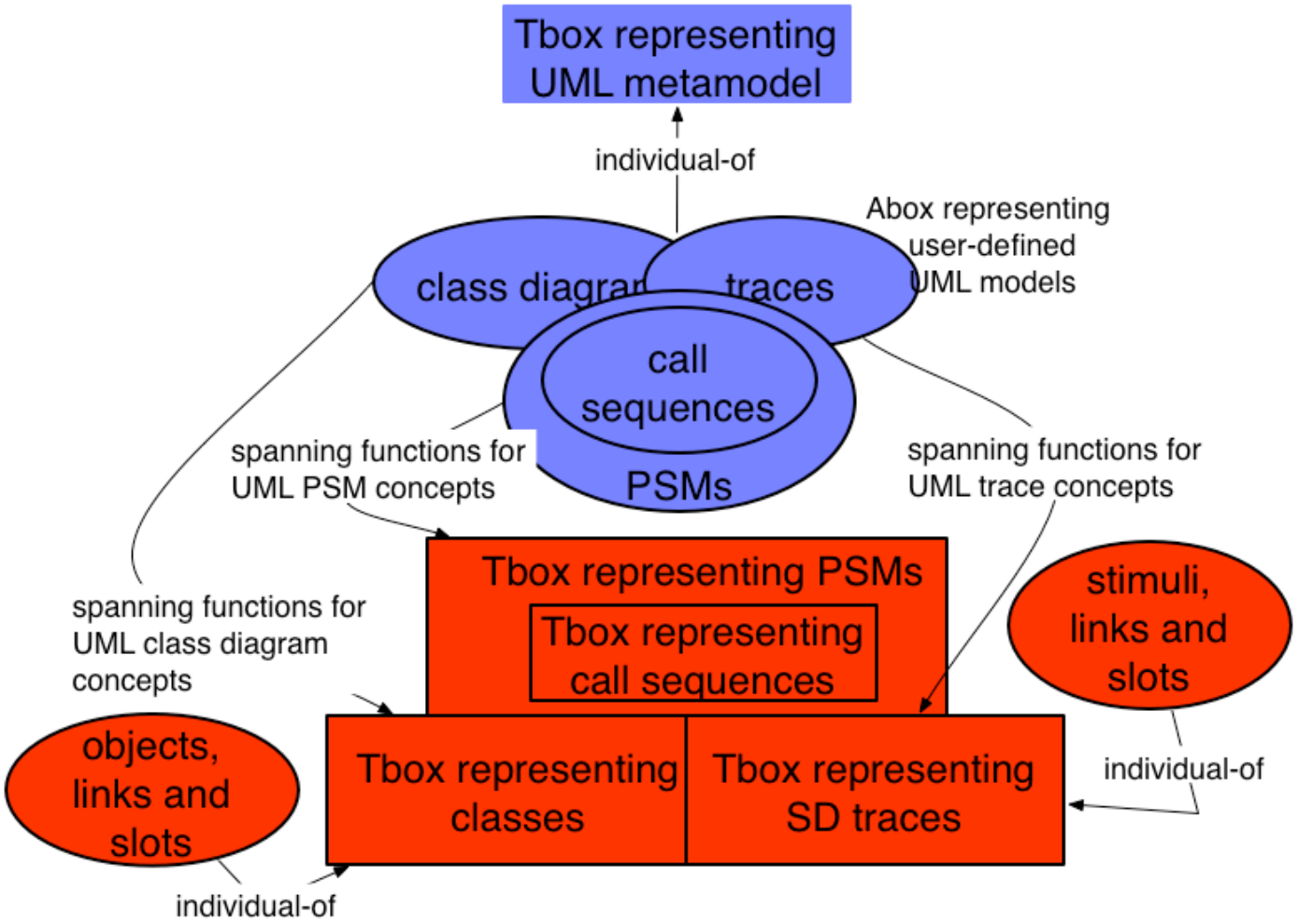
UML Models as DL KBs



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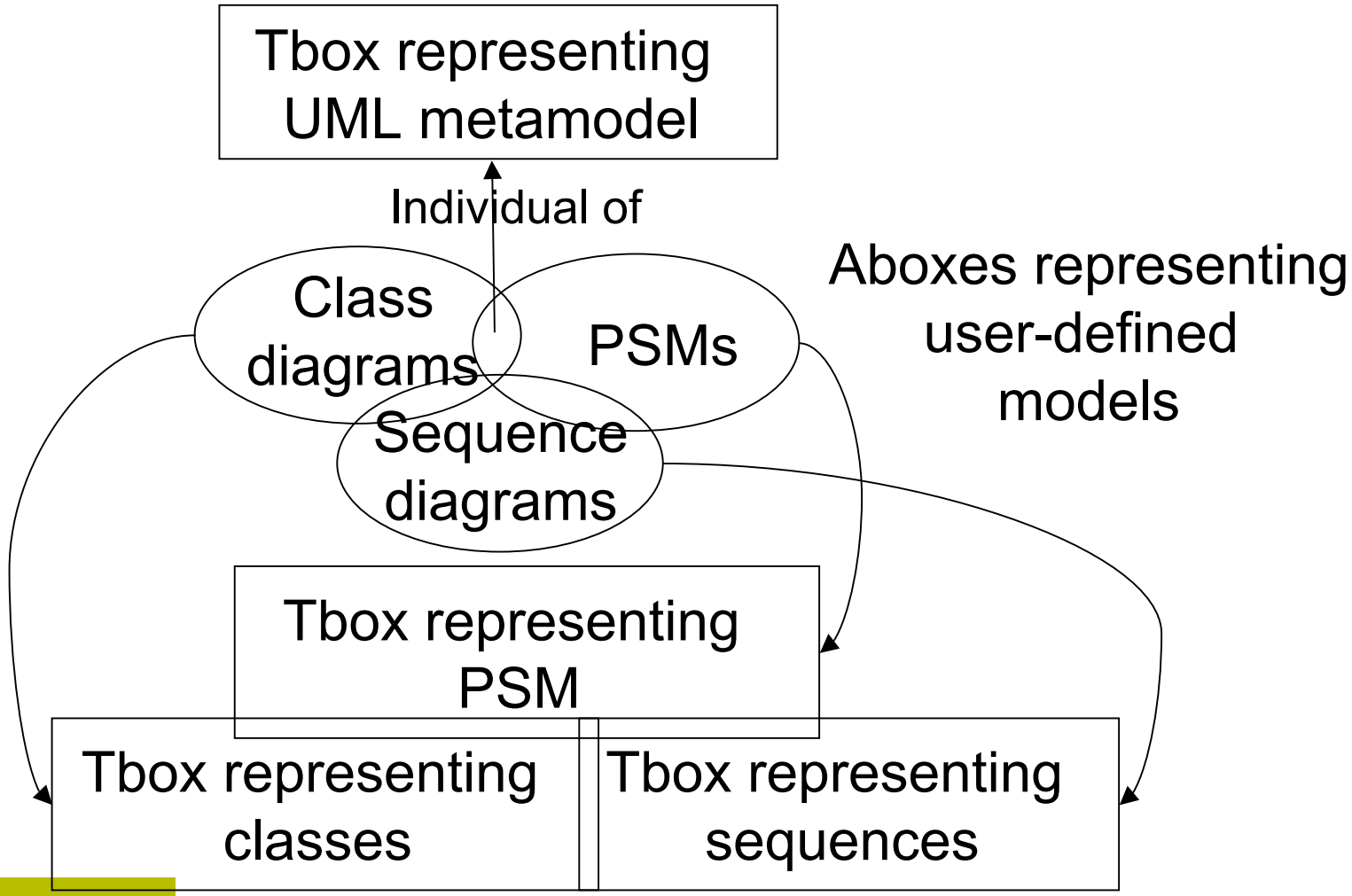
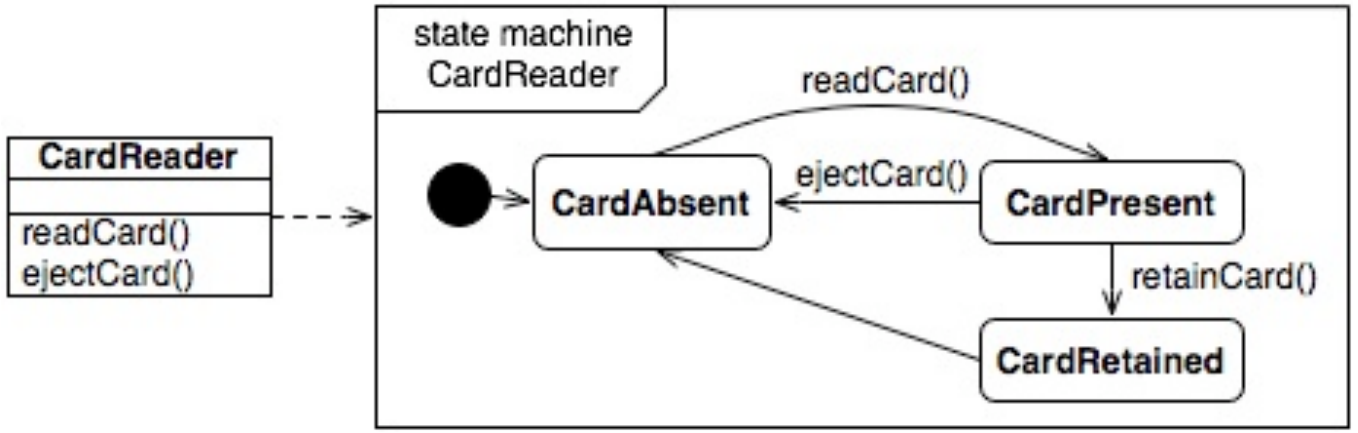
UML Models as DL Knowledge Bases



Detection of Inconsistencies



$$
\begin{aligned}
&ans(psm, cl, op) \\
&\quad \leftarrow \quad protocolstatemachine(psm) \wedge contextbehavior(psm, cl) \wedge \\
&\qquad regions(psm, r) \wedge transitions(r, t) \wedge protocoltransition(t) \wedge \\
&\qquad referredoperation(t, op) \wedge \ (\backslash(has\_known\_successor(ownedoperation, op)) \ \vee \\
&\qquad ((not(ownedoperation(cl, op))) \wedge (not(general(superc, c))) \wedge ownedoperation(superc, op)))
\end{aligned}
$$

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Resolution of Inconsistencies

- Rule-based Inconsistency Resolution Approach

Condition:

check inconsistency

information about state of the model

user interaction

Conclusion

resolution actions: add/delete instances, fillers

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Inconsistency Resolution: Iterative & incremental

- Induced Inconsistencies
  - Resolution of one inconsistency may induce other inconsistencies as a side effect
- Conflicting Resolutions
  - Some resolutions may not be jointly applicable
- Resolution Cycles
  - Certain sequences of resolutions may reintroduce a particular inconsistency occurrence

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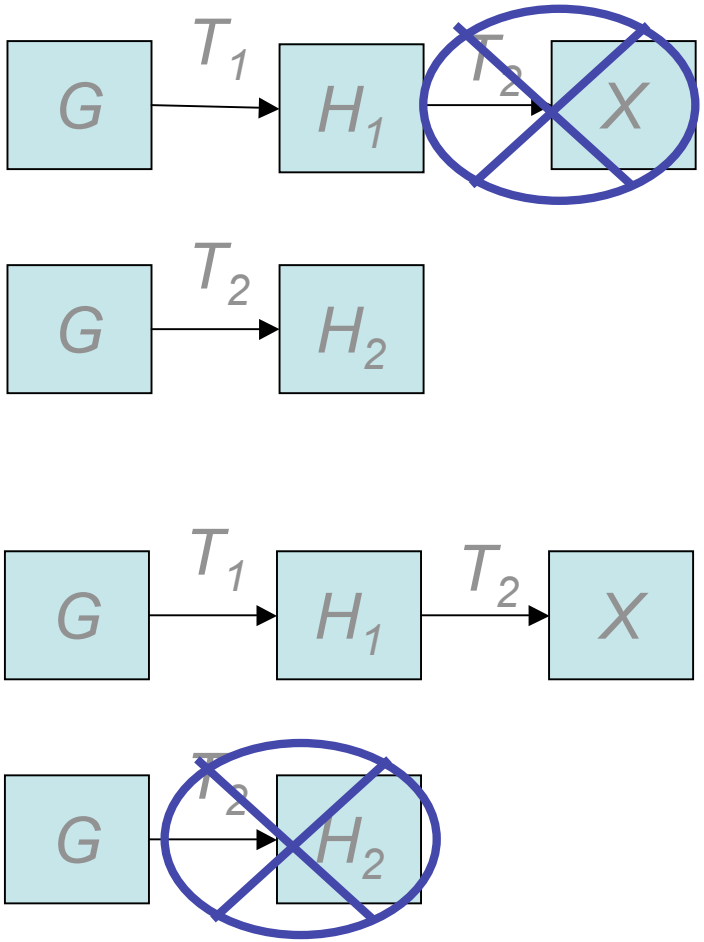
Graph Transformations: Critical Pair Analysis

- T_1 and T_2 form a *critical pair* if
  - they can both be applied to the same initial graph G
  - applying T_1 prohibits application of T_2
- T_2 *sequentially depends* on T_1 if
  - T_1 can be applied to G but T_2 cannot
  - applying T_1 triggers application of T_2



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Tool Support

- Poseidon plug-in
  - but:
    - Translation UML meta -> DL manually
    - UML 1.x
- Eclipse plug-in (was planned for 2006/Q4, 2007/Q1)
  - Usage of Ecore, EMF, UML2 editor(?), AGG Eclipse plug-in,
  - Automatic translation UML meta -> DL

Overview

- THE PAST
  - Classification of inconsistencies,
  - Description Logics for detection and resolution,
  - Graph Transformation for interdependencies,
  - Tool Support.
- THE FUTURE
  - General inconsistency management framework
    - Classification, comparison of formalisms,
    - Different modeling languages,
    - Bridging the gap between theory and practice.

WP4

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Classification, comparison and integration of formalisms

- *Our research*
  - DL <--> Graph Transformations
- *Goal*
  - integrate variety of formal approaches
  - classify, compare and combine different formalisms for inconsistency management
- *Collaboration*
  - partners working in the area of inconsistency management or studying certain formalisms.
  - compare, integrate formalisms.

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Different Modeling Languages

- *Our research*
  - Until now: UML class, sequence and state machine diagrams
- *Goal*
  - Incorporate other modeling languages, e.g., workflow languages and their AO extensions.
  - Which kinds of inconsistencies?
  - Formalism for detection and resolution?
  - Integrate, compare, … with other formalisms.
- *Collaboration*
  - Defining semantics of these MLs.
  - Defining right formalism.

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Bridging the gap between theory and practice

- *Goal*
  - Based on comparison of formalisms:
    - Improve existing approaches
  - Use, apply formal techniques of other partners from other WPs
- *Research*
  - Integrate these approaches in our framework and provide feedback to the partners developing/investigating these formalisms.
- *Collaboration*
  - Partners studying certain formalisms -> provide these formalisms for inconsistency management.