Meta Modeling: Re-architecting the UML Infrastructure

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Overview

- Current UML Metamodel
- 3 Problems and Proposed Solutions w/ UML Metamodel
- Combining the Proposals
Major Goals of UML 2.0

- Provide an extensible framework.
- Customized abstraction mapping to implementation concepts.
  - E.g. modify concept of class
- No consensus of how to accomplish this.
Four Level Metamodelling Architecture
Problems w/ Architecture

- The “Instance-Of” relationship is:
  - not well defined.
  - not the same between levels.
  - not the same within a level.
Strict Metamodelling

- Improves definition of “Instance-Of” relationships with the constraints:
  1. “Instance-Of” relationships only allowed between levels, not within a level.
  2. Elements must be an “Instance-Of” exactly one element from the level immediately higher.
Problem I: Instance-Of Types

- Does not recognize and support the two fundamental "Instance-Of" relationship types:
  - Logical Classification
  - Physical Classification
Logical Classification

- Defines a model element’s domain type and content.
- E.g. *2001: A Space Odyssey* is a Video.
- Dominant classification from modelers' point of view.
Physical Classification

- Defines structure and presentation of a model element.
- E.g. *2001: A Space Odyssey* is an Object
- Dominant classification from tool builder’s point of view.
Strict Metamodeling Violation

Integrating both logical and physical into linear hierarchy violates strict metamodeling.
Proposal I: Use Two Metadimensions

- Explicitly define “Instance-Of” relationships of type logical or physical.
- Split linear hierarchy into logical and physical metadimensions.
Physical Metadimension

- Video has attributes and associations.
- 2001 has slots and links.
- No logical relationship shown.
- Strict metamodelling not violated.
Logical Metadimension
Outcome: Two Dimensional Framework

- Logical and physical dimensions are:
  - Orthogonal.
  - Have equal importance.
- Strict Metamodelling achieved.
Problem II: More Logical Metalevels

- Modelers want more logical metalevels.
  - E.g. 2001 is a template for different copies.
- Need corresponding element in $P_1$.
- Redundant physical classifiers.
Proposal II: Unify Modeling Elements

- **Solution:** simplify $P_1$ by merging all its elements.
- **Tradeoff:** cannot query sets of element types as efficiently.
Outcome: Unified Structural Element

- $P_0$ elements are physical instances of *Structural Element*.
- Number of logical metalevels in $P_0$ is irrelevant.
Problem III: Shallow Instantiation

- Traditional instantiation:
  - can only specify properties of direct instances.
  - can not specify properties of instances of its instances.

- Can not enforce requirements on indirect instances.
Proposal III: Deep Instantiation

- Assign *potency* value to model elements representing number of instantiations allowed.
- Decrement potency with every instantiations.
- E.g. traditional class: potency = 1
- E.g. traditional object: potency = 0
Outcome: Potency

- If more logical levels required then higher potency.
- Information can transcend more than two levels.
Combine Proposals

- Put $P_1$ above all logical levels in $P_0$.

- Recall:
  - One unified structural element for all logical levels.
  - Deep instantiation: information can be defined in a higher level.
Combine Proposals: Outcome

- Logical and Physical re-aligned.
- Proposal I unnecessary?
3 Proposals are complementary but independent.

Help make the UML Metamodel extensible for both tool builders and users.
Questions?
References