Traceability in Viewpoint Merging: A Model Management Perspective

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Synopsis

Stakeholders

Requirements Analyst

Interviews, Negotiation

New/Evolved Artifacts

Context for Further Elaboration

Artifact Repository

Operator + Operands

Output

Artifact Manipulation Operators

Guidance
Problem: Traceability from the output of an operator to its input
What is model management?

Keeping track of model interrelationships and providing a set of model manipulation operations

Idea:
- Capturing conceptual data using independent but interrelated units
- Describing interrelations by explicit mappings

Major operations:
- Matching: finding correspondences between models
- Differencing: finding discrepancies between models
- Merging: consolidating models w.r.t. known relationships between them
Traceability in Viewpoint Merging

→ Example: Merging ER Viewpoints

Initial viewpoints of Mary and Bob

(i) Mary
   Employee → works for → Department
   name    salary    name

(ii) Bob
   Company → employed by → Person
   name    name    dob

Initial viewpoints of Mary and Bob
First Merge Attempt
The Merged Viewpoint

- **Concern 1 (origin traceability):**
  - Where did each element originate from?
Viewpoints evolve over time
- hence, merge scenarios may get more complex
- ... and assumptions about correspondences may be scattered across several mappings
Viewpoints evolve over time

- hence, merge scenarios may get more complex
- ... and assumptions about correspondences may be scattered across several mappings
Evolution – Part I
Evolution – Part II

Bob

Company
employed by
Person

name
dob
name

Bob-Evolution

Company
employed by
Person

name
do
name

Bob Evolved
The New Merge Hypothesis

Concern II (assumption traceability):

What correspondence assumptions were involved in each unification?
The Merge Algorithm

➡️ Theory:

➡️ Based on an algebraic concept called colimit
  ➢ Colimits combine a set of models w.r.t. to their relationships as defined by a set of mappings

➡️ Main idea of the algorithm:

➡️ Assume all model elements are distinct
➡️ Unify elements deemed equal by the mappings
Merging Sets

$A = \{x, y, w\}$ \hspace{2cm} $B = \{x, y, t\}$

$C = \{z, w\}$

The given interconnection diagram
Merging Sets

Given interconnection diagram:

\[ A = \{x, y, w\} \quad B = \{x, y, t\} \]

\[ C = \{z, w\} \]

Compute the disjoint union.
Merging Sets

\[ A = \{ x, y, w \} \quad B = \{ x, y, t \} \]

\[ C = \{ z, w \} \]

Connect up the related pairs (This yields a unification graph)
Merging Sets

\[ A = \{x, y, w\} \quad B = \{x, y, t\} \]

\[ C = \{z, w\} \]

Find the connected components
Generating Traceability Links

➡️ Origin Traceability

➡️ For each merged element, the set of nodes in the connected component corresponding to the element

➡️ Assumption Traceability

➡️ Problem: we did not keep track of which mapping induced each edge in the unification graph

➡️ Need to label each edge in the unification graph with the name of the mapping that induces it
Unification Graph Example

Diagram showing relationships between entities such as Corporation, Employee, and Department, with arrows indicating associations like "employed by" and "works for."
Stored Traceability Links
Recap

→ Summary

➔ A traceability framework for viewpoint merging
  ➢ independent of any particular modeling language
  ➢ scalable to arbitrary number of viewpoints and mappings

→ Limitations and weaknesses

➔ Mappings are purely syntactic
  ➢ . . . hence, semantics-based traceability concerns need to be addressed separately
Future Work

Extending our viewpoint merging tool to:

- generate and visualize traceability links
- support model-to-model navigation

Doing further experiments to surface other potential traceability concerns in viewpoint merging

Exploiting traceability links for adaptive analysis of viewpoints

- Simple examples include: filtering and layout of the merges based on traceability data and stakeholders’ preferences
Thank You!

Questions?