UNIVERSITÄT
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Megamodel-driven Traceability Recovery & Exploration of Correspondence & Conformance Links

Bachelorarbeit

zur Erlangung des Grades eines Bachelor of Science
im Studiengang Informatik

vorgelegt von

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(Ort, Datum) (Maximilian Meffert)

Zusammenfassung

TBD.

Abstract

TBD.

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Introduction

TBD.

Chapter 2

Related Work

TBD.

Chapter 3

Background

TBD.

3.1 Mathematical Background

3.1.1 Relations

A n-ary, $n \in \mathbb{N}$, relation is the subset of the Cartesian product of n sets:

$$R \subseteq A_1 \times ... \times A_n = \{(a_1, ..., a_n) | a_1 \in A_1 \wedge ... \wedge a_n \in A_n\} \tag{3.1}$$

and a binary relation is the subset of the Cartesian product between two sets:

$$R \subseteq A \times B = \{(a, b) | a \in A \wedge b \in B\} \tag{3.2}$$

3.1.1.1 Homogeneous & Heterogeneous Relations

A relation $R \subseteq A \times B$ is called homogeneous if $A = B$, otherwise it is called heterogeneous. However, an arbitrary relation $R \subseteq A \times B$ is also homogeneous in the sense of:

$$R \subseteq A \times B \subseteq (A \cup B) \times (A \cup B) \tag{3.3}$$

3.1.1.2 Composition

The composition $S \circ R \subseteq A \times D$ of two binary relations $R \subseteq A \times B$ and $S \subseteq C \times D$ is defined as:

$$S \circ R := \{(a,d) \in A \times D | \exists x \in B \cap C : (a,x) \in R \wedge (x,d) \in S\} \tag{3.4}$$

3.1.1.3 Identity Relation

The relation I over a set A with:

$$I := \{(a,b) \in A \times A | a = b\} = \{(a,a) | a \in A\} \subseteq A \times A \tag{3.5}$$

is called identity relation.

3.1.1.4 Exponentiation

The n-th power R^n of a relation R with $n \in \mathbb{N}$ is the product of its composition n-times with itself:

$$R^n = \underbrace{R \circ ... \circ R}_{n} \tag{3.6}$$

and can be recursively defined with:

$$R^0 := I \tag{3.7}$$

$$R^n := R \circ R^{n-1} \tag{3.8}$$

3.1.1.5 Properties

A relation R is called ...

Property	**Requirement**
bijective	$\forall b \in B \exists! a \in A : (a, b) \in R$
function	$\forall a \in A \exists! b \in B : (a, b) \in R$
reflexive	$\forall a \in A : (a, a) \in R$
irreflexive	$\forall a \in A : (a, a) \notin R$
transitive	$\forall a, b, c \in A : (a, b) \in R \wedge (b, c) \in R \Rightarrow (a, c) \in R$
intransitive	$\forall a, b, c \in A : (a, b) \in R \wedge (b, c) \in R \Rightarrow (a, c) \notin R$
symmetric	$\forall a, b \in A : (a, b) \in R \Rightarrow (b, a) \in R$
asymmetric	$\forall a, b \in A : (a, b) \in R \Rightarrow (b, a) \notin R$
antisymmetric	$\forall a, b \in A : (a, b) \in R \wedge (b, a) \in R \Rightarrow a = b$

3.1.1.6 Closures

For a relation R over a set A its closure:

- $R \cup I$ is called *reflexive closure*
- $R^+ := R^1 \cup R^2 \cup R^3 \cup ...$ is called *transitive closure*

$$\begin{aligned}
(a, b) \in R^+ &\Leftrightarrow (a, b) \in R^1 \vee (a, b) \in R^2 \vee (a, b) \in R^3 \vee ... && (3.9)\\
&\Leftrightarrow \exists n \in \mathbb{N} : n \geq 1 \wedge (a, b) \in R^n && (3.10)\\
&\Leftrightarrow \exists n \in \mathbb{N} : n \geq 1 \wedge (a, b) \in R \circ R^{n-1} && (3.11)\\
&\Leftrightarrow \exists n \in \mathbb{N} : n \geq 1 \wedge [\exists x \in A : (a, x) \in R \wedge (x, b) \in R^{n-1}] && (3.12)\\
&\Leftrightarrow \exists n \in \mathbb{N} \exists x \in A : n \geq 1 \wedge (a, x) \in R \wedge (x, b) \in R^{n-1} && (3.13)
\end{aligned}$$

- $R^* := R^+ \cup I$ is called *reflexive-transitive closure*

$$\begin{aligned}
(a, b) \in R^* &\Leftrightarrow (a, b) \in R^+ \vee (a, b) \in I && (3.14)\\
&\Leftrightarrow (a, b) \in R^+ \vee a = b && (3.15)
\end{aligned}$$

3.2 Formal Languages & Grammars

3.2.1 Context-Free Languages & Grammars

3.3 Traceability

[1] TBD.

3.3.1 Traceability Relationship

3.3.2 Traceability Link

3.3.3 Traceability Recovery

3.3.4 Traceability Exploration

3.4 Megamodeling

TBD.

3.4.1 MegaL

3.4.1.1 MegaL/Xtext

3.5 Ontologies

TBD.

3.6 Mereology

$$x \ \mathsf{partOf} \ x \qquad \text{(Reflexivity)} \tag{3.16}$$

$$x \ \mathsf{partOf} \ y \wedge y \ \mathsf{partOf} \ x \Rightarrow x = y \qquad \text{(Antisymmetry)} \tag{3.17}$$

$$x \ \mathsf{partOf} \ y \wedge y \ \mathsf{partOf} \ z \Rightarrow x \ \mathsf{partOf} \ z \qquad \text{(Transitivity)} \tag{3.18}$$

TBD.

3.7 Program Analysis

TBD.

3.8 XML Data Binding

TBD.

3.8.1 Java Architecture for XML Binding (JAXB)

3.9 Object Relational Mapping

TBD.

3.9.1 Java Persistence API (JPA)

3.9.2 Hibernate

3.10 Another Tool For Language Recognition (ANTLR)

Chapter 4

Hypotheses

TBD.

4.1 Fragments

4.2 Correspondence

4.3 Conformance

Chapter 5

Methodology

TBD.

5.1 The 101companies Human Resource Management System

Description of the 101companies Human Resource Management System

5.2 Link Proper Part Ratio

The ratio between all proper parts of two artifacts and the proper parts of the same artifacts in a relationship.

$$\pi_{R,A_1,A_2} = \frac{|\{(p_1, p_2) \in R : p_1 \text{ properPartOf } A_1 \wedge p_2 \text{ properPartOf } A_2\}|}{|\{p : p \text{ properPartOf } A_1 \vee p \text{ properPartOf } A_2\}|}$$

Chapter 6

Requirements

TBD.

R1 asdf

R2 asdf

R3 asdf

R4 asdf

Chapter 7

Design

TBD.

Chapter 8

Implementation

TBD.

8.1 Context-Free Grammar Fragmentation

8.2 Name Correspondence Heuristic

Heuristics are quick and "simple" methods for finding good approximate solutions for complex problems. The Name Correspondence Heuristic determines correspondence between artifacts simply by finding similarities of names in those artifacts.

TBD.

Chapter 9

Results

TBD.

Chapter 10

Conclusion

TBD.

Bibliography

[1] Stefan Winkler and Jens Pilgrim. "A Survey of Traceability in Requirements Engineering and Model-driven Development". In: *Softw. Syst. Model.* 9.4 (Sept. 2010), pp. 529–565. ISSN: 1619-1366. DOI: 10.1007/s10270-009-0145-0. URL: http://dx.doi.org/10.1007/s10270-009-0145-0.