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Solving Proximity Constraints

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1 Introduction

2 System Model

3 Workflow

Motivation

For proving theorems, a frequently occurring problem is to find common instances of formulae.

Example 1

Let f be a function, a, b constants and x a variable. The two expressions

$$f(a, x) \quad \text{and} \quad f(a, b)$$

can be unified with $\{x \mapsto b\}$.

Motivation

For proving theorems, a frequently occurring problem is to find common instances of formulae.

Example 2

Let f, g be functions, a, b constants and x a variable. The two expressions

$$f(a, x) \quad \text{and} \quad g(a, b)$$

cannot be unified as $f \neq g$.

Motivation

In 1965 Robinson presented his unification algorithm and solved this problem, his algorithm was improved for better(=faster) performance since.

If we consider now the unification problem

$$f(a, x) \simeq^? g(a, b)$$

again, we might wonder, if we could not ignore $f \neq g$, if they are "close" to each other, i.e. if they are equal in a fuzzy logic sense. Being close is represented as a proximity relation, which are symmetric and reflexive, but not necessarily transitive. C. Pau and T. Kutsia solved this problem, presenting an algorithm, which we implemented.

Introduction

4 sets:

- P: unification problem to be solved
- C: neighborhood constraint
- σ: set of pre-unifier
- Φ: name-class mapping

Pre-Unification rules

(Tri) Trivial: ...
(Dec) Decomposition: ...
...

Rules for Neigborhood Constraints

(FFS) $\{f \approx^? g\} \uplus C; \Phi \Rightarrow C; \Phi;$ if $\mathcal{R}(f, g) \geq \lambda$

(NFS) $\{N \approx^? g\} \uplus C; \Phi \Rightarrow C; \mathit{update}(\Phi, N \rightarrow \mathbf{pc}(g, \mathcal{R}, \lambda))$

(FSN) $\{g \approx^? N\} \uplus C; \Phi \Rightarrow \{N \approx^? g\} \cup C; \Phi$

(NN1)
$\{N \approx^? M\} \uplus C; \Phi \Rightarrow C; \mathit{update}(\Phi, N \rightarrow f, M \rightarrow \mathbf{pc}(f, \mathcal{R}, \lambda))$,
where $N \in \mathit{dom}(\Phi)$, $f \in \Phi(N)$

(NN2) $\{M \approx^? N\} \uplus C; \Phi \Rightarrow \{N \approx^? M\} \cup C; \Phi$, where
$M \notin \mathit{dom}(\Phi)$, $N \in \mathit{dom}(\Phi)$

(Fail1) $\{f \approx^? g\} \uplus C; \Phi \Rightarrow \perp$, if $\mathcal{R}(f, g) < \lambda$

(Fail2) $C; \Phi \Rightarrow \perp$, if there exists $N \in \mathit{dom}(\Phi)$ such that $\Phi(N) = \emptyset$

Simple example

Pre - fail: $p(x, a) =?q(f(a), g(b))$

Test 3 in Test.java

Pre - ok, CS - fail: - des ging bei mir, i hätt 5 Schritte und 2 Branches, die aber failen-

$p(x, y, x) =?q(f(a), g(b), y); R = \{(b, c), (c, d), (f, g), (p, q)\}$

Test 4 in Test.java

Pre - ok, CS - ok: - des ging bei mir, i hätt 4 Schritte und 1 Branch-

$p(x, z) =?q(f(b), f(x)); R = \{(a, a'), (a', b), (b, c'), (c', c), (p, q)\}$

Solution: ...

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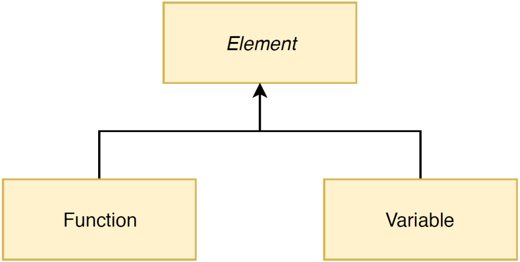
System Model

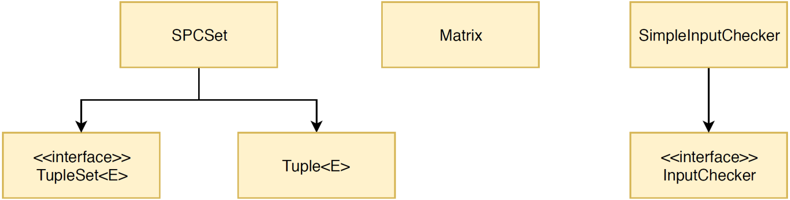
Project consists of 4 packages:

- elements : deals with elements
- tool : offers important tools (e.g. read input)
- unificationProblem : treats the unification problem
- userInterfaces : allow user interfaces

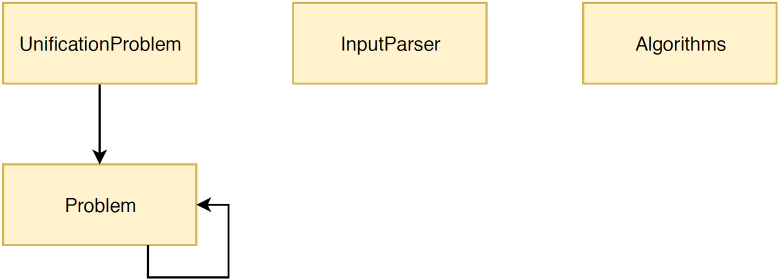
Package elements



Package tool



Package `unificationProblem`



Package `userInterfaces`

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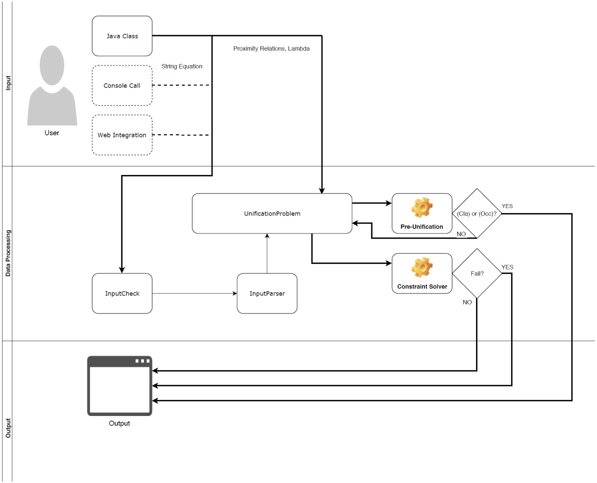
Workflow


Input
Data Processing
Output
User
Java Class
Console Call
Web Integration
String Equation
Proximity Relations, Lambda
UnificationProblem
Pre-Unification
(Cla) or (Occ)?
YES
NO
Constraint Solver
Fail?
YES
NO
InputCheck
InputParser
Output