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Knowledge-Based Systems, TU Dresden

Efficient Dependency Analysis for Rule-Based Ontologies

ISWC 2022, 26th October 2022

Motivation

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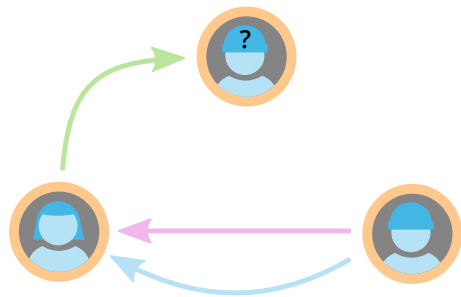
Motivation

Reliances

Reliances describe interactions between rules

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A rule **positively relies** on another rule if the application of the first enables the application of the second.

- Important termination criterion

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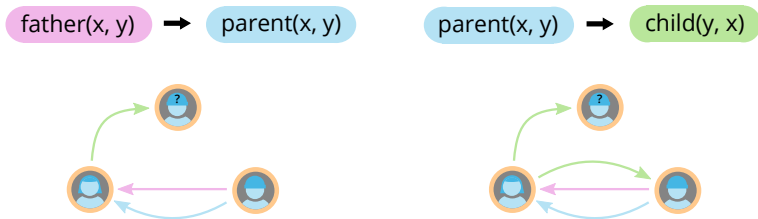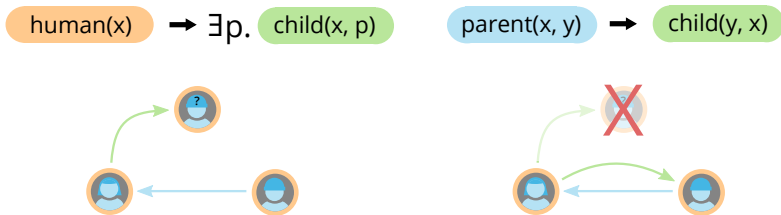UNIVERSITÄT
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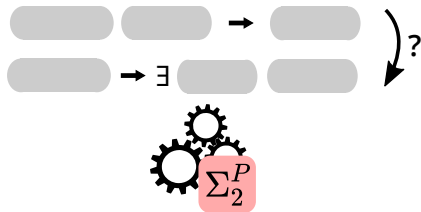for Computational Logic

Reliances

Reliances describe interactions between rules

A rule **restrains** another rule if applying the second before the first introduces a redundancy.

- Checking for core stratification
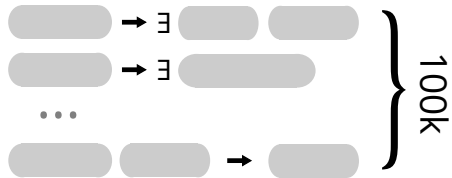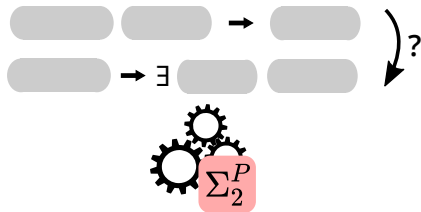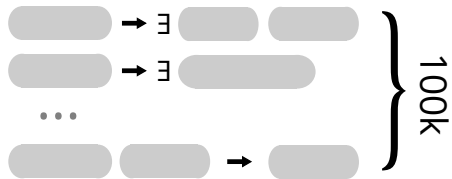
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Computing Reliances is Hard

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Computing Reliances is Hard

Global Optimizations
Reduce number of
considered rule pairs

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Computing Reliances is Hard
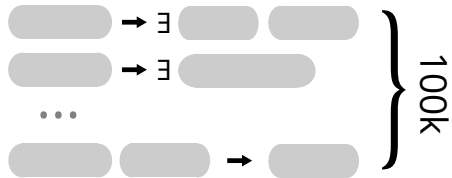
Global Optimizations
Reduce number of considered rule pairs
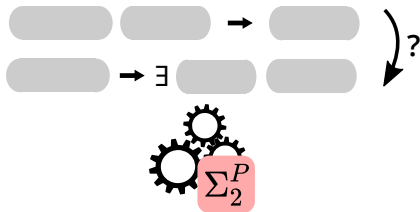
Local Optimizations
Reduce effort of computing reliance for a single pair

Global Optimizations
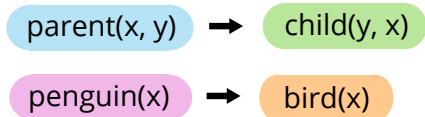
Goal: Reduce the number of considered rule pairs

parent(x, y) ➡ child(y, x)

penguin(x) ➡ bird(x)

parent(x, y) ➡ child(y, x)

mother(x, y) ➡ parent(x, y)

=

author(z, t) ➡ written(t, z)

writer(q, w) ➡ author(q, w)

Only consider compatible rules

Hash previous results

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Global Optimizations

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Local Optimizations
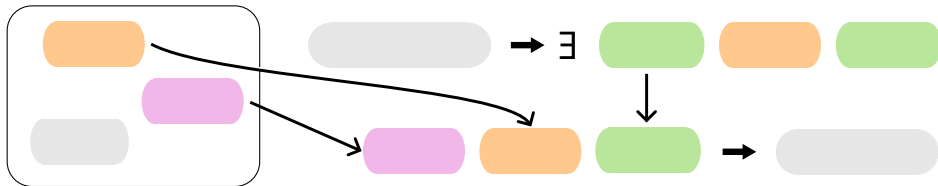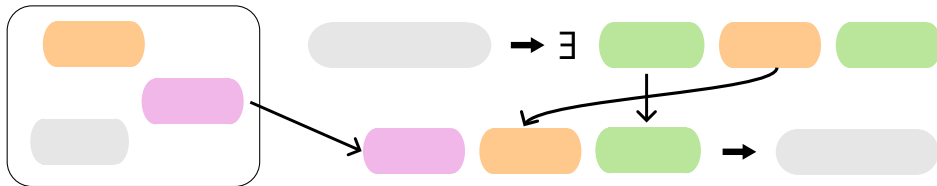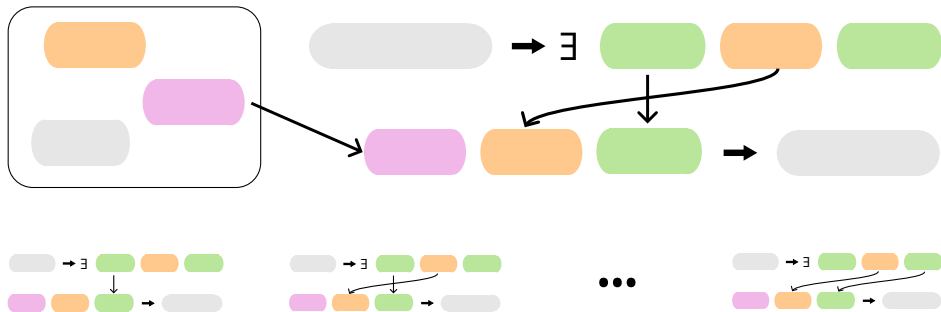
Goal: Check whether there is a positive reliance

Local Optimizations

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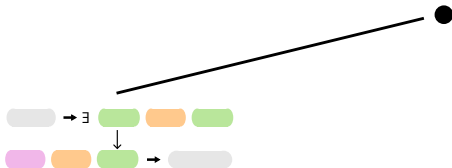Alex Ivliev

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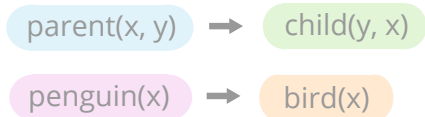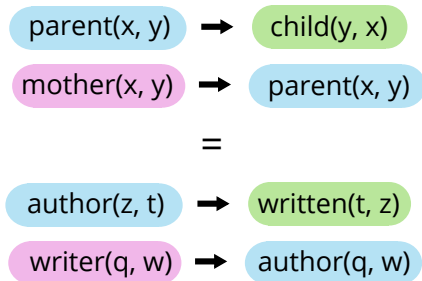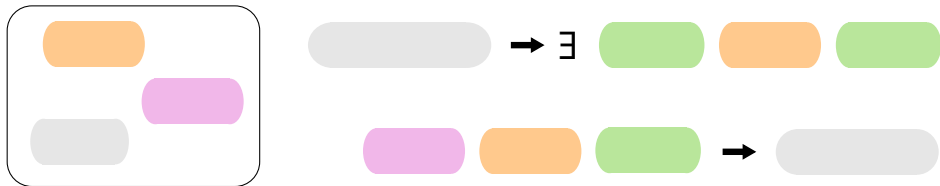
Local Optimizations

Goal: Check whether there is a positive reliance

Problem: Exponentially many possibilities

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Local Optimizations

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Local Optimizations

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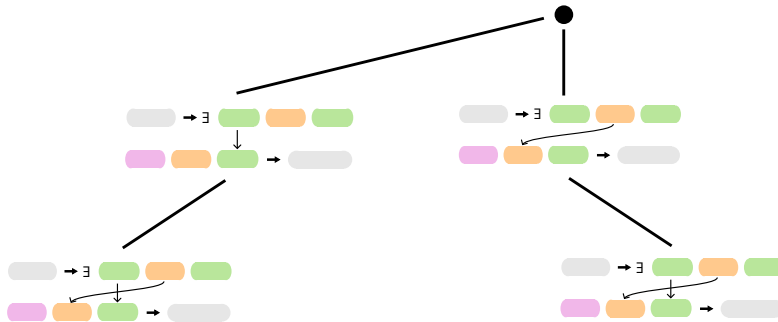International Center
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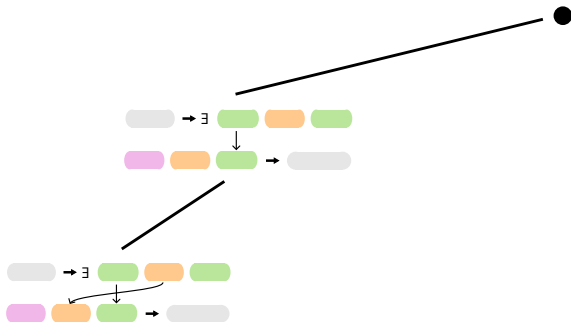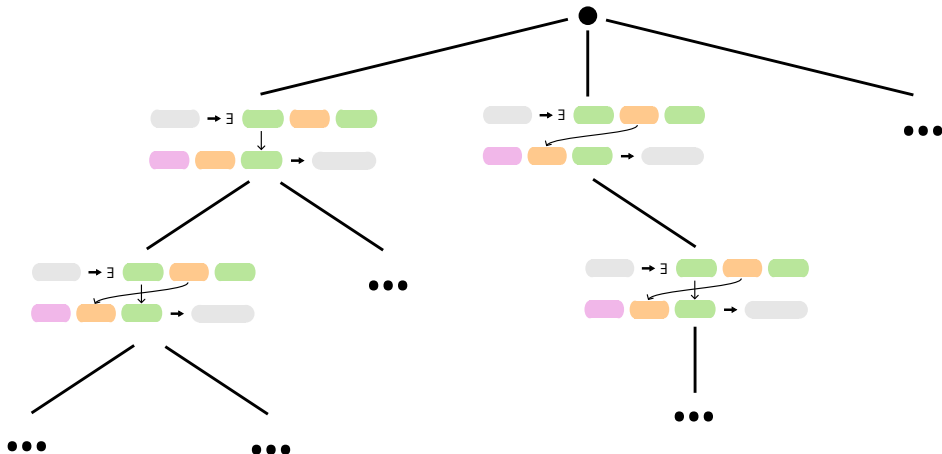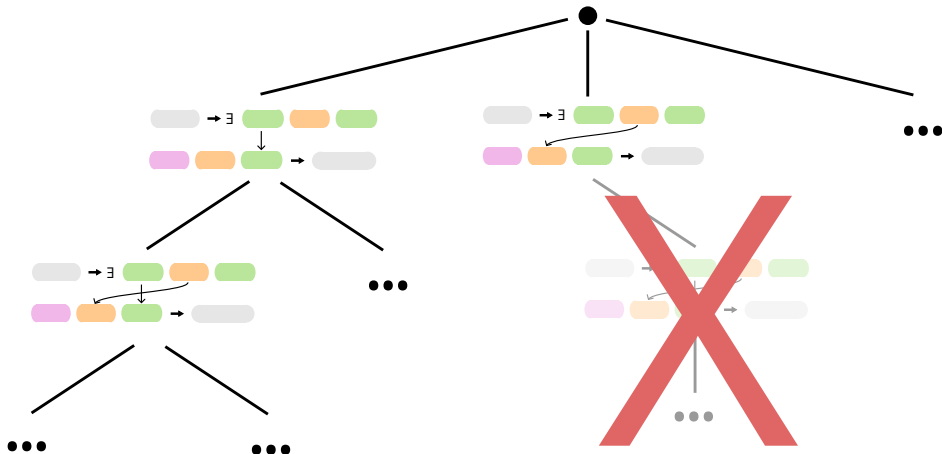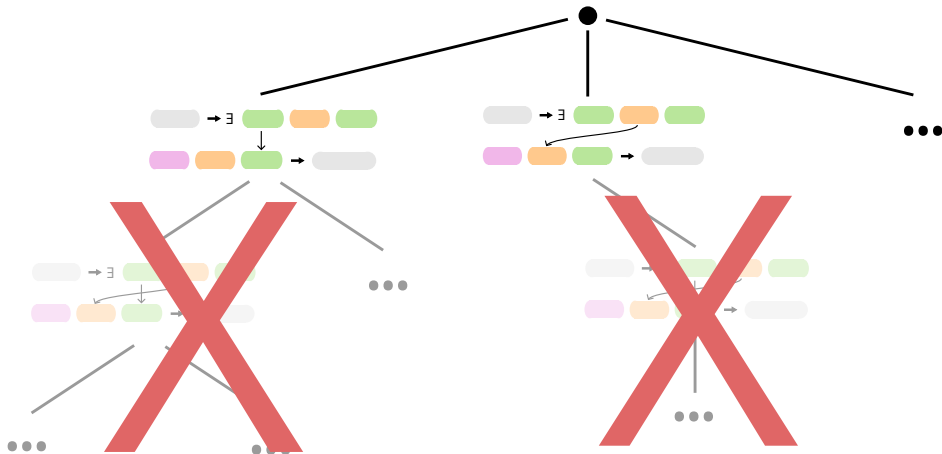
Local Optimizations

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Experiments
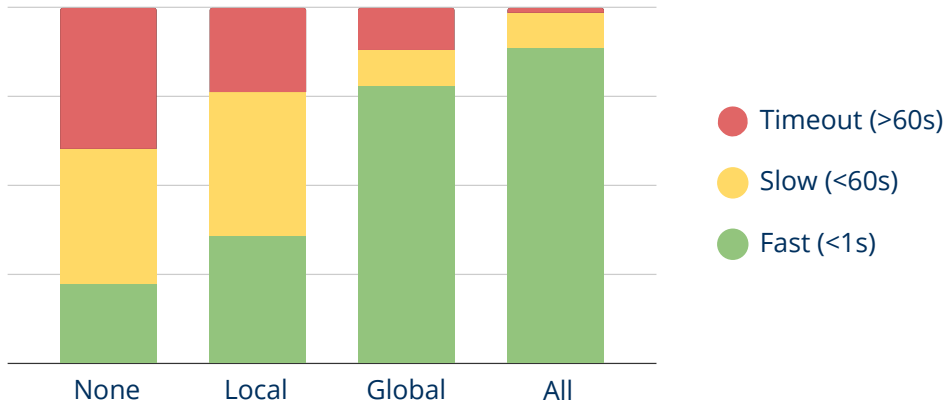
Oxford Ontology Repository

- 201 rule sets of various sizes
  - 63 small (<1000 rules)
  - 90 medium (<10.000 rules)
  - 49 large (>10.000 rules)
- Individual rules contain up to 31 atoms

Questions

- Impact of optimizations
- Speedup in example applications
- Proportion of core stratified rule sets

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Impact of Optimizations

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Application – MFA

MFA: Expensive termination criterion

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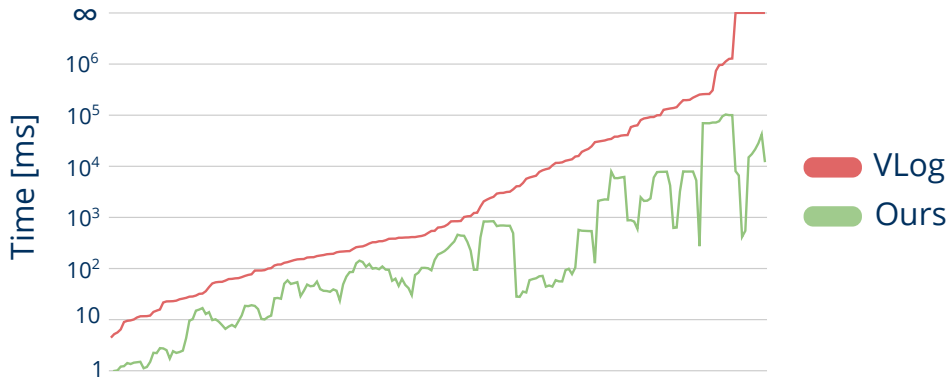
Proportion of Core Stratification

Core-Stratification: Redundancy can be avoided
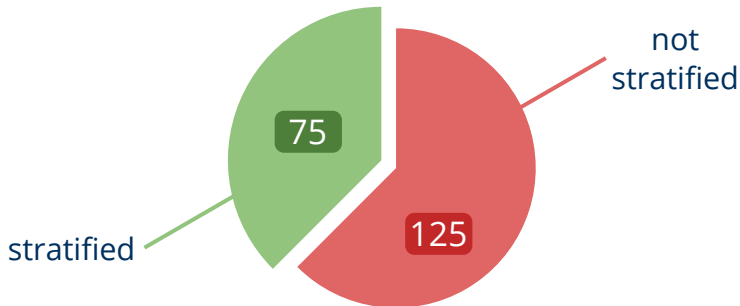
Future work: Improved notion might cover more cases

Summary

What have we learned?

- Computing reliances is feasable
- Performance of applications was improved
- Core stratification appears often in practice

> More scalable computation obtaining more natural results for rule-based reasoning with ontologies and knowledge graphs

What is left to do?

- Utilize reliances to speed up reasoning
- Improve the notion of core stratification