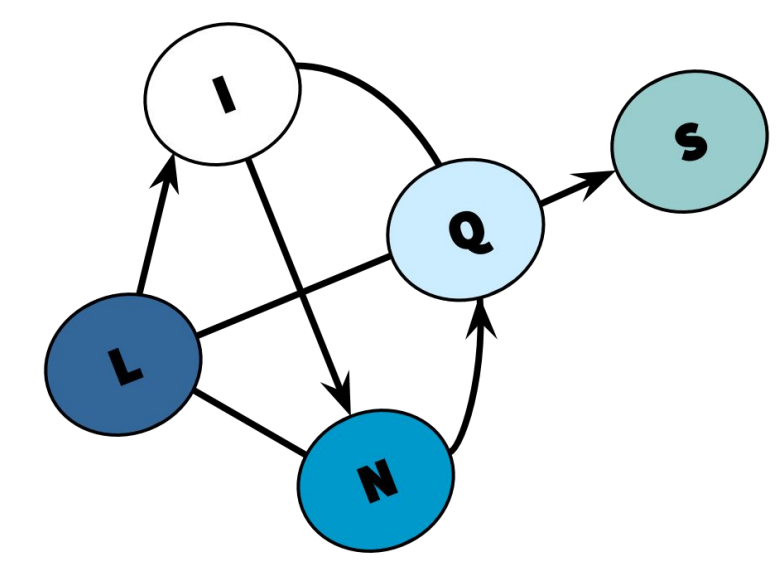




Efficient Grounding of Templated SRL Languages

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Background

Templated SRL

- Statistical Relational Learning (SRL) is a field of machine learning that models both uncertainty and complex relational structures.
- SRL methods typically model their problems using a Markov random field (MRF).
- Many SRL frameworks use first order logic-like rules to serve as templates for the MRF.

Grounding

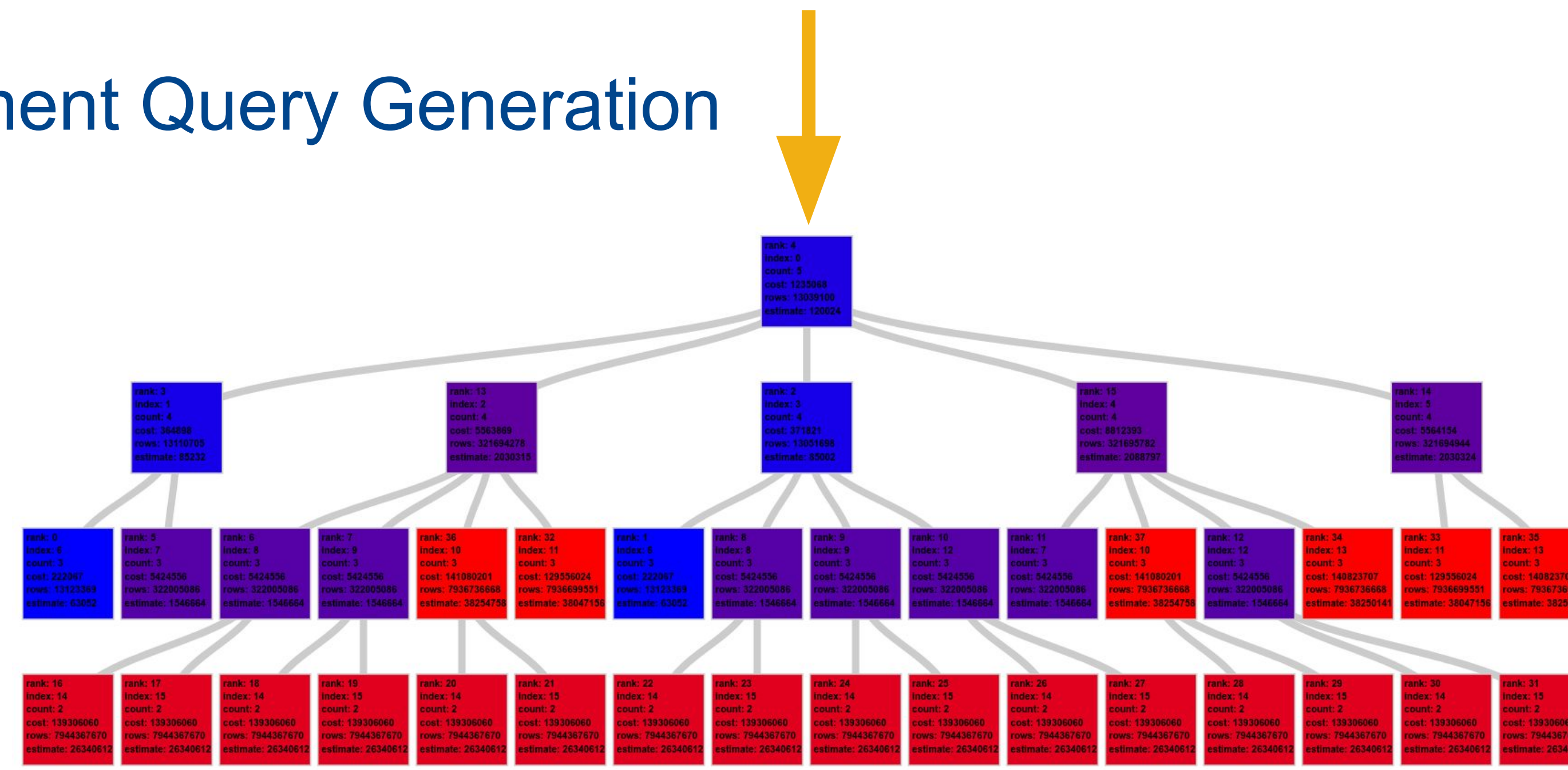
- Grounding is the process of instantiating a full graphical model from templates (rules) and data.
- Grounding is typically the most computationally expensive component of a SRL framework.
- The size of the ground MRF is typically polynomial with the number of entities represented.

Contributions

- New Formulation of Templated SRL Grounding
- Query Rewriting using Containment Queries
- Approximate Search over Containment Queries
- Sharing of Database Queries

LivedAt(P1, A) & LivedAt(P2, A) & LivedAt(P3, A)
 & Friends(P1, P2) & Friends(P2, P3)
 -> Friends(P1, P3)

Containment Query Generation



Budgeted Approximate Search



Database Query

P1	P2	P3	A
Alice	Bob	Claire	Palo Alto
Varun	Sriram	Shrestha	Santa Cruz
Vibin	Jason	Vihang	Santa Cruz
Eriq	Connor	Lise	Santa Cruz
Pigi	Dhanya	Sabina	New York

Validation

P1	P2	P3	A
Varun	Sriram	Shrestha	Santa Cruz
Vibin	Jason	Vihang	Santa Cruz
Eriq	Connor	Lise	Santa Cruz

Ground Rule Instantiation

LivedAt('Varun', 'Santa Cruz') & LivedAt('Sriram', 'Santa Cruz') & LivedAt('Shrestha', 'Santa Cruz')
 & Friends('Varun', 'Sriram') & Friends('Sriram', 'Shrestha')
 -> Friends('Varun', 'Shrestha')

LivedAt('Vibin', 'Santa Cruz') & LivedAt('Jason', 'Santa Cruz') & LivedAt('Vihang', 'Santa Cruz')
 & Friends('Vibin', 'Jason') & Friends('Jason', 'Vihang')
 -> Friends('Vibin', 'Vihang')

LivedAt('Eriq', 'Santa Cruz') & LivedAt('Connor', 'Santa Cruz') & LivedAt('Lise', 'Santa Cruz')
 & Friends('Eriq', 'Connor') & Friends('Connor', 'Lise')
 -> Friends('Eriq', 'Lise')

Results

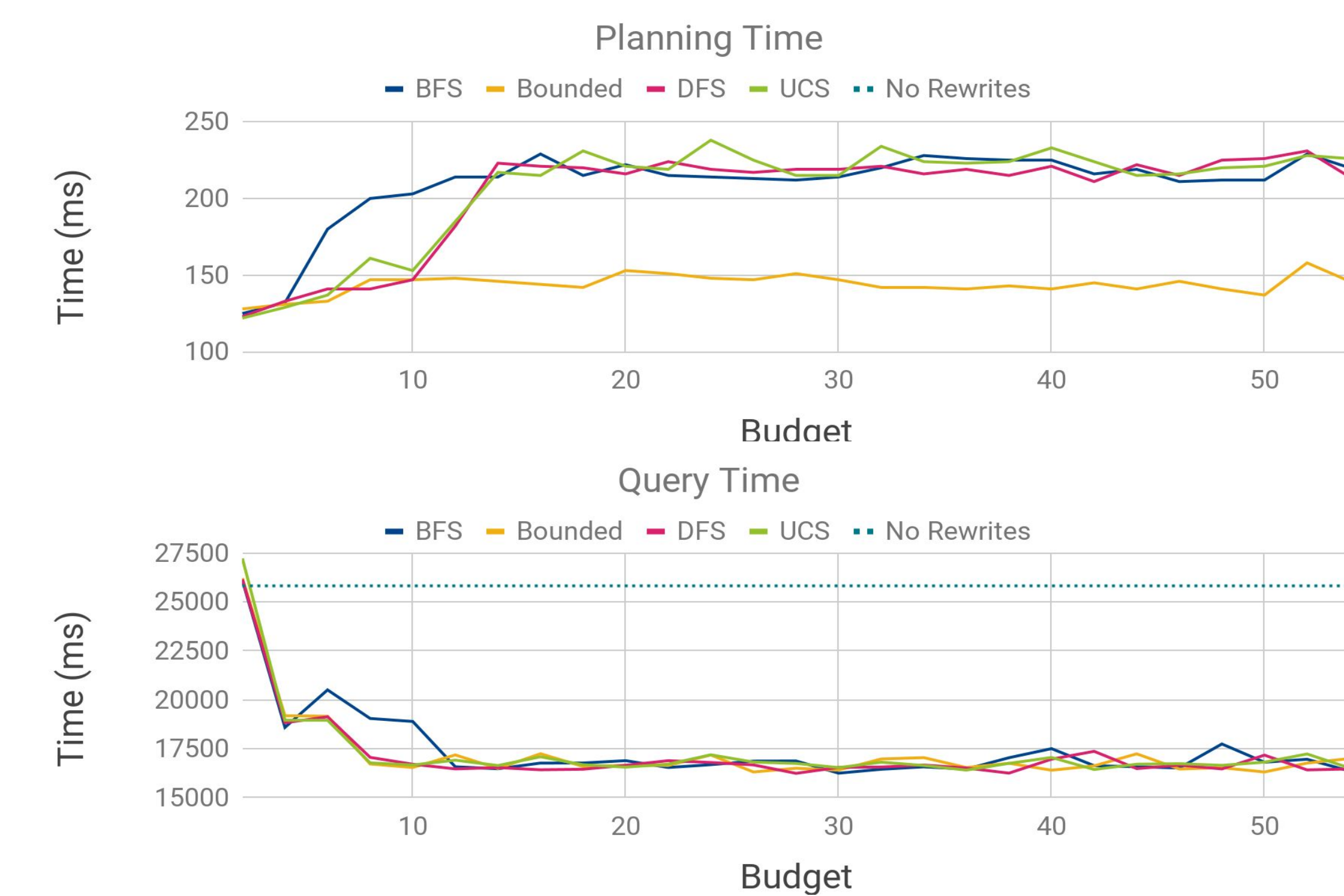
Explore Full Rewrite Space

- Execute all possible rewrites.
- Compute optimal combination of rewrites and compare against rewrites selected by search.

Dataset	Without Rewrites	Optimal Rewrites	Selected Rewrites	Total Misranks vs Optimal
Friendship Augustine SysML 2018	28394 ± 705	22042 ± 661	22042 ± 661	0 ± 0
Trust Prediction Huang SBP 2013	3452 ± 057	2656 ± 033	3464 ± 042	158 ± 3
ER Bhattacharya TKDD 2007	3928.3 ± 081	3402 ± 077	3404 ± 078	1 ± 0

Search Methods

- Search rewrite space using new and common searches.



Overall Effectiveness

- Rewriting's total effect on grounding.

