



What is Approximate Reasoning?

- Existing commonly used **reasoning procedures** are **impractical** against realistic **scalable ontologies**.
- To solve the problem, **Approximate Reasoning** is an **optimization** that involves compromising the **soundness or the completeness** of reasoning over description logic ontologies in favor of significant speed up in the run time.

The efficiency of Approximate Reasoning can further be improved by making the entailment rules amenable for parallel processing i.e **Concurrent Reasoning**.

Approximation + Concurrency

Rules for Approximation

Concurrent Strategy

Concurrent Approximate Reasoner

- Current **16 Rules for Approximation** are **Subsumption(8)**, **Complement(3)** and **Cardinality(5)** enriched.
- 8 rules** of Approximate Reasoning i.e Subsumption had been revised in **ELK style** to **support concurrency**.
- The goal is to revise the remaining 8 Cardinality and Complement Rules into Elk(concurrent) style.

How good is Concurrent Reasoner?

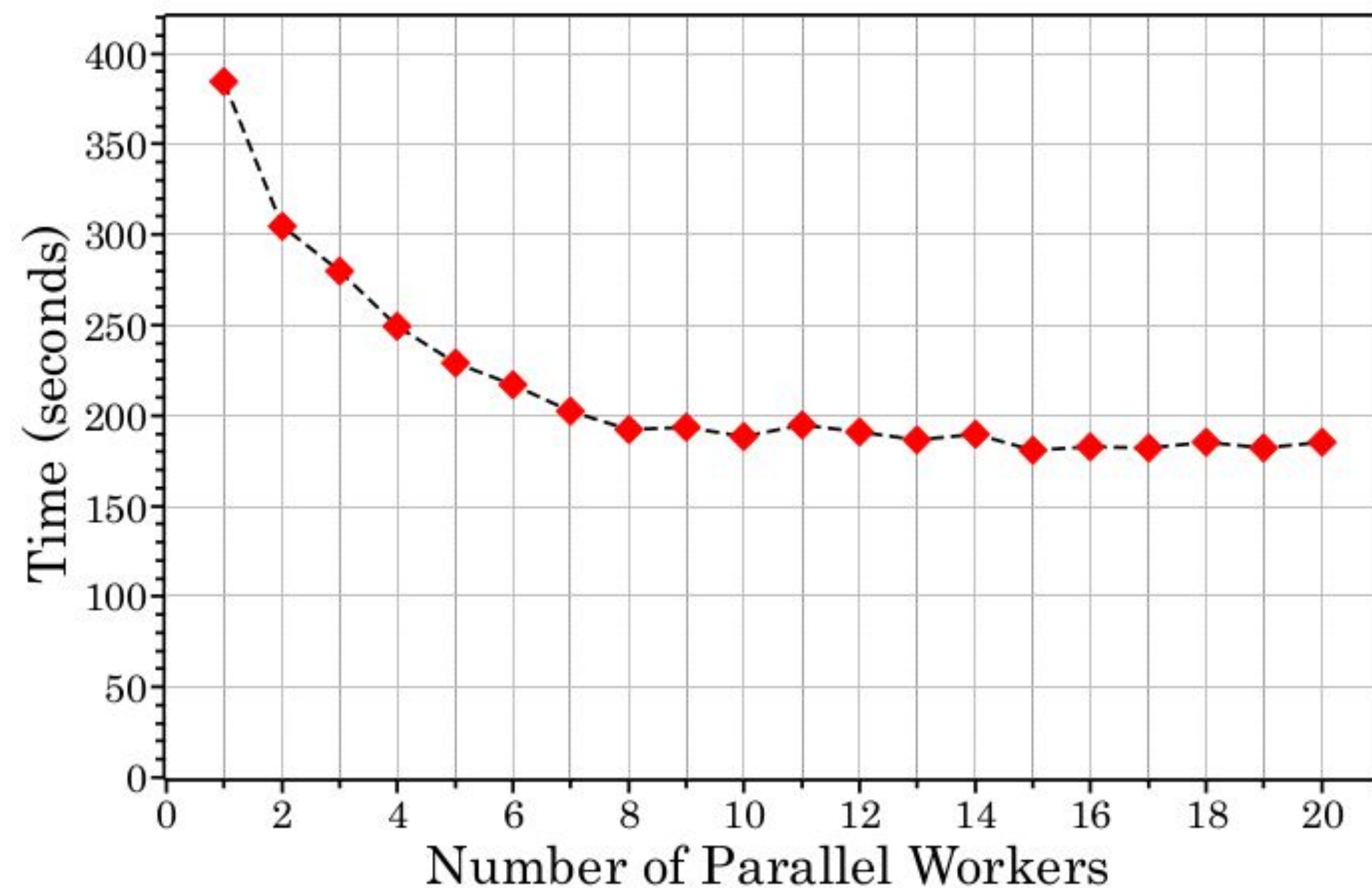
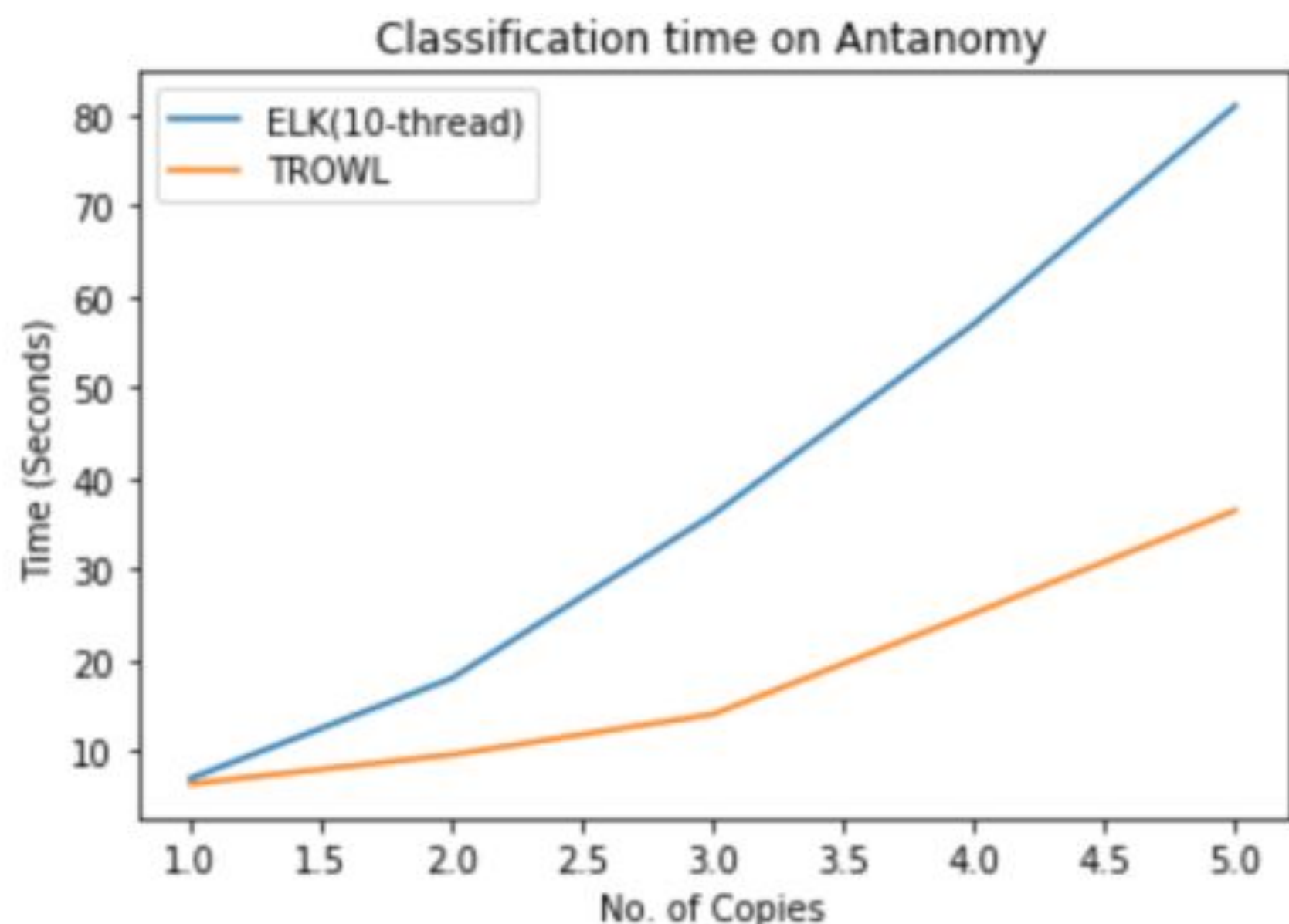
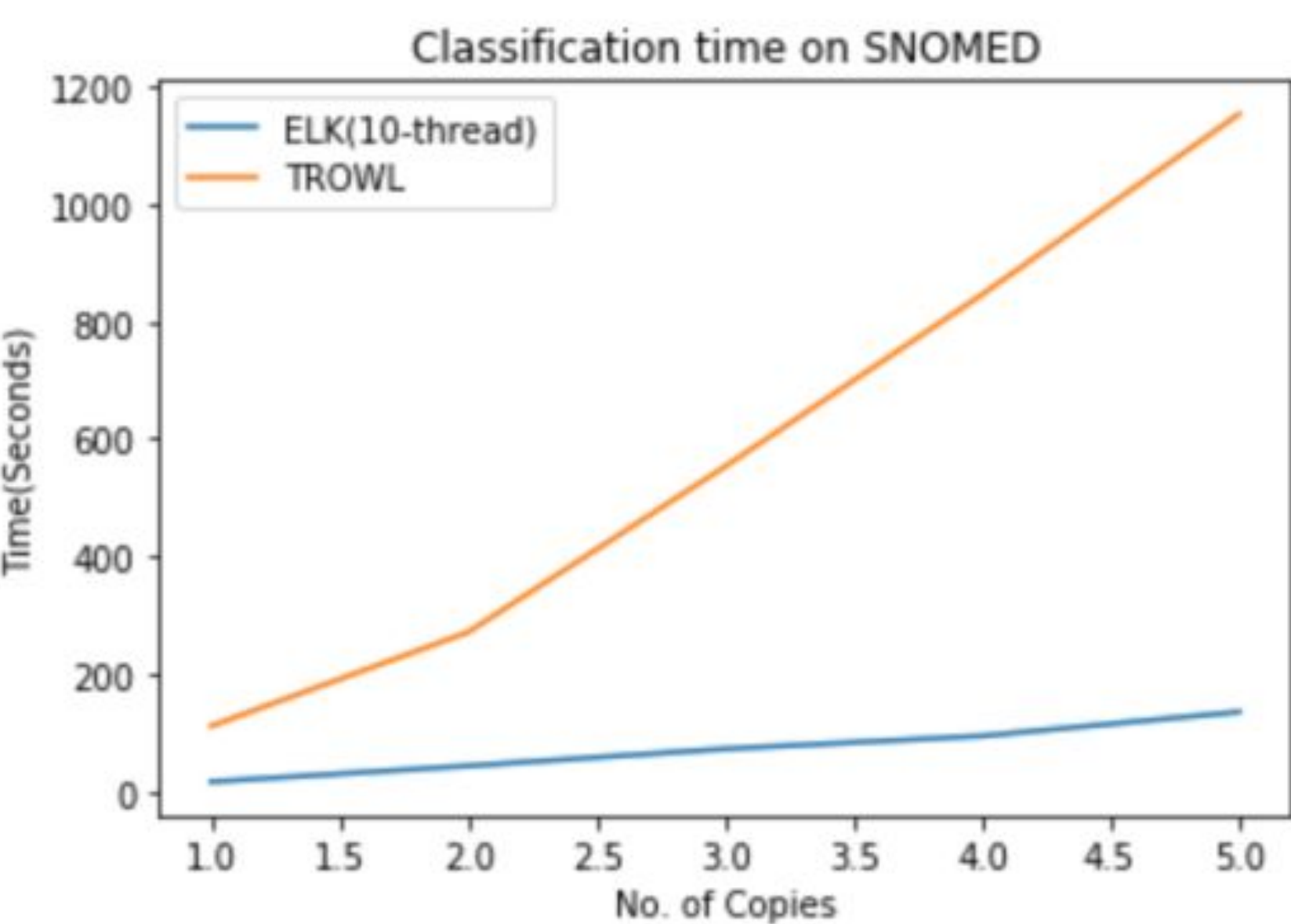
- Reasoners' scalability** are compared over **5** different ontologies of sizes – **GALEN** (37,696axioms), **GO** (107,909 axioms), **FMA** (126,548 axioms), **Anatomy** (268,513 axioms) and **Snomed** (569,701 axioms) and their interlinked copies.
- Runtime performance of **TrOWL** (an approximate reasoner), **ELK** (a concurrent reasoner), and three other commonly used reasoners (**Pellet**, **Hermit**, and **JFact**).

	Anatomy			FMA			Galen			GO			SNOMED CT		
Copies	1	5	10	1	5	10	1	5	10	1	5	10	1	5	10
ELK (1)	28.23	383.95	1203.28	4.86	37.65	87.37	3.30	11.71	25.63	5.66	32.44	130.30	38.89	254.02	505.97
ELK (5)	10.84	115.01	799.94	3.37	28.23	60.16	1.89	5.77	12.42	3.74	16.97	122.54	20.48	161.63	317.19
ELK (10)	7.44	80.9	621.48	3.2	25.92	67.12	1.75	4.88	10.18	3.68	20.23	121.11	14.89	139.06	261.75
TrOWL-EL	4.34	35.31	79.96	7.99	62.08	212.41	63.91	jh	jh	75.5	520.93	1168.5	104.04	1212.15	to
TrOWL-DL	4.47	36.08	85.61	7.14	62.15	205.43	79.26	jh	jh	72.95	462.1	1170.59	105.35	1208.82	to
Pellet	so	so	so	580.62	3490.06	to	gc	gc	gc	to	gc	gc	369.49	gc	gc
Hermit	to	to	to	21.18	330.2	1178.44	gc	gc	gc	742.74	to	to	1810.86	to	to
JFact	so	so	so	410.36	to	to	gc	gc	gc	to	to	to	to	to	to

What we found?

Classification of Ontologies using the Concurrent(ELK) reasoner outperforms all the other reasoners.
Only for Anatomy, however, TrOWL(Approximate) reasoner outperforms ELK (even with 10 parallel

Gains in performance could be achieved by increasing the number of parallel processes, and the gains saturate at about 10 parallel workers.



References

- Antoniou, G., et al.: A Survey of Large Scale Reasoning on the Web of Data. The Knowledge Engineering Review 33.
- Asim, M.N., Wasim, M., Khan, M.U.G., Mahmood, W., Abbasi, H.M.: A survey of ontology learning techniques and applications. Database 2018 (2018)
- Kazakov, Y., Krötzsch, M., Simančík, F.: The Incredible ELK: From Polynomial Procedures to Efficient Reasoning with EL ontologies. Journal of Automated Reasoning 53(1), 1–61 (2014).
- Ren, Y., Pan, J.Z., Zhao, Y.: Soundness Preserving Approximation for TBox Reasoning. In: AAAI. pp. 351–356 (2010).
- Rudolph, S., Tserendorj, T., Hitzler, P.: What Is Approximate Reasoning? In: Web Reasoning and Rule Systems. pp. 150–164.