

Preface

SemREC 2021 was the first edition of the Semantic Reasoning Evaluation Challenge (SemREC). It was co-located with the 20th International Semantic Web Conference (ISWC 2021).

Despite the development of several ontology reasoning optimizations, the traditional methods either do not scale well or only cover a subset of OWL 2 language constructs. As an alternative, neuro-symbolic approaches are gaining significant attention. However, the existing methods still can not deal with very expressive ontology languages. To find and improve these performance bottlenecks of the reasoners, we ideally need several real-world ontologies that span the broad spectrum in terms of their size and expressivity. However, that is often not the case. One of the potential reasons for the ontology developers to not build ontologies that vary in terms of size and expressivity is the performance bottleneck of the reasoners. Aiming to deal with this chicken and egg problem, the challenge included three tasks.

- Task-1 - Submitting a real-world ontology that is a challenge in terms of the reasoning time or memory consumed during reasoning.
- Task-2 - Submitting a description logic reasoner that uses traditional techniques such as tableau algorithms and saturation rules. This will provide an insight into the progress in the development of reasoners since the last reasoner evaluation challenge (ORE 2015).
- Task-3 - Submitting an ontology/RDFS reasoner that uses neuro-symbolic techniques for reasoning and optimization [1-5].

There were six submissions across the three tasks. Four were in Task-1, one each in Tasks 2 and 3. This volume contains peer-reviewed papers of all the ontologies and systems that participated in the challenge. More details about the challenge can be found at <https://semrec.github.io/>.

Challenge Winners

Task-1: ***The CaLiGraph Ontology as a Challenge for OWL Reasoners***, Nicolas Heist, Heiko Paulheim

Task-2: ***Query Answering and Scaling Extensions of Konclude***, Andreas Steigmiller, Birte Glimm, Thorsten Liebig

Task-3: ***EmELvar : A Neuro-Symbolic Reasoner for the EL++ Description Logics***, Biswesh Mohapatra, Sumit Bhatia, Raghava Mutharaju G. Srinivasaraghavan

Presentations

All the six submissions to SemREC 2021 presented their work at the ISWC 2021 conference on October 27, 2021. Around 20 members attended this session. The following was the schedule of the presentations.:

- Challenge overview - 10 min. live.
- A Reasoner-Challenging Ontology from the Microelectronics Domain (presented by Frank Wawrzik) - 5 min recorded + 2 min live Q&A
- Reasoning Challenges on Gene Variants Data (presented by Asha Subramanian) - 5 min recorded + 2 min live Q&A
- CaLiGraph Ontology (presented by Nicolas Heist) - 5 min recorded + 2 min live Q&A
- DACOC3 (presented by Johannes Frey) - 5 min recorded + 2 min live Q&A
- EmELvar (presented by Biswesh Mohapatra) - 5 min recorded + 2 min live Q&A
- Query Answering and Scaling Extensions of Konclude (presented by Andreas Steigmiller) - 5 min recorded + 2 min live Q&A
- Wrap-up - 5 min live.

Evaluations

For fair evaluation, we ran all the submissions on our hardware. In summary-

- For task 1, all four submitted ontologies were evaluated in terms of the time-taken (in seconds) by different OWL 2 DL reasoners (HermiT 1.4.5.456, JFact 5.0.05, Konclude 0.7.0, OpenIlet 2.6.46 , and Pellet 2.3.6). We set the heap space to 24GB. The time-out was set to 30 minutes. We reported the average time taken in 2 independent runs for the classification task.
- For task 2, we evaluated the submitted description logic reasoner [Konclude 0.7.0](#) in terms of time-taken(in seconds) and memory consumed (in GB) on the test ontologies.
- For task 3, we evaluated the submitted neuro-symbolic reasoner EmELvar for the subsumption task on the test ontologies in terms of Hits at ranks 1, 10 and 100, median rank, and 90th percentile rank.

For more details refer to <https://semrec.github.io/evaluation.html>.

Organization

In this section, we list the people who organized and contributed to the success of this event.

Challenge Chairs

- Gunjan Singh, KRaCR Lab, IIIT-Delhi, India
- Raghava Mutharaju, KRaCR Lab, IIIT-Delhi, India
- Pavan Kapanipathi, IBM T.J. Watson Research Center, USA

Challenge Programme Committee Members

The challenge programme committee helped peer-review the six submitted papers, and the organizers would like to thank them for their valuable time.

- Ankur Padia, Philips Research, USA
- Monika Jain, IIIT-Delhi, India
- Sudip Mittal, Mississippi State University, USA
- Cogan Shimizu, Kansas State University, USA
- Monireh Ebrahimi, IBM Watson, USA
- Sumit Bhatia, Adobe Inc., India
- Nandana Mihindukulasooriya, IBM Research, USA
- Manas Gaur, University of South Carolina, USA
- Md. Kamruzzaman Sarker, University of Hartford, USA
- Fariz Darari, University of Indonesia
- Srinivas Ravishankar, IBM Research, USA

Acknowledgments

We would like to thank the ISWC Semantic Web Challenge chairs, Ernesto Jiménez-Ruiz, Jiaoyan Chen, Despoina Magka, and the ISWC organizing committee for their invaluable support. We would also like to thank the challenge participants who played a key role in the success of SemREC by submitting their quality work and informative presentations during the event.

References

1. Jiaoyan Chen, Pan Hu, Ernesto Jimenez-Ruiz, Ole Magnus Holter, Denvar Antonyrajah, Ian Horrocks. OWL2Vec*: embedding of OWL ontologies. Mach Learn (2021).
2. Sutapa Mondal, Sumit Bhatia, Raghava Mutharaju. EmEL++: Embeddings for EL++ Description Logic. Spring Symposium on Combining Machine Learning and Knowledge Engineering (AAAI-MAKE), 2021.
3. Gunjan Singh, Sutapa Mondal, Sumit Bhatia, Raghava Mutharaju. Neuro-Symbolic Techniques for Description Logic Reasoning. Student Abstract, Association for the Advancement of Artificial Intelligence (AAAI), 2020.
4. Monireh Ebrahimi, Aaron Eberhart, Federico Bianchi, Pascal Hitzler. Towards bridging the neuro-symbolic gap: deep deductive reasoners. Applied Intelligence, 2021.
5. Claudia dAmato, Andrea G. B. Tettamanzi, Tran Duc Minh. Evolutionary Discovery of Multi-relational Association Rules from Ontological Knowledge Bases. European Knowledge Acquisition Workshop (EKAW), 2016.